State of Water in Cities

Analysis of water resource and its management in Cities

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Executive Summary

The South African Cities Network (SACN) has included water management on its agenda as one of its focus areas under the Strategic Objective – Dealing with City Vulnerabilities of the 2016 Business Plan – owing to the growing threat of freshwater scarcity largely as a consequence of increasing demand, pollution, unsustainable use and climate change. To facilitate the reporting on water and its management by the SACN, this research project was commissioned and awarded to WR Nyabeze and Associates (WRNA). The main objective for this research was to conduct an assessment of the current state and quality of water infrastructure within cities as well as the condition of the freshwater resources (rivers and wetlands). This would facilitate the determination of infrastructural and human capacity needs and allow for implementation of adequate resource monitoring protocols. SACN would then be well placed to provide assistance to these cities to improve their alignment with the national imperatives of good water management to achieve food and energy security, ecosystems conservation and reduction of risks from water scarcity (climate change).

This document contributes to addressing the above objective through:

i) Determining indicators that adequately describe/determine the current state and quality of water infrastructure within the cities.

ii) Presenting the indicators populated with available data

iii) Analyzing the indicator data to facilitate the assessment of the cities alignment with the national imperatives of good water management.

The research used as an assessment tool the impact pathway framework assessment tool to identify the important indicators for sustainable water resources management at city level. The assessment tool was applied on the following topics:

- *Topic 1: Resource availability at city level in relation to its use*
- *Topic 2: Fitness for use of water (water quality)*
- *Topic 3: Condition of freshwater resources (ecosystems) and impacts on people and infrastructure*
- *Topic 4: Condition of water infrastructure and management in the cities*
- *Topic 5: Responses to climate change impacts*
- *Topic 6: Revenue management, pricing and budgeting for water supply services, including water loss management.*

For each of the above topics, indicators were determined through an extensive literature review which brought the total number of indicators tracked for this research to a set of 142 indicators. The number of indicators relevant for each topic is as follows:

Source	***Number of indicators per topic number***					
	1	***2***	***3***	***4***	***5***	***6***
SALGA/WRC MBI (2014)	*18*	*14*	*4*	*20*	*13*	*13*
SACN (2008)	*10*	*5*	*7*	*11*	*5*	*2*
DESKTOP RESEARCH	*44*	*38*	*28*	*86*	*31*	*16*

This research relied on readily available data to populate the various key performance indicators (KPIs). As shown in the table below, based on the impact pathway complete coverage can be achieved with the KPIs identified on this study i.e. the "DESKTOP RESEARCH". Lack of multi-year data meant that trends over a number of years could not be analysed. Using a threshold of 30% coverage, the current status for topics 1, 2, 5 and 6 could be described with some confidence with the indicators from the SALGA/WRC MBI (2014) study. The potential added benefit of partially completed data from this study to all topics is quite significant. The lack of data for topic 3 remains is a serious cause for concern.

Source	Status	Number of indicators per topic number					
		1	2	3	4	5	6
SALGA/WRC MBI	Multi-year	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Partially complete	18 (41%)	14(37%)	4(14%)	20(23%)	13(42%)	13(81%)
	Total	18 (41%)	14(37%)	4(14%)	20(23%)	13(42%)	13(81%)
DESKTOP RESEARCH	Multi-year	1 (2%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Partially complete	13 (30%)	11 (29%)	4 (14%)	11(13%)	6(19%)	2 (13%)
	No data	30 (68%)	26(68%)	24(86%)	75 (87%)	25(81%)	14(87%)
	Total	44 (100%)	38 (100%)	28 (100%)	86(100%)	31(100%)	16(100%)

One of the aims of SACN is to encourage the exchange of information, experience and best practices on urban development and city management. To this end indicators where certain SACN cities performed well are shown in the table below.

No	Measure	SACN Member City									Indicator
		1	2	3	4	5	6	7	8	9	
1	CAPEX			A							Water and waste water infrastructure
		A									Investment in water infrastructure
				A			A				Capital investment per person
			A				A				Water supply infrastructure reaching citizens
			A	A				A		A	Metered connections
			A								Capital requirements
			A								Access to water and sanitation services
2	OPEX	A		A		A					Per capita expenditure on OPEX
3	Technical capacity			A					A		Technical capacity
4	Monitoring, forecasting and early warning			A						A	Ecosystem services and Freshwater Ecosystem Priority Areas
		A			A	A					Managing pollution from anthropogenic activities etc.
			A				A		A		Fish Support Areas
				A			A	A		A	Wetland clusters
			A				A		A		Threatened or near threatened fish species
			A								Weather stations
5	Waste treatment	A	A			A	A				Access to flush toilets
								A		A	Use of ventilated improved pit (VIP) latrines
		A	A	A							Drinking water quality
7	Enforcement of regulations				A		A				Consumer debt

No	Measure	SACN Member City									Indicator
		1	2	3	4	5	6	7	8	9	
10	Asset management		A	A	A	A	A				Variance on budget
		A	A			A					Current replacement value
			A				A				Carrying value for water and wastewater infrastructure
		A				A				A	Completion of water supply management audits
				A							Completion of waste water asset management audits
		A		A							Infrastructure asset management health checks
			A								Operation and maintenance
12	Information/data										Completion of bulk water infrastructure data
		A	A				A				Information management and availability
21	Sales volumes for water	A			A	A					Income from the sale of water
25	Metering and billing						A		A		Customer care health check
26	Non-revenue water		A		A		A				Water losses to lower than 30%
		A						A		A	Progressive improvement
		A			A	A					Most to benefit from tackling non-revenue water
			A		A						Revenue water
					A						Revenue per capita per day and per household per monthly
			A								Cost of providing water services vs revenue from services
			A								Cost of service vs revenue to keep cost to consumers low
			A	A				A			Current ratio
			A				A				Level of salaries vs operational costs
Total		**12**	**19**	**12**	**8**	**8**	**12**	**5**	**4**	**6**	

1=Johannesburg, 2=Cape Town, 3=eThekwini, 4=Tshwane, 5=Ekurhuleni, 6=Nelson Mandela Bay, 7=Mangaung, 8=Buffalo City, 9=Msunduzi

Those SACN member cities whose water management practices have achieved recognition were identified. Lessons from these cities may benefit other members of SACN. The specific achievements are as follows:

1. *Resource availability at city level in relation to its fitness for use was understood the include the water resource types available to the cities, level of capital expenditure on the infrastructure necessary to abstract, treat and convey the water to the ultimate user, level of operating expenditure, the availability of the technical capacity to support the infrastructure in adequate working condition and the management of the relevant assets. Analysis revealed the existing water and wastewater infrastructure in Cape Town is more adequate and the city has relatively lower new infrastructural needs. Along with Nelson Mandela Metro, it also has the highest proportion of households with piped water inside dwellings (as reported in 2010) and along with eThekwini, Mangaung and Msunduzi, leads with respect to percentage number of metered connections. In addition, Cape Town along with eThekwini, Tshwane, Ekurhuleni, and Nelson Mandela Bay demonstrate the best performance with respect to budgeting for spending on asset management. With respect to technical capacity, the 2014*

Stockholm Industry Water Award winner - eThekwini Municipality – and Buffalo City edge out the City of Cape Town.

2. *It was observed that generally, operating expenditure for the SACN member cities was closely correlated with the population size within each city. However, the data on capital spending revealed that Nelson Mandela Bay Metro incurs the most capital expense per person followed by eThekwini and may be a consequence of rapid urbanization and/or huge backlogs that may be getting addressed. It may also be a manifestation of wasteful expenditure unfortunately.*

3. *With respect to the condition of freshwater resources and likely impacts on people and infrastructure, the existing wastewater collection and treatment capacity at the larger SACN metros are relatively fine and the risks to human health relatively lower owing to the larger metros' comparative ability to attract and keep the technical skill essential for delivery of adequately treated water to the final consumer and treat wastewater to an adequate level such that its release into the environment has a lower impact on the freshwater resources. This may be that these metros are economic hubs populated by consumers that are better able to demand and pay for high services levels and support these Cities' revenue streams. This has implications for control of outbreaks and spread of water borne epidemics.*

4. *The Cities of Johannesburg, Cape Town and Nelson Mandela Bay performed better than the other SACN member cities on information management aspects and as such can be expected to be best placed to assess the water resources challenges they face and anticipate those yet to manifest themselves. Indeed, the City of Cape Town, from the data obtained, while able to impose a relatively low tariff for water services, has along with the Cities of Tshwane and Nelson Mandela Bay consistently kept the percentage of water losses below 30%. This makes the City of Cape Town the SACN member city whose water services income is least impacted by non-revenue water losses.*

5. *In terms of revenue Management, pricing and budgeting for water supply services, the City of Cape Town was considered the best performer. With the highest proportion of persons with piped water inside dwelling and with among the best metered reticulation system, it is perhaps not so surprising that Cape Town closely followed by the City of Tshwane are among the cities that manage the water losses better and subsequently get paid for most of the water supplied. What distinguishes the City of Cape Town, however, is that its unit water consumption (per person and per household) figures are not as high as the corresponding figures for the City of Tshwane which has the highest unit consumption for both measures of all the SACN Cities. Moreover when the income contribution per person per year and per household per year respectively are considered, it is observed to have unit income figures that are less than 50% of what the City of Johannesburg derives for both the individual and the household. This supports the earlier conclusion that the tariffs for water services in City of Cape Town are significantly lower than tariffs imposed by the other cities. On this basis one can say the City of Cape Town has struck the best balance between ensuring their cost of service delivery are covered by the revenue generated and keeping the cost to consumers as low as possible.*

6. *The research also found the following information gaps that can impact on the ability to make reliable assessments on the water resources at City level and the sustainability of the existing management.*

    - *Data for all the indicators identified was not readily available particularly for the smaller metros that are only beginning to raise the level of performance of their information management systems. While the gaps vary from city to city for the different topics looked at above, it was observed for all cities that there is a lack of adequate monitoring for the indicators for the "Fitness for Use" at city level. The available data was derived from a nationwide project – the NFEPA - conducted at a spatial scale of sub-Water Management Area (WMA) level. This may not be sufficient for city level assessments.*
    - *Even when available, the reliability of the audited finance figures as contained in financial reports was brought into question by the adjustments noted in some financial reports that carried different figures for the same item.*
    - *The likely climate change scenarios for the region paint a grim picture which the cities would be well advised to be already planning to address. However, the research team did not find much evidence at city level that this was being prioritized through the development of specific detailed action plans. This suggests the threats posed by climate change impacts may not currently be regarded a priority compared to the other challenges the cities management may be facing.*

7. *Finally, it was suggested that to manage water resources sustainably and to support social and economic development of the country, managers of water resources and infrastructure need to get adequately acquainted with an number of issues that can be broadly grouped into the following four categories:-*

    i) Intimate knowledge about their ultimate customer, the consumer of their product namely water and the user of the ecosystem;
    ii) An appreciation of the different water resource types that are available and,
    iii) An appreciation of the existing and any emerging threats to reliability of delivery of this product to the consumer.
    iv) Building the necessary capacity (technical and financial) to address the challenges.

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1 Background

The South African Cities Network (SACN) has included water management on its agenda as one of its focus areas under the Strategic Objective – Dealing with City Vulnerabilities of the 2016 Business Plan – owing to the growing threat of freshwater scarcity largely as a consequence of increasing demand, pollution, unsustainable use and climate change.

To fully appreciate the likely impact of fresh water scarcity on SACN member cities' ability to drive the country's economic growth and poverty alleviation, SACN recognizes the need to base its strategic plans on water resource assessments conducted at city level. This, it is felt, would ensure that the strategies would address the water resources issues that are more peculiar to the individual cities as opposed to strategies based on findings contained in nationwide assessments such as the Annual National State of Water Resources Report by the Department of Water Affairs.

The main objective for this research was to conduct an assessment of the current state and quality of water infrastructure within cities as well as the condition of the freshwater resources (rivers and wetlands). This would facilitate the determination of infrastructural and human capacity needs and allow for implementation of adequate resource monitoring protocols. SACN would then be well placed to provide assistance to these cities to align themselves closely with the national imperatives of good water management to achieve food & energy security, ecosystems conservation and reduction of risks from water scarcity (climate change).

This document contributes to addressing the above objective through:

iv) Determining indicators that adequately describe/determine the current state and quality of water infrastructure within the cities.

v) Presenting the indictors populated with available data

vi) Analyzing the indicator data to facilitate the assessment of the cities alignment with the national imperatives of good water management.

In order to identify the important indicators the impact pathway analytical framework was applied on the following topics:

- Topic 1: Resource availability at city level in relation to its use
- Topic 2: Fitness for use of water (water quality)
- Topic 3: Condition of freshwater resources (ecosystems) and impacts on people and infrastructure
- Topic 4: Condition of water infrastructure and management in the cities
- Topic 5: Responses to climate change impacts
- Topic 6: Revenue management, pricing and budgeting for water supply services, including water loss management.

Plausible impact pathways were derived from a core problem as primary, secondary and tertiary causes. The dominant causes or "repeated" causes of the core problem associated with each of the six topics are listed in **Table 1.1.** The letter X identifies a cause with its respective topic. It is evident that some causes are repeated across the topics, which further highlights their importance. Where a repeated cause also appears in a topic but without repetition a letter "A" is applied for that topic. The causes which are common to most topics are at the top of the table.

Table 1-1: Summary of repeated causes derived from the impact pathway analysis framework

No.	Repeated Cause	Topic Number					
		1	2	3	4	5	6
1	Inadequate CAPEX	X	X		X	X	
2	Inadequate OPEX	X	X		X	X	
3	Inadequate technical capacity	X	X		X	X	
4	Inadequate monitoring, forecasting and early warning	X	X			X	
5	Inadequate waste treatment	A		X	A		
6	Inadequate waste collection service	A		X	A		
7	Weak enforcement of regulations	A		X	X		
8	Aged Infrastructure		A		X	X	
9	Lack of best practice guidelines, procedures standards and tools	A			X	X	
10	Poor asset management	X	X				
11	Inadequate awareness and education		X	X			
12	Poor information/data				X	X	
13	Inadequate inspection and monitoring				X	X	
14	Low CAPEX spend				X		
15	Poor operation of water supply system	X					
16	Over abstraction of water from source			X			
17	Littering			X			
18	Dumping of waste			X			
19	Poor planning and implementation				X		
20	Unfavorable regulations and procedures				X		
21	Low sales volumes for water				X		
22	Inappropriate service tariffs				X		
23	System blockages and damages				X		
24	Lack of knowledge of climate change scenarios and possible impacts					X	
25	Incorrect metering and billing						X
26	High non-revenue water						X
27	Poor cost recovery and investment strategy						X
28	Poor pricing of services						X
29	Poor budgeting						X

The majority of the causes are linked to how water and waste management is done while a good number of causes are linked to financial management including the first two and the last five causes. The number of causes per topic can be summarized as follows:

- 10 causes are associated with Topic 1: Resource availability at city level in relation to its use;
- 7 causes are associated with Topic 2 Fitness for use of water (water quality).
- 7 causes are associated with Topic 3: Condition of freshwater resources (ecosystems) and impacts on people and infrastructure

- 16 causes are associated with Topic 4: Condition of water infrastructure and management in the cities;
- 9 causes are associated with Topic 5: Responses to climate change impacts
- 5 causes are associated with topic 6: Revenue management, pricing and budgeting for water supply services, including water loss management.

It can be concluded from these results that the impact pathway framework provides a plausible method of addressing the research objectives.

This report consolidates available data from several different sources into a 'statistical almanac' covering the nine SACN cities. Summarized city-specific comparative data and information is provided as graphs. These graphs are used to analyze key issues currently affecting these cities and the trends. The way in which the trends are likely to evolve over time is examined and the strategic challenges and opportunities they are likely to present in the medium to longer-term are considered. By describing and analyzing trends, the report sets up a strategic agenda for further research, planning and action that could improve the future prospects of life in South African cities in a fairly decisive way.

2 Descriptors of Good Water Management at City Level (indicators)

The SALGA/WRC MBI (2014) has 34 indicators of some relevance to this study. They are listed in Appendix A of this report. These indicators describe 14 of the 29 causes as shown in **Table 2.1.** The 2008 review report - *State of Cities Reporting*: *Good Practice Guide and Toolkit* (SACN, 2008) provides 20 indicators which have some relevance to this study. These are listed in Appendix B. The indicators describe 15 of the 29 causes as shown in **Table 2.1.** This means that the indicators in these two studies do not provide an adequate description of the six topics investigated on this study.

Table 2-1: Indicators for selected measures

No.	Measure	INDICATORS		
		SALGA/WRC MBI	SACN (2008)	DESKTOP RESEARCH
1	CAPEX	8	2	5
2	OPEX	1	0	2
3	Technical capacity	3	0	3
4	Monitoring, forecasting and early warning	0	2	2
5	Waste treatment	4	3	4
6	Waste collection service	0	1	4
7	Enforcement of regulations	0	0	4
8	Aged Infrastructure	0	0	3
9	Use of best practice guidelines, procedures standards and tools	0	0	5
10	Asset management	2	1	17
11	Level of awareness and education	0	0	2
12	Status of information/data	1	1	8
13	Inspection and monitoring	0	0	4
14	CAPEX spend	0	0	4
15	Operation of water supply system	0	1	2
16	Demand versus capacity of infrastructure	0	1	9
17	Littering	0	0	3
18	Dumping of waste	0	2	2
19	Planning and implementation	1	2	13
20	Regulations and procedures	0	0	13
21	Sales volumes for water	2	0	5
22	Service tariffs	0	1	7
23	System blockages and damages	0	1	2
24	Climate change scenarios and possible impacts	0	0	3
25	Metering and billing	1	0	2
26	Non-revenue water	6	1	6
27	Cost recovery and investment strategy	1	1	3
28	Pricing of services	2	0	1
29	Budgeting	3	0	4
Total		**35**	**20**	**142**

The causes in **Table 1.1** were turned into *measures* and a set of 142 indicators were formulated and verified though an extensive literature review. The link to the *measures* meant that the wording of the indicators from this study was different from those in SALGA/WRC MBI (2014) and SACN (2008). The 142 indicators are listed in Appendix C. The 142 indicators describe all the 29 measures as shown in **Table 2.1**.

The number of indicators relevant for each topic is shown in **Table 2.2.** The extend of overlap can be estimated by taking each source summing up the number of indicators per topic in **Table 2.2** and dividing this total by the number of indicators from **Table 2.1**. The overlap provides some degree of confidence that the topics can be adequately described using the impact pathway framework.

Table 2-2: Indicators per topic

Source	Number of indicators per topic number						Overlap Factor
	1	2	3	4	5	6	
SALGA/WRC MBI (2014)	18	14	4	20	13	13	2.3
SACN (2008)	10	5	7	11	5	2	1.9
DESKTOP RESEARCH	44	38	28	86	31	16	1.7

If the number of indicators from the Desktop Research is taken as the desired situation (i.e. the indicators per topic for Desktop Research provided 100% description of a topic) then it is clear from **Table 2.3** that even if the indicators from SALGA/WRC MBI (2014) and SACN (2008) are fully populated with data they can only provide partial descriptions of each topic. For a threshold of 30% coverage (1 to 2 indicators per measure) the SACN (2008) is inadequate for all topics and only topics 1, 2, 5 and 6 are adequately covered by the SALGA/WRC MBI (2014) study.

Table 2-3: Coverage of indicators for each topic

Source	Topic Number					
	1	2	3	4	5	6
SALGA/WRC MBI (2014)	41%	37%	14%	23%	42%	81%
SACN (2008)	23%	13%	25%	13%	16%	13%
DESKTOP RESEARCH	100%	100%	100%	100%	100%	100%

One of the requirements of this research was to identify the key indicators. However it is evident from this exercise that the 142 indicators are rather too exhaustive. Indicators should be Suitable, Meaningful, Accurate, Relevant and Timely (SMART). Ideally, the indicators should:

- capture the essence of the problem and be clearly understood
- be easily quantifiable
- be comparable as far as practicable with the standards applied nationally and internationally
- not impose too large a burden in terms of data collection effort and cost
- consistent and remain suitable over time

However, SMART indicators can still be many. For example Asset Management has 17 of which 8 (numbers 10 to 17) describe financial management as shown below.

1) Water infrastructure leakage index ,IWA
2) Number of water service interruptions, IWA
3) Blue Drop - Water supply asset management audits
4) Green Drop - Wastewater asset management audits
5) Green Drop – Wastewater water asset management
6) Flooding incidents
7) Period to fix reported leaks
8) Carrying value of water network (R)
9) Carrying value of waste water network (R)
10) *Budget for water and sanitation (R)*
11) *Water and sanitation OPEX (R)*
12) *Water and sanitation CAPEX (R)*
13) *Expenditure on water supply (R)*
14) *Expenditure on wastewater(R)*
15) *Actual spending on asset management vs budget (%)*
16) *OPEX for water as percentage of total city budget (%)*
17) *Water and sanitation total expenditure (R)*

The types of indices also reflect the reporting practices which tend to place emphasis on financial performance. Some reports combine financial figures for water and sanitation indicators while others keep them separate. The typology or characteristics of area or system affects appropriateness of indicators. The choice of the important set of indicators that can be applied consistently across cities is a complex matter.

The approach taken on this study was to first define indicators which best describe the causes and use the situation assessment to filter out some of the indicators based on reporting practices and availability of data. The review of literature identified some internationally-used indicators and this allowed for further refinement of the indicators in Chapter 2.

This situation assessment also provides a good indication of possible improvements in current reporting strategies in order to inform water management in SACN member cities. This approach was also followed in the 2004 and 2006 Sate of Cities Reports (SACN, 2008).

3 Data Sources and Level of Information Available

This report presents the current status of water management in SACN member Cities as described in existing data, reports and programmes that are relevant for city water management.

Considerable research effort has been undertaken in developing key performance indicators (KPI's) for water utilities around the world. Standardized data collection and presentation tools facilitate local and international comparison of information and lesson-sharing.

The International Water Association (IWA) book - Performance indicators for water supply services (Alegre, et al 2006) continues to be referenced extensively in developing and updating guidelines, toolkits and regulations for utilities and cities all over the world. For water and wastewater utilities in South Africa the "Blue Drop Requirements" and "Green Drop Requirements" also adopts some of the indicators in Alegre, et al (2006). The Blue Drop and Green Drop requirements were developed to be a transparent method for assessing water and waste water quality management by the Department of Water Affairs (DWA) and thus indicate the level of confidence the department has in various utilities. Blue and Green Drop reports with relevant information on the nine SACN member cities namely Johannesburg, Cape Town, eThekwini, Tshwane, Ekurhuleni, Nelson Mandela Bay, Mangaung, Buffalo City and Msunduzi were obtained from DWA web page http://www.dwaf.gov.za/Documents/RSP.aspx and relevant information/data was adopted for this study.

At the start of this assignment the SALGA/WRC Municipal Benchmarking Initiative was finalizing the 2013 annual report on water services in South Africa (SALGA/WRC MBI, 2014). This initiative considered more indicators than the Blue and Green Drop requirements. It uses a web based system called Munibench (www.munibench.co.za) to capture data and produce informative reports. Data from this initiative was obtained from Emanti Management (Pty) Ltd with SALGA's consent as well as from the SALGA/WRC MBI (2014) report.

The Audited Annual Financial Statements for the cities and utilities were obtained from their respective web sites and the National Treasury web page. The links are provided in the reference section of this report. Some of them have considerable information on water supply, waste water and sanitation, revenue management, pricing and budgeting for water supply services.

The Department of Water Affairs (DWA) owns and manages the majority of the country's bulk water infrastructure. Current infrastructure and future infrastructure is captured in Water Services Development Plans and some information was obtained from the web page: http://www.dwa.gov.za/dir_ws/WSDP/

Human and economic well-being are directly or indirectly dependent on the goods and services provided by river systems. South African Cities like urban areas around the world are particularly vulnerable to climate change impacts due to the high concentration of people and assets. The Department of Water Affairs publishes the "State of Rivers" reports and relevant copies were obtained from the web-page: http://www.dwa.gov.za/iwqs/rhp/state_of_rivers.html. The reports are produced under the South African River Health Programme. Available reports on how the condition of water and waste water infrastructure and services infrastructure impacts on the condition of freshwater sources were reviewed.

Population census data for 2001 and 2011 was obtained from Statistics South Africa reports, on the following web page: (http://beta2.statssa.gov.za/).

The 2012 South Africa Environment Outlook by the Department of Environmental and the National Freshwater Ecosystem Priority Areas (NFEPA) project (Driver et. al., 2011) were the sources of the information about the status of the country's freshwater ecosystems and the water resource potential/availability.

The summary of the number of indicators and their sources used in the report is presented in Table 3-1 with each indicator identified according to the repeated cause it best describes and depending on the status of completeness of the respective data whether it falls in the Multi- Year (MY), Partially Complete (PC) or No data Available (NA) category. As the indicators were populated, where necessary, the causes derived from the impact pathway were reworded and **Table 1.1** was updated, care being taken to maintain the causal link to the core problem. The literature review covered the period 2010 to 2013.

Table 3-1: Status of available indicators for selected causes

No.	Measure	DESKTOP RESEARCH				SALGA/WRC MBI			
		Total	MY	PC	NA	Total	MY	PC	NA
1	CAPEX provision	5	0	2	3	8	0	8	0
2	OPEX provision	2	0	0	2	1	0	1	0
3	Technical capacity	3	0	2	1	3	0	3	0
4	Monitoring, forecasting and early warning	2	0	0	2	0	0	0	0
5	Waste treatment	4	0	1	3	4	0	4	0
6	Waste collection service	4	0	0	4	0	0	0	0
7	Enforcement of regulations	4	0	3	1	0	0	0	0
8	Aged infrastructure	3	0	2	1	0	0	0	0
9	Use of best practice guidelines, procedures standards and tools	5	0	0	5	0	0	0	0
10	Asset management	17	1	6	10	2	0	2	0
11	Level of awareness and education	2	0	0	2	0	0	0	0
12	Status of information/data	8	0	0	8	1	0	1	0
13	Inspection and monitoring	4	0	0	4	0	0	0	0
14	CAPEX spend	4	0	0	4	0	0	0	0
15	Operation of water supply system	2	0	0	2	0	0	0	0
16	Demand versus capacity of infrastructure	9	0	0	9	0	0	0	0
17	Littering	3	0	0	3	0	0	0	0
18	Dumping of waste	2	0	0	2	0	0	0	0
19	Planning and implementation	13	0	1	12	1	0	1	0
20	Regulations and procedures	13	0	0	13	0	0	0	0
21	Sales volumes for water	5	0	0	5	2	0	2	0
22	Service tariffs	7	0	0	7	0	0	0	0
23	System blockages and damages	2	0	0	2	0	0	0	0
24	Climate change scenarios and possible impacts	3	0	0	3	0	0	0	0
25	Metering and billing	2	0	0	2	1	0	1	0
26	Non-revenue water	6	0	0	6	6	0	6	0
27	Cost recovery and investment strategy	3	0	1	2	1	0	1	0
28	Pricing of services	1	0	1	0	2	0	2	0
29	Budgeting	4	0	0	4	3	0	3	0
Total		**142**	**1**	**17**	**124**	**35**	**0**	**35**	**0**

The status of data for the KPIs for each topic is shown in **Table 3.2.** Of the 29 causes 15 have KPIs with some data. Topic 3 is the most affected by lack of data.

Table 3-2: Summary of status of information on KPs for repeated causes and topics

No.	Measures	SALGA/WRC MBI						DESKTOP RESEARCH					
		Topic Number						Topic Number					
		1	2	3	4	5	6	1	2	3	4	5	6
1	CAPEX	100%	100%		100%	100%		40%	40%		40%	40%	
2	OPEX	100%	100%		100%	100%		0%	0%		0%	0%	
3	Technical capacity	100%	100%		100%	100%		67%	67%		67%	67%	
4	Monitoring, forecasting and early warning							50%	50%			50%	
5	Waste treatment	100%		100%	100%			25%		25%	25%		
6	Waste collection service							0%		0%	0%		
7	Enforcement of regulations							29%		29%	29%		
8	Aged Infrastructure								0%		0%	0%	
9	Best practice guidelines, procedures standards and tools							0%			0%	0%	
10	Asset management	100%	100%					35%	35%				
11	Awareness and education								0%	0%			
12	Information/data				100%	100%					0%	0%	
13	Inspection and monitoring										0%	0%	
14	CAPEX spend										0%		
15	Operation of water supply system							0%					
16	Demand versus capacity of infrastructure and resource capability									0%			
17	Littering									0%			
18	Dumping of waste									0%			
19	Planning and implementation				100%						8%		
20	Regulations and procedures										0%		
21	Sales volumes for water				100%						0%		
22	Service tariffs										0%		
23	System blockages and damages										0%		
24	Knowledge of climate change scenarios and possible impacts											0%	
25	Metering and billing						100%						0%
26	Non-revenue water						100%						0%
27	Cost recovery and investment strategy						100%						33%
28	Pricing of services						100%						100%

29	Budgeting						100%						0%

Table 3.3 shows the completeness of data for the KPIs. The percentages consider that complete coverage is achieved with the KPIs identified on this study i.e. the "DESKTOP RESEARCH". Lack of multi-year data means that trends over a number of years cannot be analysed. Using a threshold of 30% coverage, the current status for topics 1, 2, 5 and 6 could be described with some confidence with the indicators from the SALGA/WRC MBI (2014) study. The potential added benefit of partially completed data from this study to all topics is quite significant. The lack of data for topic 3 remains is a serious cause for concern.

Table 3-3: Status of indicators for per topic (as number of indicators)

Source	Status	Number of indicators per topic number					
		1	2	3	4	5	6
SALGA/WRC MBI	Multi-year	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Partially complete	**18 (41%)**	**14(37%)**	4(14%)	20(23%)	**13(42%)**	**13(81%)**
	Total	18 (41%)	14(37%)	4(14%)	20(23%)	13(42%)	13(81%)
DESKTOP RESEARCH	Multi-year	1 (2%)	1 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
	Partially complete	**13 (30%)**	11 (29%)	4 (14%)	11(13%)	6(19%)	2 (13%)
	No data	30 (68%)	26(68%)	24(86%)	75 (87%)	25(81%)	14(87%)
	Total	44 (100%)	38 (100%)	28 (100%)	86(100%)	31(100%)	16(100%)

4 State of Water Resource and its Management in Cities

In this chapter the available information on key performance indicators is presented in the form of graphs and maps. For some indictors there is no readily available data and others have data gaps. An attempt is made to answer the following questions:

- What is the **status of reporting** on each topic in each SACN member city?
- Based on the complete and partially complete indicators, for each SACN member city:
    - What is the **observed performance** on each topic?
    - What are the **water resource and management issues**?

The cities are not similar in terms of geographical setting, economic activities, demographics etc. This should be considered in cross-comparisons. The population in each city is presented in **Figure 4.1.**

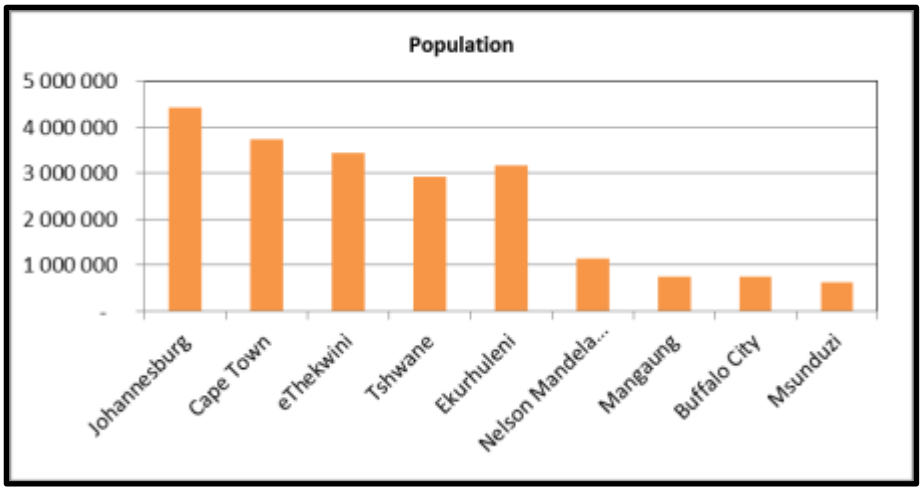

Figure 4.1 - Population (Statistics South Africa, 2012)

It is evident that some of the cities have much higher population than others. The cities of Johannesburg and Tshwane have experienced relatively high population growth rates since 2001 as shown in **Figure 4.2**.

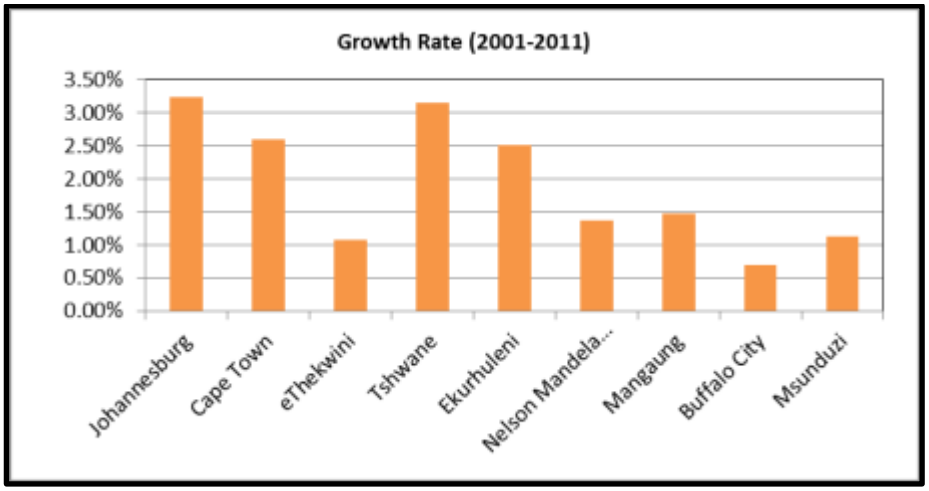

Figure 4.2 - Population growth rate ((Statistics South Africa, 2002 and 2012))

With high population and high growth rates, growth in commercial and industrial activities increasing water demand and puts pressure on infrastructure and water courses including wetlands.

4.1 Topic 1: Resource availability at city level in relation to its use

The quantity of water available in cities and municipalities depends on the availability and sustainability of the resource. Water can be obtained from surface water resources or groundwater reserves or as is usual, some combination of the two. **Figure 4.3** adapted from the South Africa Environment Outlook (2012) shows "high water yield" areas of the country and the location of the SACN member cities. According to Nel et. al. (2011) for high water yield areas the mean annual run-off is at least three times more per annum than the average for the whole primary catchment. It is therefore evident that management of surface water resources in SACN member cities is important.

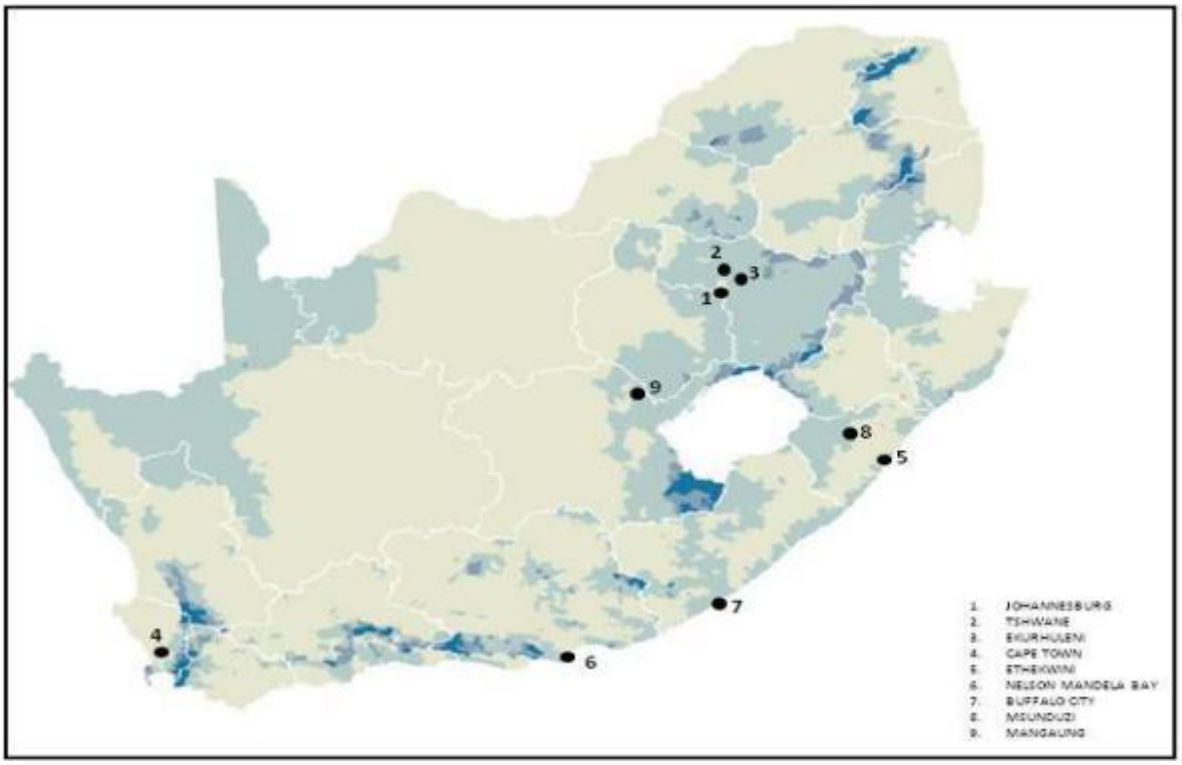

Figure 4.3 – High water yield areas in South Africa (Source: SAEO, 2012)

Figure 4.4 is also adapted from the South Africa Environment Outlook (2012). It shows groundwater recharge capacity. In high groundwater recharge areas the recharge rate is greater than 300 per cent of the average for the entire primary catchment and they are shown in blue (Nel et. al., 2011). Such areas are essential for sustaining river flows particularly in dry periods. It is quite evident that management of groundwater water resources in the coastal towns and in SACN member cities is important.

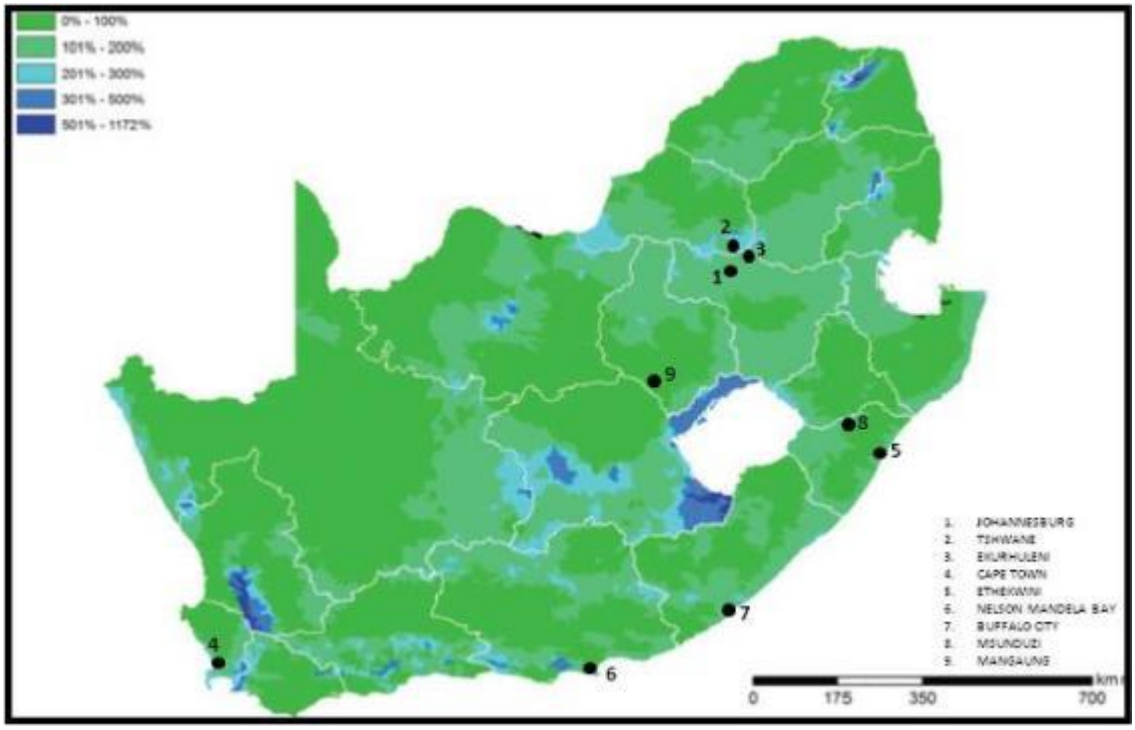

Figure 4.4 – High Groundwater Recharge areas (*Source: SAEO, 2012*)

Rainfall and streamflow replenish/recharge dams and groundwater resources. The availability of water at source is intimately linked with land cover, land use and other factors in the hydrological cycle which needs to be managed in an integrated way. **Figure 4.5** shows the uneven distribution of mean annual rainfall.

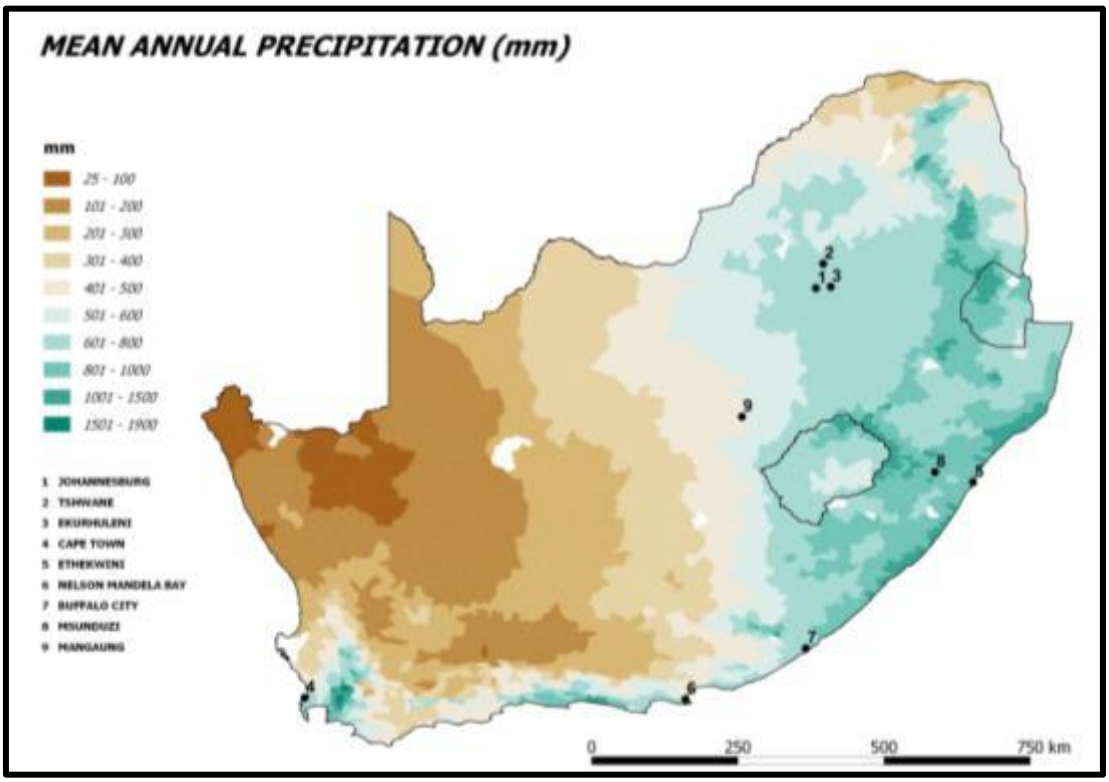

Figure 4.5 – Mean Annual Rainfall

Most of the northern and western part of the country receives less rain and is semi-arid. The country's highly seasonal cycles characterized by short wet seasons and long dry seasons in many parts of the country further complicate the management of the country's water resources as the opportunity to receive rainfall and subsequent runoff, is limited. Therefore to maintain an adequate assurance of water supplies requires the provision of storage dams to bridge periods of low flow as well as the development of infrastructure for transferring water to those parts of the country with inadequate surface and groundwater resources.

The traditional way of supplying water to cities involves dams and transfer schemes. The cost associated with transfer schemes is rising owing to the longer distances and rapidly rising pumping costs, while climate change and variability pose serious risks to sustaining water supply at acceptable risks from these sources. Non-conventional sources such as rain water harvesting, groundwater and recycling are likely to be a common feature as the cities try to adapt.

The different SACN member cities will experience challenges that may differ owing to their geographical locations and topographical differences.

As stated in **Chapter 2,** this topic can be adequately described using 51 indicators. **Table 4.1** shows that 29 indicators (17 SALGA/WRZ MBI and 12 Desktop Research). have some data and one indicator has multi-year data.

Table 4-1: Status of indicators for resource availability at city level and its use.

No	Measure	SALGA/WRC MBI				DESKTOP RESEARCH			
		Total	MY	PC	NA	Total	MY	PC	NA
1	CAPEX	8	0	8	0	5	0	2	3
2	OPEX	1	0	1	0	2	0	0	2
3	Technical capacity	3	0	3	0	3	0	2	1
4	Monitoring, forecasting and early warning	0	0	0	0	2	0	0	2
5	Waste treatment	3	0	3	0	4	0	1	3
6	Waste collection service	0	0	0	0	4	0	0	4
7	Enforcement of regulations	0	0	0	0	7	0	2	5
9	Use of best practice guidelines, procedures standards and tools	0	0	0	0	5	0	0	5
10	Asset management	2	0	2	0	17	1	5	11
15	Operation of water supply system	0	0	0	0	2	0	0	2
Total		**17**	**0**	**17**	**0**	**51**	**1**	**12**	**38**

There is no data on indicators of 4 of the 10 measures. The data collected on the following measures is presented in this section.

i) CAPEX
ii) OPEX
iii) Technical capacity
iv) Waste treatment
v) Enforcement of regulations and
vi) Asset management

4.1.1 CAPEX

The following 10 KPIs which talk to CAPEX (partially compete KPIs in **Table 4.1**) are presented in this section:

- Audited expenditure on water services (audited financial statements (AFS))
- Capital investment in water infrastructure (Rand) - SALGA/WRC MBI (2014)
- Capital investment per person per year in water infrastructure (Rand/person/year) - SALGA/WRC MBI (2014)
- Capital investment in water and wastewater infrastructure (Rand/person/year) - SALGA/WRC MBI (2014)
- Capital investment per person per year in water and wastewater infrastructure (Rand/person/year) - SALGA/WRC MBI (2014)
- Total number of people with access to water SALGA/WRC MBI (2014)
- Access to water (%) SALGA/WRC MBI (2014)
- Percentage of households with piped water inside dwelling
- Number of households per connection - SALGA/WRC MBI (2014)
- Percentage number of metered connections - SALGA/WRC MBI (2014)

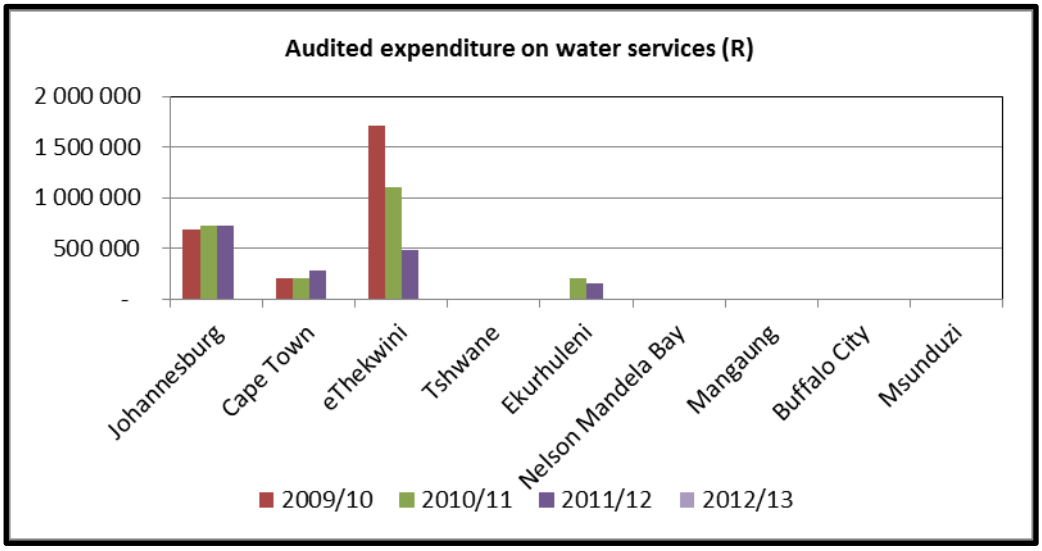

Figure 4.6 – Expenditure on water services (AFS)

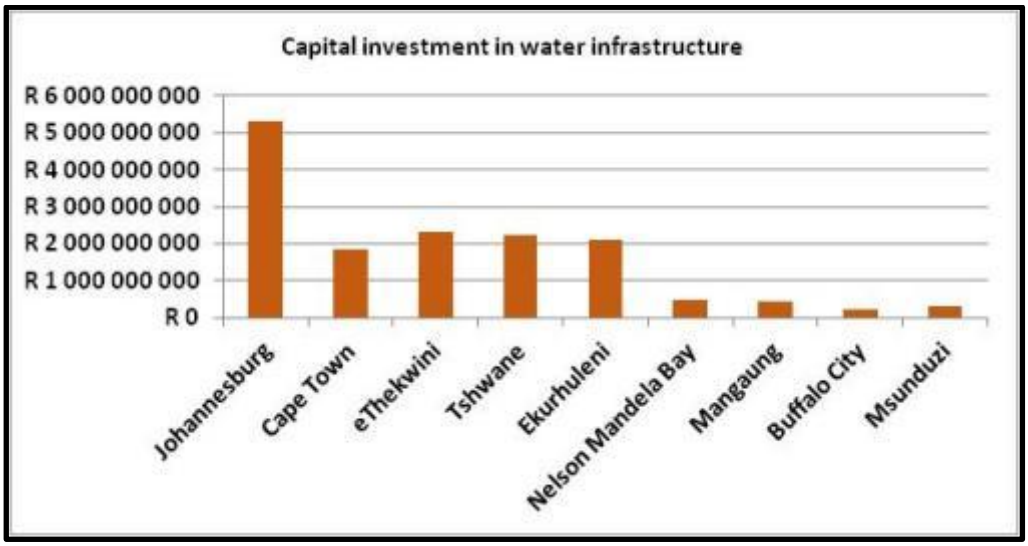

Figure 4.7 – Capital Investment in water infrastructure (Rand) - SALGA/WRC MBI (2014)

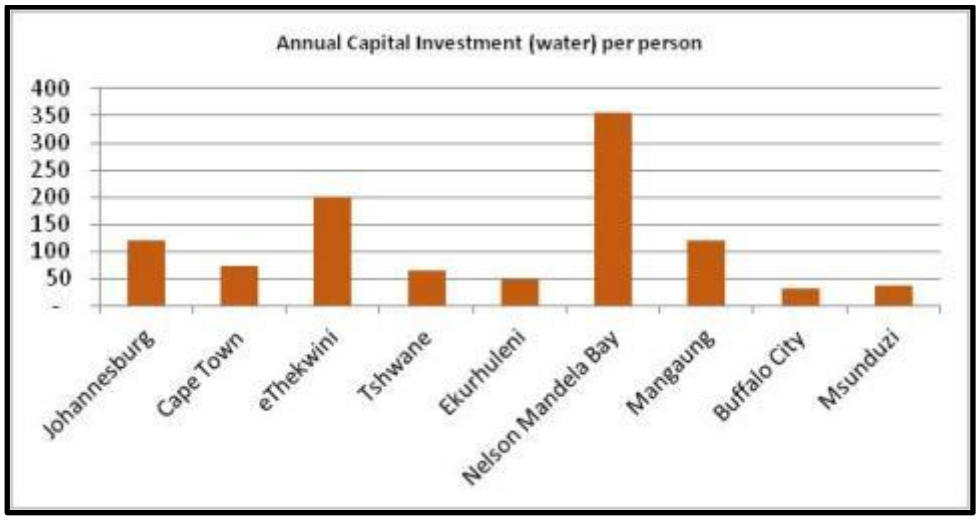

Figure 4.8 – Capital Investment in water infrastructure (Rand/person/year) - SALGA/WRC MBI (2014)

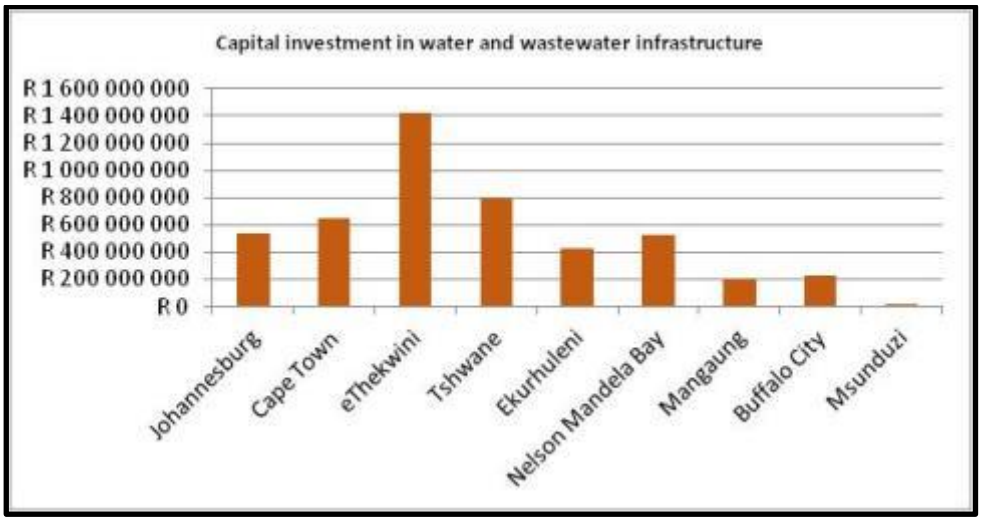

Figure 4.9 – Capital Investment in water and wastewater infrastructure (Rand) - SALGA/WRC MBI (2014)

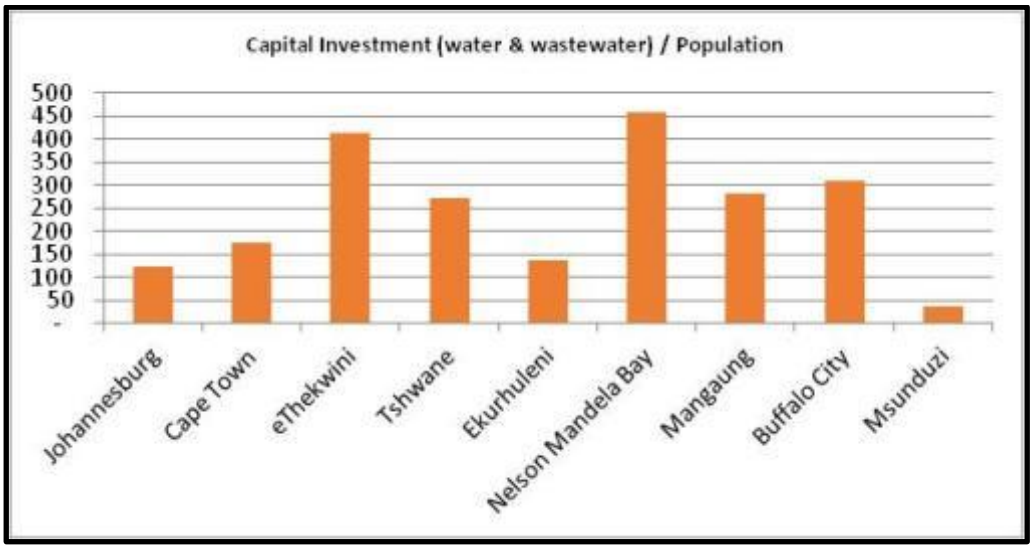

Figure 4.10 – Capital Investment in water and wastewater (Rand/person/year) - SALGA/WRC MBI (2014)

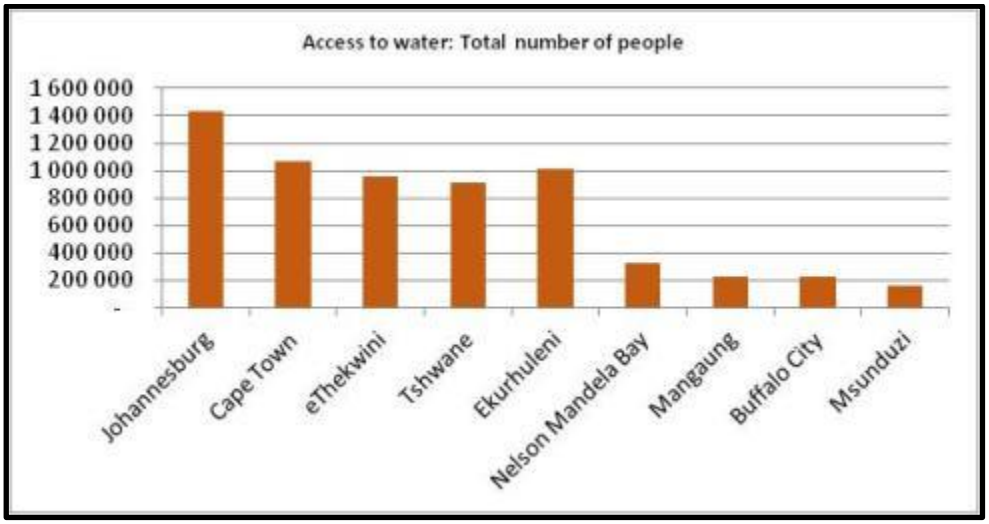

Figure 4.11 – Number of people with access to water - SALGA/WRC MBI (2014)

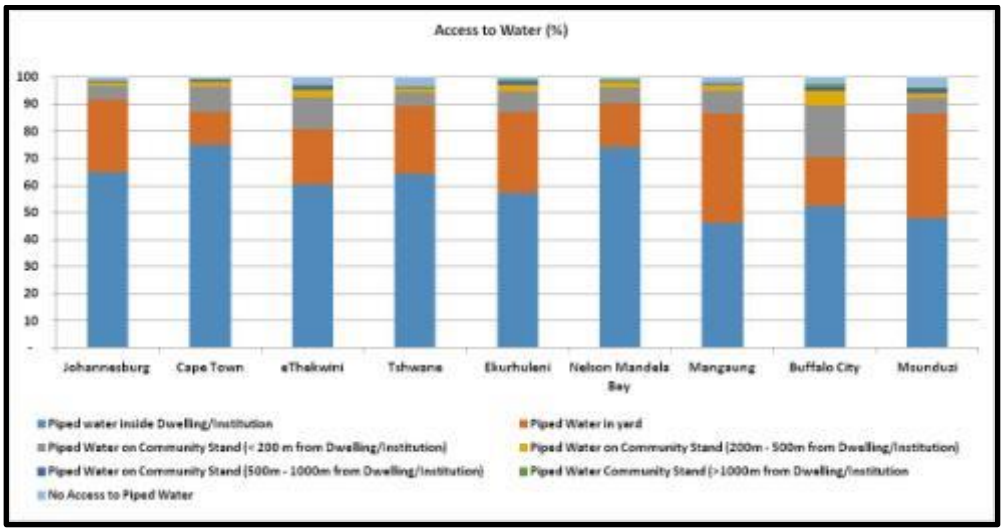

Figure 4.12 – Access to water % - SALGA/WRC MBI (2014)

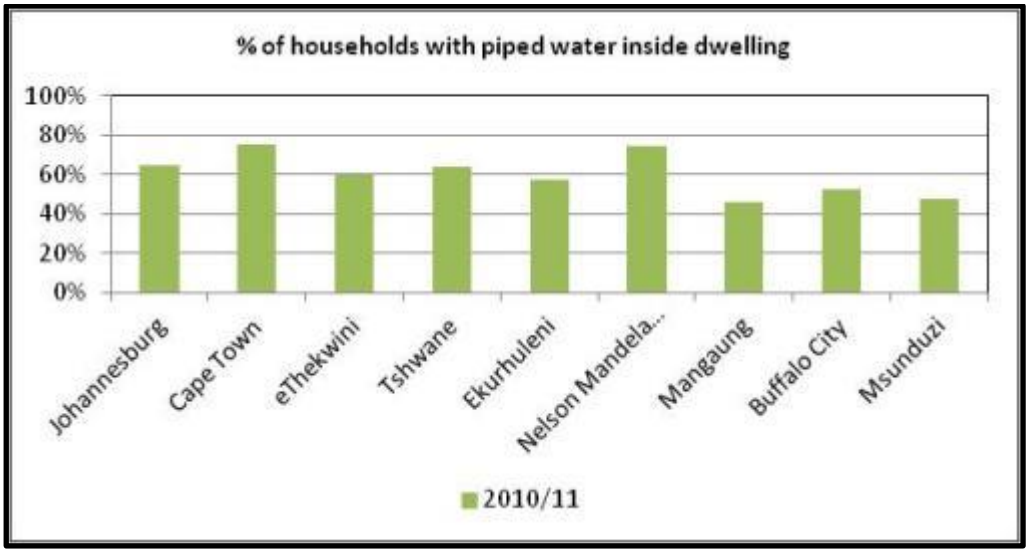

Figure 4.13 – Households with piped water inside dwelling

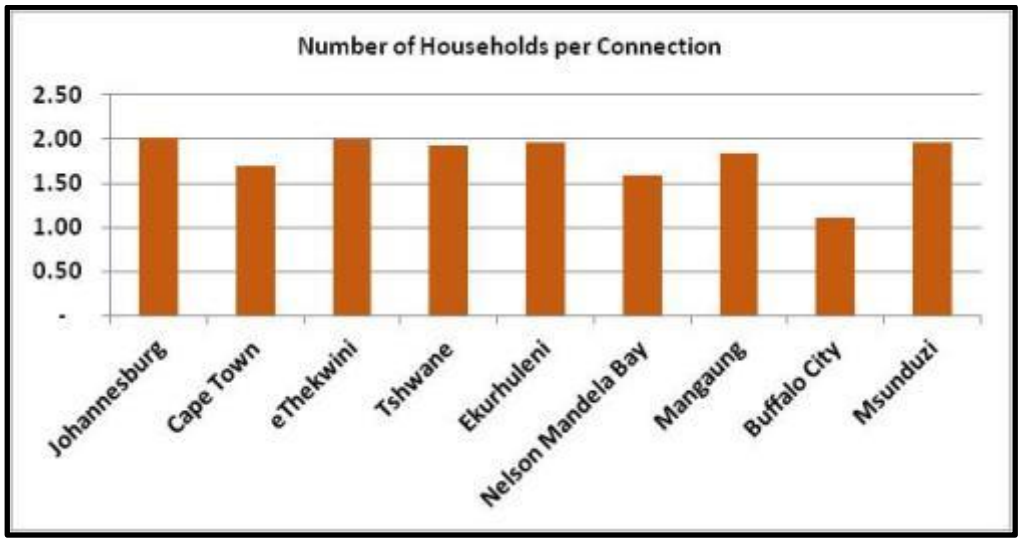

Figure 4.14 – Number of households per connection - SALGA/WRC MBI (2014)

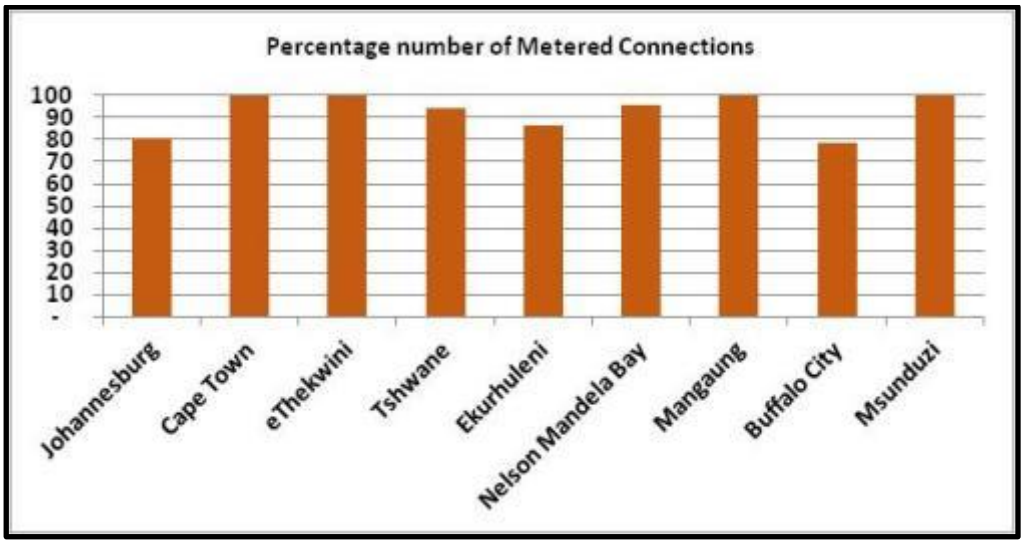

Figure 4.15 – Percentage number of metered connections - SALGA/WRC MBI (2014)

Complete, multi-year data for **Figures 4.6** to **4.15** would allow the following assessments to be undertaken:-

i) An indication of the extent to which the need for capital infrastructural are being addressed

ii) Adequacy of the level of capital spending

An attempt is made here to present assessment based on the available data.

Nelson Mandela Bay Metro and eThekwini have significantly higher capital investment per person for water and waste water infrastructure than the other cities as shown in **Figures 4.8** and **4.10**. For Nelson Mandela Bay Metro this may be due to urbanization that necessitates the extension of piped water supply to previously rural areas or the transformation of water supply infrastructure to the more convenient types (e.g. piped water within dwelling) from the existing less convenient types. Unfortunately the expenditure per person may also be a manifestation of slow pace of implementation of infrastructure projects particularly when the data in **Figure 4.8** shows that Nelson Mandela Bay Metro's expenditure per person is 175% of the closest peer and in excess of 200% of the rest of the cities. In absolute terms the City of Johannesburg has invested much more

on water infrastructure than any other city while eThekwini tops the list when water and waste water infrastructure is combined (see **Figures 4.7** and **4.9)**. This might be an indication that eThekwini is achieving the right balance.

It can be inferred from **Figures 4.11, 4.12** and **4.13** that the water supply infrastructure in the City of Cape is reaching a higher percentage of its citizens closely followed by Nelson Mandela Bay Metro. **Figure 4.14** shows that the City of Johannesburg and eThekwini have a higher density of connections then the other cities.

In terms of metered connections (**Figure 15**) Cape Town, eThekwini, Mangaung and Msunduzi, are well placed to implement water use monitoring programmes and to address issues associated with billing, losses management, etc provided the meters are in a good working condition. In summary, the City of Cape Town can be said to be meeting its capital requirements relative to the other member cities.

The higher outcomes for City of Cape Town tend to suggest a longer term capital expenditure than the other cities which may be dealing with significant water and waste water service backlogs.

4.1.2 OPEX

There is one KPI on OPEX with some data (the partially compete KPI in **Table 4.1** and this is presented in this section.

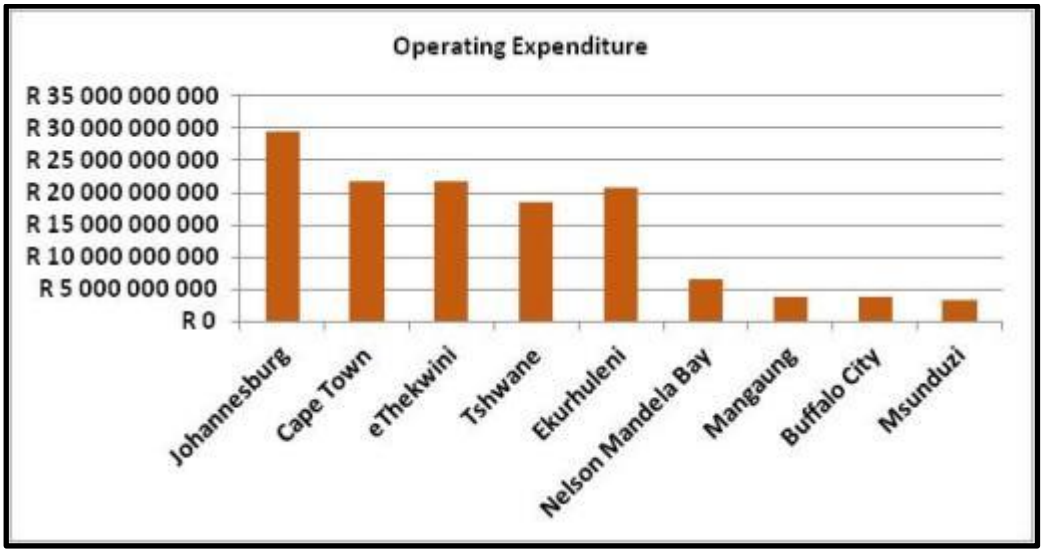

Figure 4.16 – Operating Expenditure (Rands) - SALGA/WRC MBI (2014)

Figure 4.16 shows the operating expenditure for the SACN member cities. The City of Johannesburg has the highest expenditure in absolute terms while Msunduzi has the lowest. Even if we factor in the 2012 population for each city presented in **Figure 4.1,** the City of Johannesburg has the highest per capita expenditure on OPEX as shown below:

Johannesburg	R6 413/person/year
Cape Town	R5 647/person/year
eThekwini	R6 279/person/year
Tshwane	R6 107/person/year
Ekurhuleni	R6 371/person/year
Nelson Mandela Bay	R5 669/person/year
Mangaung	R4 945/person/year
Buffalo City	R4 897/person/year
Msunduzi	R5 338/person/year

It is followed by Ekurhuleni and eThekwini. Economic activities in cities will largely determine how much revenue can be collected, the technical skills they can attract and keep and consequently the level of operating expenditure. The cities that have a lower level of economic activity will subsequently be constrained in this respect. However, higher OPEX spend per person may also indicate inefficiencies in the use of money or poor state of infrastructure. Data on level of service enjoyed by users is required to improve this explanation.

4.1.3 Technical capacity

The following 5 KPIs on technical capacity with some data (the partially compete KPIs in **Table 4.1**) are presented in this section:

- Blue Drop – KPA 1: Process control, maintenance and management skill, waste water
- Blue Drop – KPA 2: Process control, maintenance and management skill, water supply
- Technical Management Skill Level Health Check – SALGA/WRC MBI (2014)
- Technical Staff Skill Level Health Check – SALGA/WRC MBI (2014)
- Technical Staff Numbers Health Check – SALGA/WRC MBI (2014)

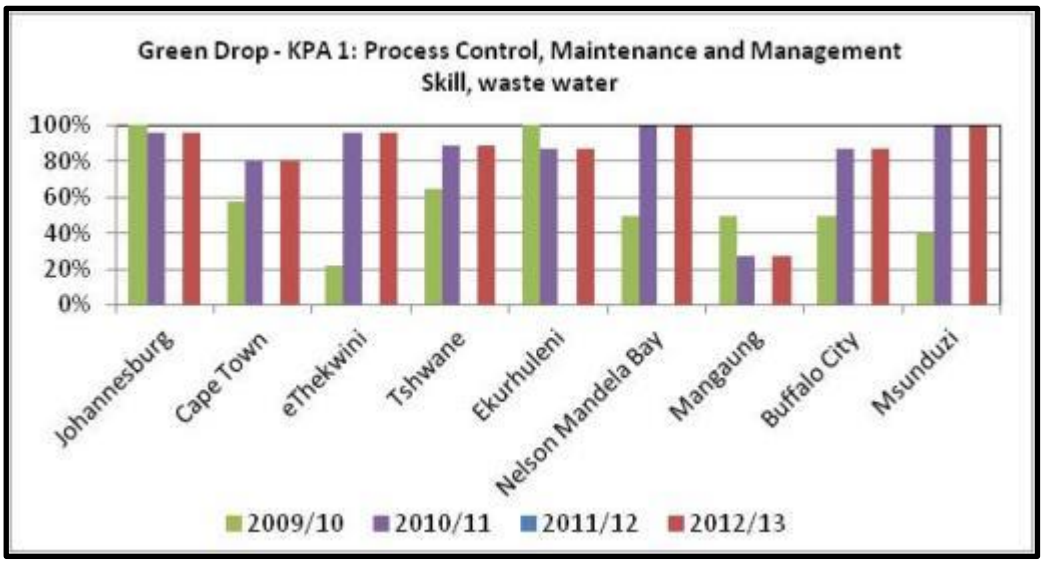

Figure 4.17 – Green Drop –KPA 1: Process control, maintenance and management skill, waste water

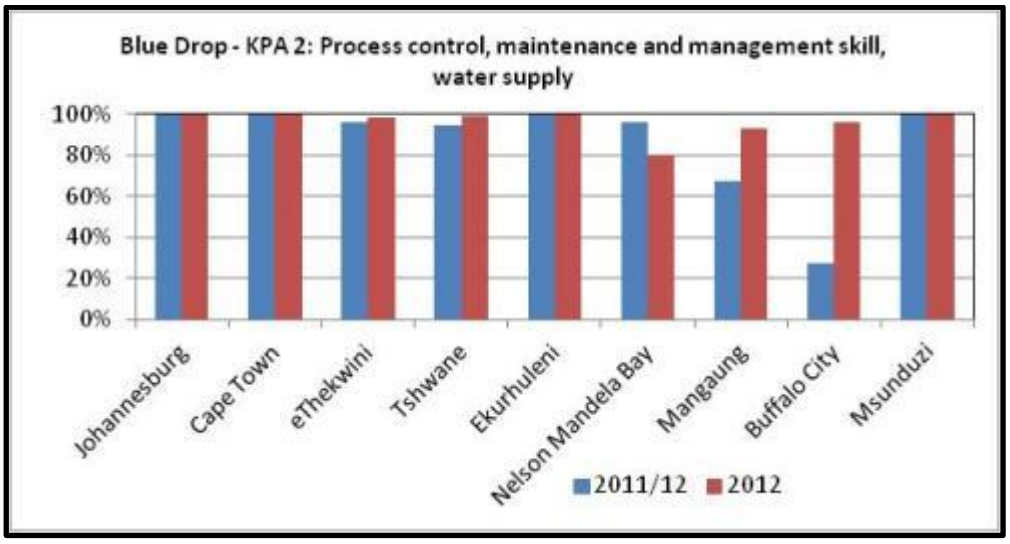

Figure 4.18 – Blue Drop – KPA 2: Process control, maintenance and management skill, water supply

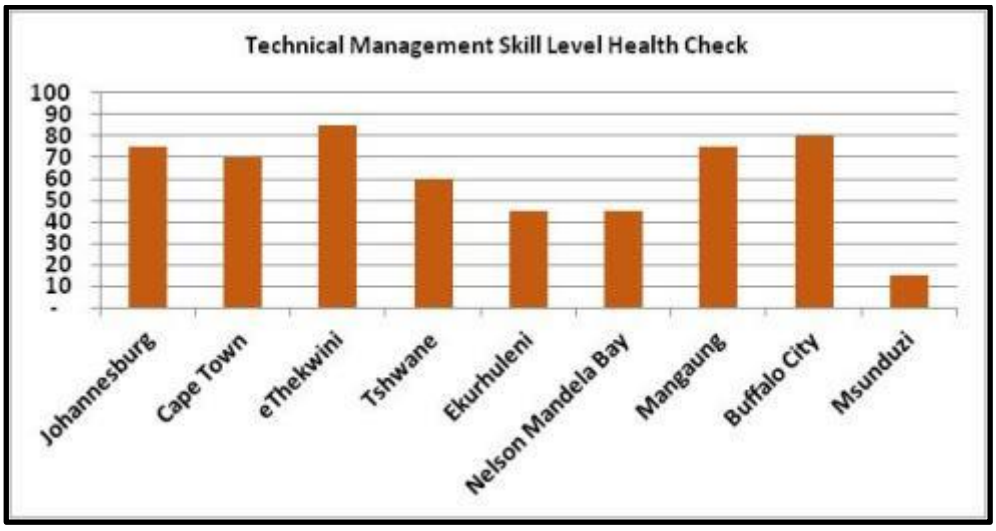

Figure 4.19 – Technical Management Skill Level Health Check – SALGA/WRC MBI (2014)

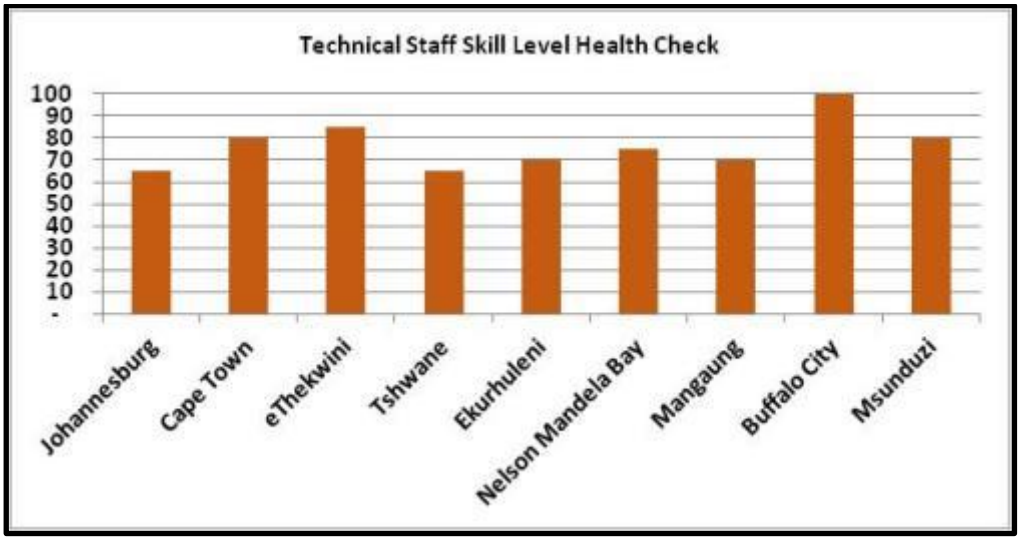

Figure 4.20 – Technical Staff Skill Level Health Check – SALGA/WRC MBI (2014)

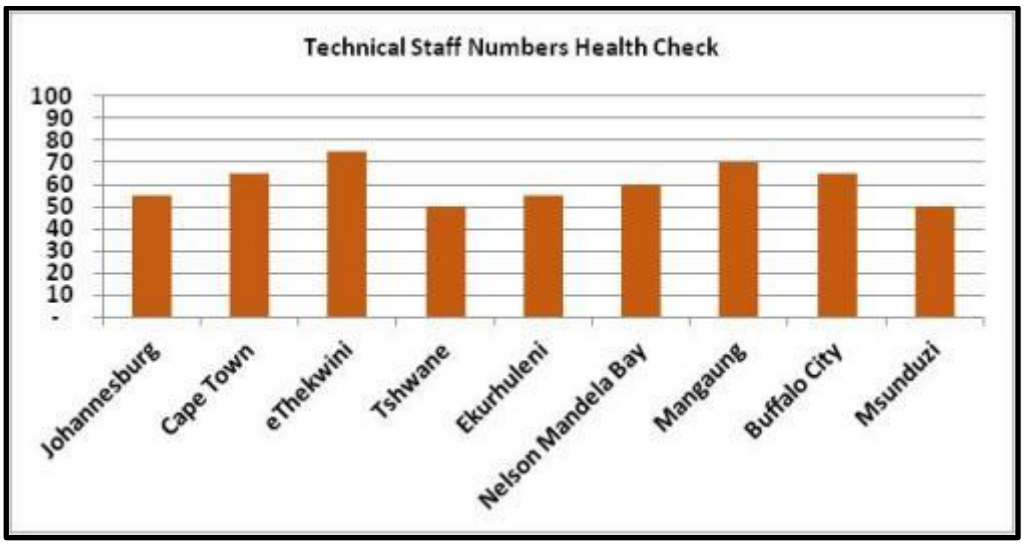

Figure 4.21 – Technical Staff Numbers Health Check – SALGA/WRC MBI (2014)

The ability to implement and maintain water services derives from the availability of adequately skilled technical staff. It is critical that these have skill levels that match the growing complexity as economic activity across the SACN cities increases. Furthermore, the need for institutional memory cannot be over emphasized. Unfortunately those parts of the country far removed from economic hubs have a difficult time attracting and keeping adequately skilled staff. They can however become learning centers to develop capacity which may eventually be attracted by opportunities offered elsewhere. This potential positive role of cities with smaller economies on development of technical skills needs to be recognized. The data on Green Drop and Blue Drop assessments presented in **Figures 4.17** and **4.18** respectively reflects that Buffalo City has improved significantly in terms of its technical capacity since 2012. There has been an improvement with time across all cities for the years with the exception of Mangaung's Green Drop technical skill assessment score.

Figures 4.19 to **4.21** present data obtained from the SALGA/WRC initiative. The cities have inadequate technical skills in terms of numbers and levels of skills. However, eThekwini Municipality has the most technical capacity followed by Buffalo City. The Water and Sanitation division of eThekwini was the 2014 winner of the Stockholm Industry Water Award, "for its transformative and inclusive approach to providing water and sanitation services as shown on the following web page:

(http://www.siwi.org/prizes/stockholmindustrywateraward/winners/2014-2/).

In summary, it is apparent that eThekwini has the best technical capacity to address the emerging challenges to water service provision.

Considering the population growth rates in **Figure 4.2**, it is clear that all the member cities need to implement strategies to improve their ability to attract, keep and grow their technical capacity as a matter of urgency.

4.1.4 Waste treatment

The following 3 KPIs on waste treatment have some data (the partially compete KPIs in **Table 4.1**) and are presented in this section:

- Access to sanitation SALGA/WRC MBI (2014)
- Drinking Water Quality Health Check SALGA/WRC MBI (2014)

- Number of people with access to different types of sanitation infrastructure SALGA/WRC MBI (2014)

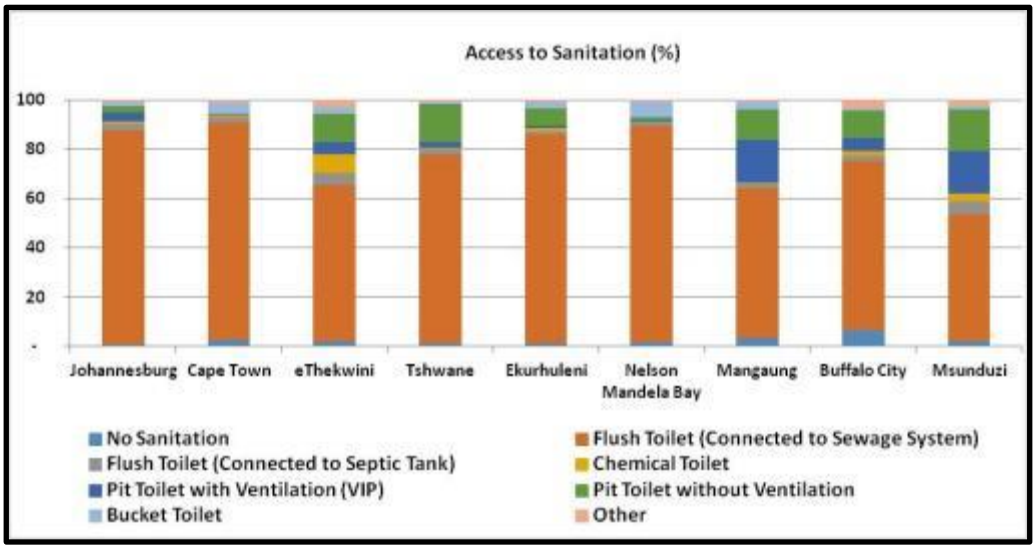

Figure 4.22 – Access to sanitation - SALGA/WRC MBI (2014)

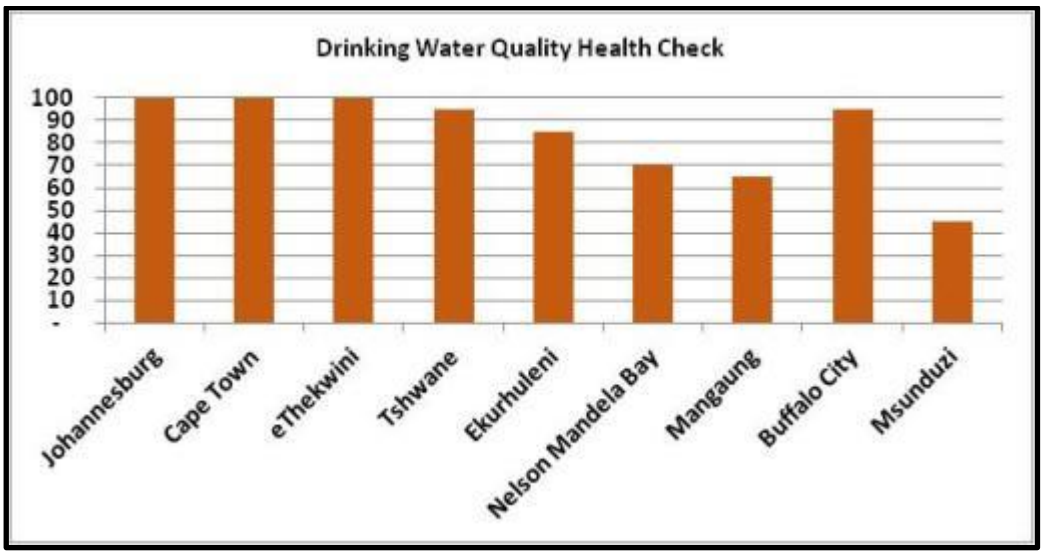

Figure 4.23 – Drinking Water Quality Health Check - SALGA/WRC MBI (2014)

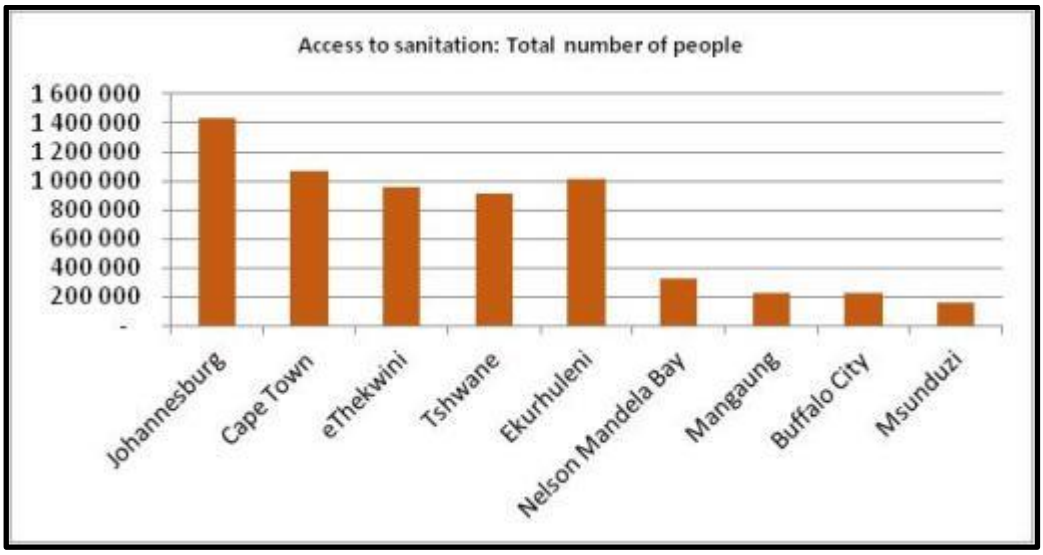

Figure 4.24 – Number of people with access to Sanitation- SALGA/WRC MBI (2014)

The information presented in **Figures 4.22** to **4.24** allows for the assessment on the existing capacity of the member Cities to treat waste. It is immediately apparent that the proportion of the population with access to flush toilets is highest in the City of Johannesburg, City of Cape Town, Ekurhuleni Municipality and Nelson Mandela Bay Metro (**Figure 4.22**) while in the cities of Msunduzi and Magaung there is significant use of ventilated improved pit (VIP) latrines. The type of sanitation system and how well it is maintained has implications for control of outbreaks and spread of water borne epidemics.

With respect to drinking water quality the City of Johannesburg, City of Cape and eThekwini are outstanding as can be seen in **Figure 4.23**. It may be a consequence, in part, of the existing capacity to collect and treat wastewater as evidenced by the greater proportion of systems connected to the sewage system. However Nelson Mandela Bay Metro is an exception to this case which suggests that the ability to attract and keep the technical skill essential for delivery of adequately treated water to the final consumer may be playing a role here. All this, however, derives from the fact the economic hubs are populated by consumers that are better able to demand and pay for high service levels.

4.1.5 Enforcement of regulations

The following 3 KPIs on waste treatment have some data (the partially compete KPIs in **Table 4.1**) and are presented in this section:

- Consumer debt – water services
- Consumer debt – waste water services
- Consumer debt – refuse collection

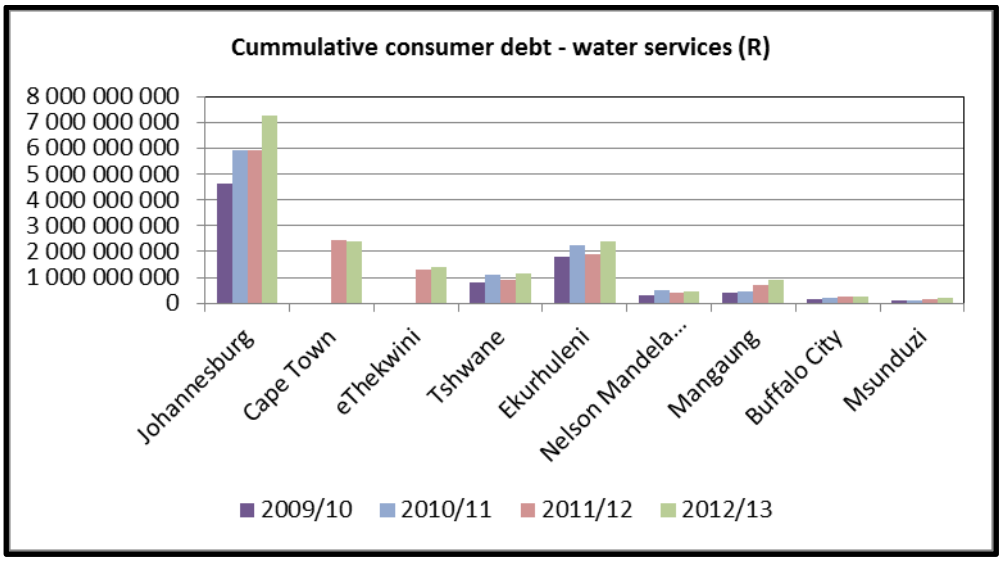

Figure 4.25 – Consumer debt – water services

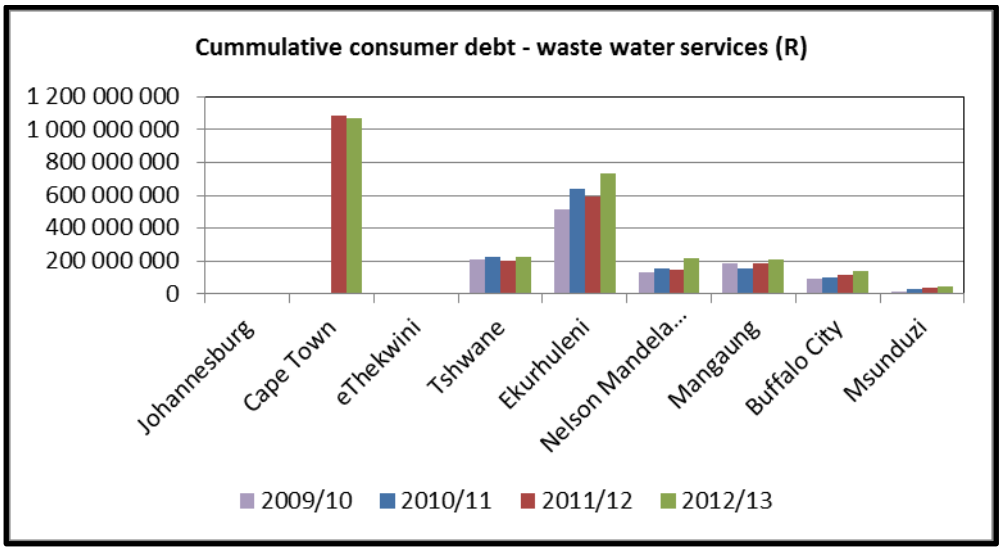

Figure 4.26 – Consumer debt – waste water services

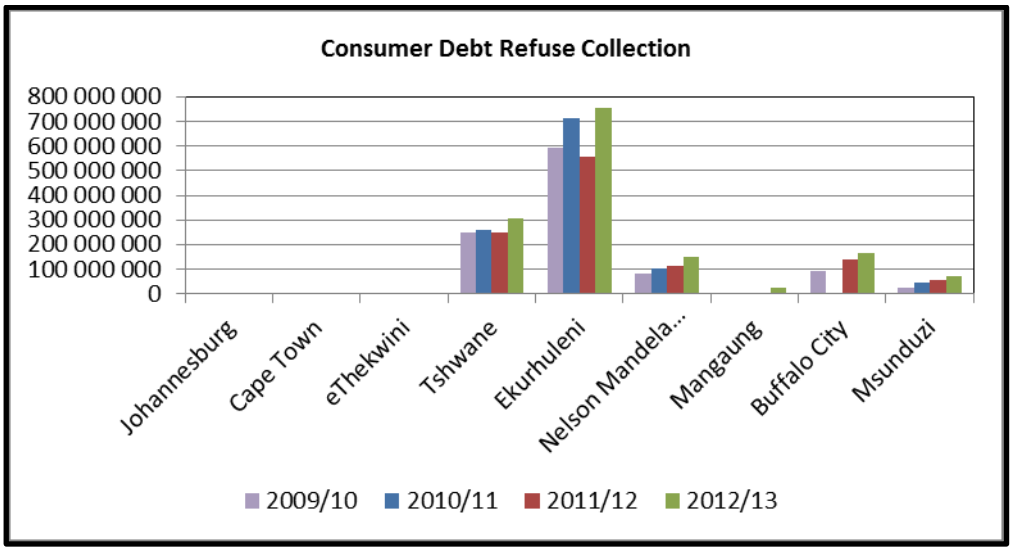

Figure 4.27 – Consumer debt – refuse collection

Assessment of the member cities' performance with respect to enforcement of regulations does not lend itself easily to quantitative methods. However, as a proxy, the outstanding dues by consumers for services rendered by the Cities were used. The available data is presented in Figures 4.25 to 4.27 and it summarizes the outstanding dues for water supply services, wastewater services and refuse collection services. The following is quite evident:

- The City of Johannesburg has by far the highest consumer debt for water services
- The City of Cape Town has by far the highest consumer debt for wastewater services followed by Ekurhuleni
- Ekurhuleni has by far the highest consumer debt for waste collection services

The City of Tshwane and Nelson Mandela Bay Metro seem to perform reasonably well on all of the three KPIs.

The ability of a city to enforce regulations may be impacted by the presence of several and sometimes conflicting regulations, lack of awareness among the enforcers about regulations, poor definition of roles and responsibilities across institutions. It can also be that the human resource capacity available to enforce the regulations is inadequate, unethical activities lack of political will, or political interference. Poor quality of service levels may lead to consumer apathy to payment for services.

4.1.6 Asset management

The following 9 KPIs on waste treatment have some data (the partially compete KPIs in **Table 4.1**) and are presented in this section:

- Spending on asset management vs budget
- Current replacement cost
- Carrying value of water network
- Carrying value of wastewater network
- Depreciated capital cost
- Blue Drop – Water supply asset management audits

- Green Drop – Water supply asset management audits
- Infrastructure Asset Management Health Check - SALGA/WRC MBI (2014)
- Operations and Maintenance of Assets Health Check - SALGA/WRC MBI (2014)

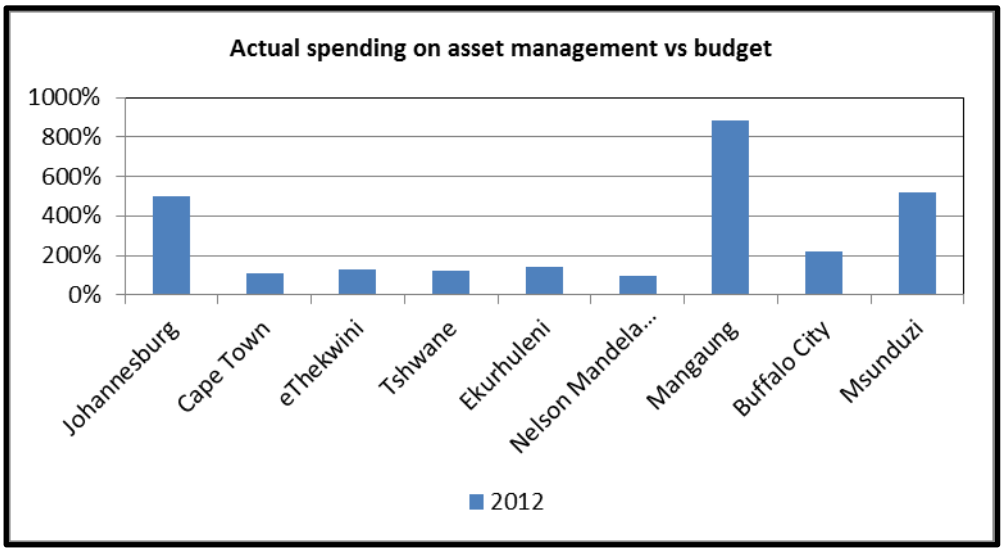

Figure 4.28 – Spending on asset management vs budget

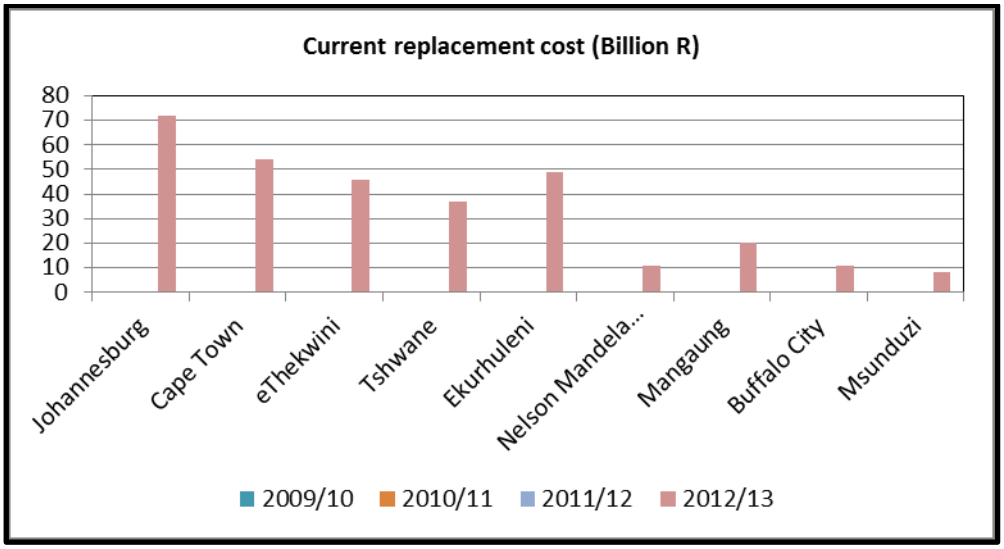

Figure 4.29 – Current replacement cost

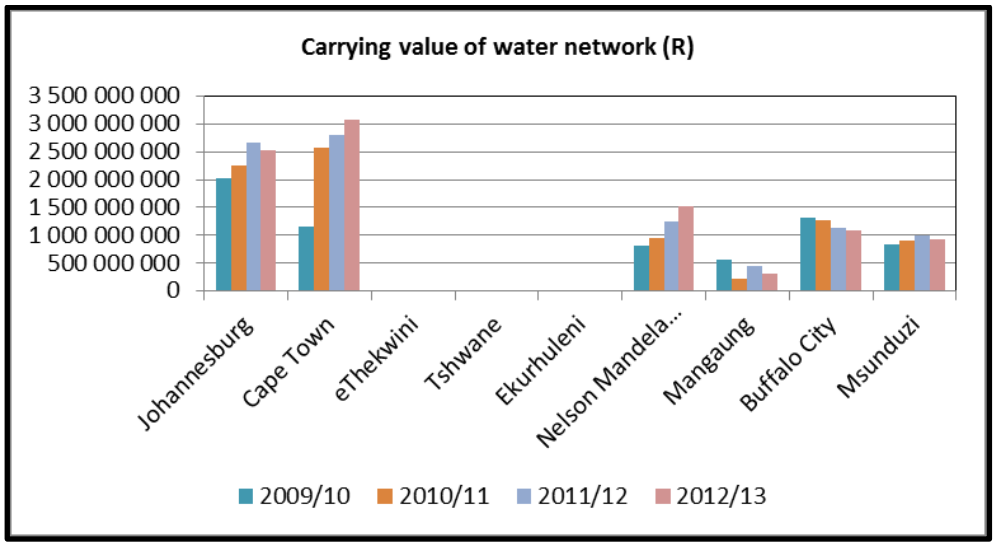

Figure 4.30 – Carrying value of water network

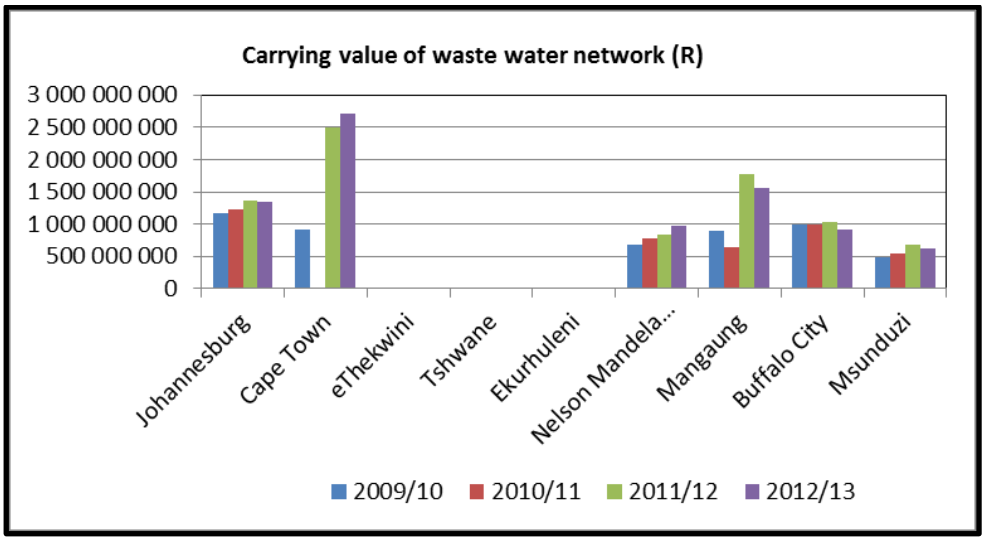

Figure 4.31 – Carrying value of waste water network

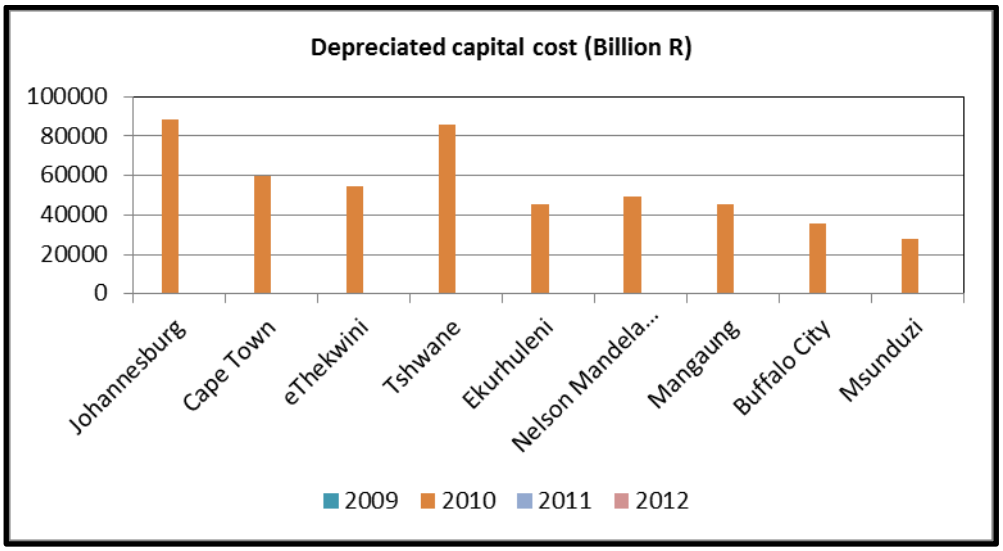

Figure 4.32 – Depreciated capital cost

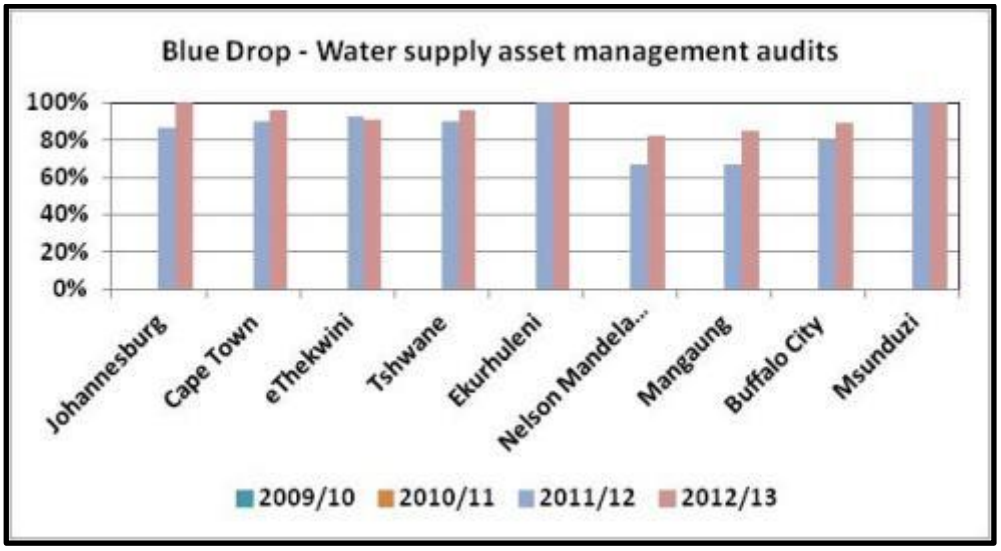

Figure 4.33 – Blue Drop – Water supply asset management audits

Figure 4.34 – Green Drop – Water supply asset management audits

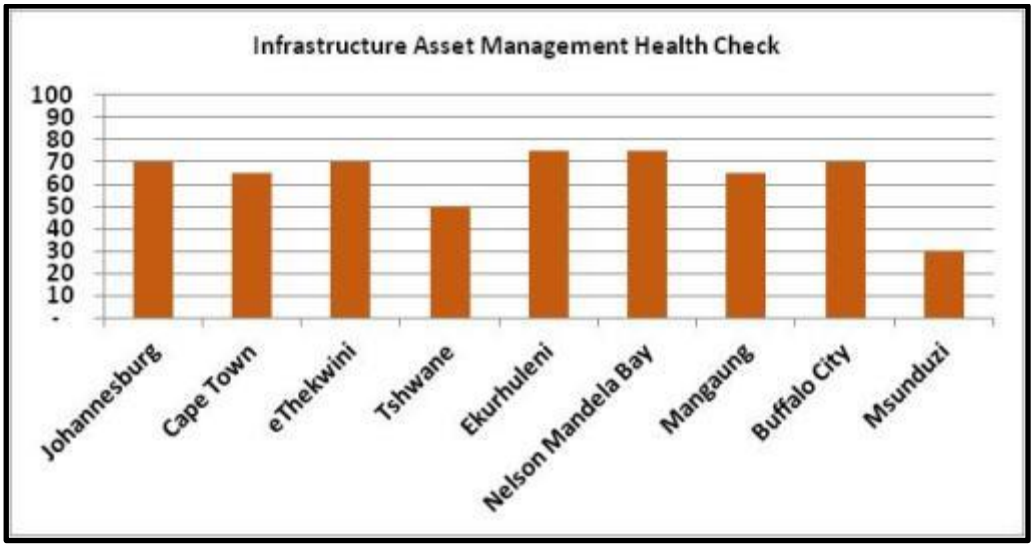

Figure 4.35 – Infrastructure Asset Management Health Check - SALGA/WRC MBI (2014)

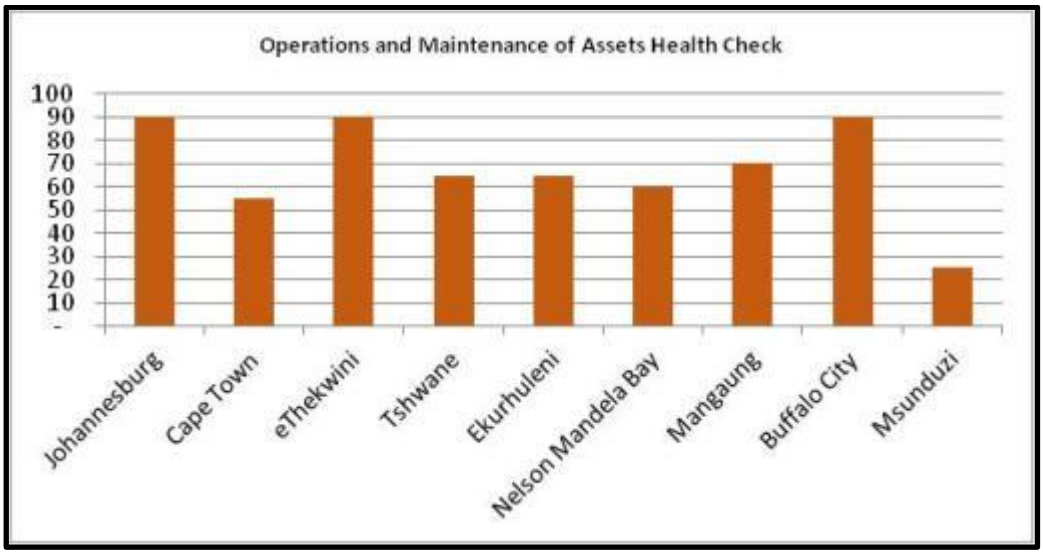

Figure 4.36 – Operations and Maintenance of Assets Health Check - SALGA/WRC MBI (2014)

Figure 4.28 shows the City of Johannesburg, Magaung, Buffalo City and Msunduzi actual spend on asset management in 2012 exceeded the budget with Magaung topping the list. This suggests serious under-budgeting for asset management. In an ideal situation the actual spending should match the budget figure but in practice, variation within some acceptable limits can be allowed. The variation for the Cities of Cape Town, eThekwini, Tshwane, Ekurhuruleni, and Nelson Mandela Bay Metro in this respect is more acceptable.

Changes in carrying value of assets can be positive or negative depending on whether recapitalization is done or not as depreciation will erode the carrying value. It is also to recapitalize through purchase/construction of new assets. The City of Johannesburg has the highest current replacement value followed by Cape Town then Ekurhuleni (**Figure 4.29**). However the City of Cape Town and Nelson Mandela Bay Metro show an increase in carrying value for water and wastewater infrastructure (**Figures 4.30** and **4.31**). The higher depreciation for the cities of Johannesburg and Tshwane in **Figure 4.32** is indicative of ageing water infrastructure.

Figures 4.33 and **4.34** show that the City of Johannesburg, Ekurhuleni and Msunduzi have excelled on completion of water supply management audits while on waste water asset management audits Cape Town and Nelson Mandela Bay Metro that have excelled.

On infrastructure asset management health checks Ekurhuleni has the highest score (about 75% see **Figure 4. 35**) all cities have a lot of work to do to get to a score above 90%. Figure 4.36 shows that on operation and maintenance the City of Johannesburg and eThekwini achieve a score of about 90% while the City of Cape Town and Msunduzi have very low scores

4.2 Topic 2: Fitness for use of water

While water quality challenges may partly result from natural causes, for the country's cities the threats are largely induced by the anthropogenic activities within the cities. These are increasingly impacting on the physical, chemical and biological characteristics of water as the population within the cities increases and are will ultimately impact on the suitability the water for use. Thus to maintain adequate fitness for use of water, cities will need to grow their budgets to meet the rising costs of water and wastewater treatment, develop and implement adequate resource monitoring protocols. In addition, their ability to protect the fitness of their precious resources will be also largely dependent on the how proactively they plan to deal with upstream

threats that may be outside their geographical precincts as well as those emerging threats that have yet to materialize.

As stated in **Chapter 2**, this topic can be adequately described using 38 indicators. **Table 4.2** shows that 23 indicators (14 SALGA/WRC MBI and 9 Desktop Research) have some data and one indicator has multi-year data.

Table 4-2: Status of indicators for fitness for use of water

No	Measure	SALGA/WRC MBI				DESKTOP RESEARCH			
		Total	MY	PC	NA	Total	MY	PC	NA
1	CAPEX	8	0	8	0	5	0	2	3
2	OPEX	1	0	1	0	2	0	0	2
3	Technical capacity	3	0	3	0	3	0	2	1
4	Monitoring, forecasting and early warning	0	0	0	0	2	0	0	2
9	Best practice guidelines, procedures standards and tools	0	0	0	0	5	0	0	5
10	Asset management	2	0	2	0	17	1	5	11
11	Awareness and education	0	0	0	0	2	0	0	2
Total		**14**	**0**	**14**	**0**	**36**	**1**	**9**	**26**

There is no data on indicators of 3 of the 7 measures. Some data was collected on the following measures:

i) CAPEX
ii) OPEX
iii) Technical capacity and
iv) Asset management

Graphs for CAPEX, OPEX, Technical capacity and Asset management are presented in **section 4.1**.

Some maps obtained from the South Africa Environment Outlook (SAEO, 2012) and National Freshwater Ecosystem Priority Areas project (NFEPA, 2011) report can be used to describe water quality and condition of ecosystems at a particular time. A time series of these maps can be used to establish trends and make extrapolations for early warning.

4.2.1 Monitoring and early warning

. In this section considers the following data:

- Surface Water Quality trends for Chlorides and Sulphates, Total Dissolved Solids and Nitrates (SAEO, 2012)
- Condition of ecosystems (NFEPA, 2011)
- Free flowing rivers (NFEPA, 2011)
- Threatened species (NFEPA, 2011)

4.2.1.1 Chlorides, Sulphates, Nitrates and Total Dissolved Solids

The South Africa Environment Outlook (SAEO, 2012) considered water quality based on the DWA National Water Quality Monitoring System. The outlook report considered data from the “top 333 sites” for the period 2005 to 2010. **Figure 4.37** shows maps obtained from this report. They show positive or negative changes since the 2006 SAEO.

A continued deterioration in the water quality condition is reported when comparisons are made with the results within the 2006 South Africa Environment Outlook (SAEO). The report suggests that the severe salinity observed in areas such as the Vaal, Crocodile and Olifants River systems may be attributed to mining activities. This has financial implications for cities such Johannesburg, Tshwane and Ekurhuleni which obtain water from these river systems as this could result in water treatment cost increases. Agriculture; industrial development (including mining) and urban development have had a large effect on the quality of water and its fitness for use. For coastal cities increased salinity may arise from seawater intrusion.

It is acknowledged that the monitoring points for the DWA National Water Quality Monitoring System may not coincide with the points of importance to cities. Cities should work with DWA to establish more relevant monitoring points.

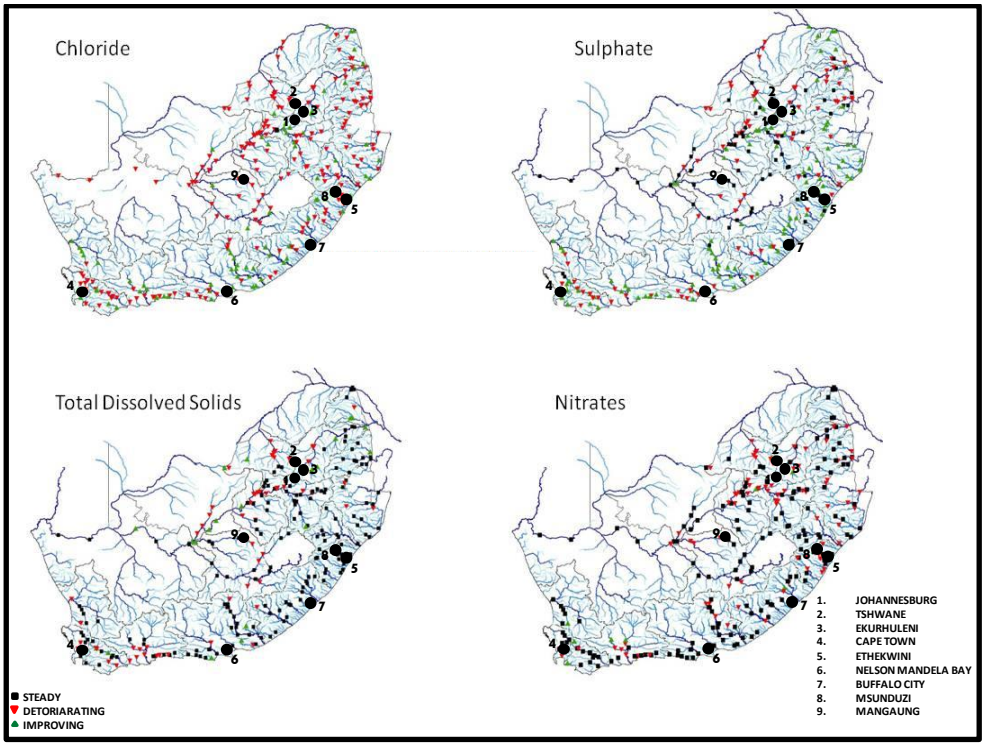

Figure 4:37 – Surface Water Quality trends for Chlorides and Sulphates (2006 to 2008), Total Dissolved Solids and Nitrates (2005 – 2010). – ***Adapted from the 2012 South Africa Environment Outlook***

4.2.1.2 Condition of ecosystems

This section of the report borrows considerably from the National Freshwater Ecosystem Priority Areas project (NFEPA, 2011) report. The NFEPA (2011) is a result of a three-year partnership project between South African National Biodiversity Institute (SANBI), CSIR, Water Research Commission (WRC), Department of Environmental Affairs (DEA), Department of Water Affairs (DWA), Worldwide Fund for Nature (WWF), South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks) that provides strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These priorities are known as Freshwater Ecosystem Priority Areas (FEPAs). FEPAs were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types. Species associated with rivers, wetlands and estuaries, described in detail in the NFEPA Technical Report.

Freshwater ecosystems when maintained in their pristine state have the potential to provide for many of our fundamental needs: water for drinking and irrigation, food such as fish and water birds, and reeds for

craftsmanship. Healthy ecosystems also provide important regulating functions such as preventing floods an recharging groundwater.

Some of the results extracted from the NFEPA technical report and a description of the relevant implications for SACN cities is provided here. The study was at sub-Water Management Area (WMA) level. The sub-WMAs are broadly based on the catchments of large tributaries within a WMA.

In **Figure 4:38** each sub-WMAs has a shade of green indicating the proportion of each sub-WMA identified by the NFEPA project as a FEPA. It is apparent from this map that aside from Msunduzi and eThekwini (numbers 5 and 8 in **Figure 4:38**) the SACN cities are located in sub-WMAs with 0% to 10% their area as FEPAs. This suggests that in these cities communities can only derive very limited ecosystem services from the available fresh water resources. This has implications particularly for the poor in these cities whose livelihoods, social and cultural activities would be more closely linked to freely available ecosystem system services. However since fresh water biodiversity is not evenly distributed the coarse scale of in **Figure 4:38** imposes some limitations on the conclusions that can be drawn from it.

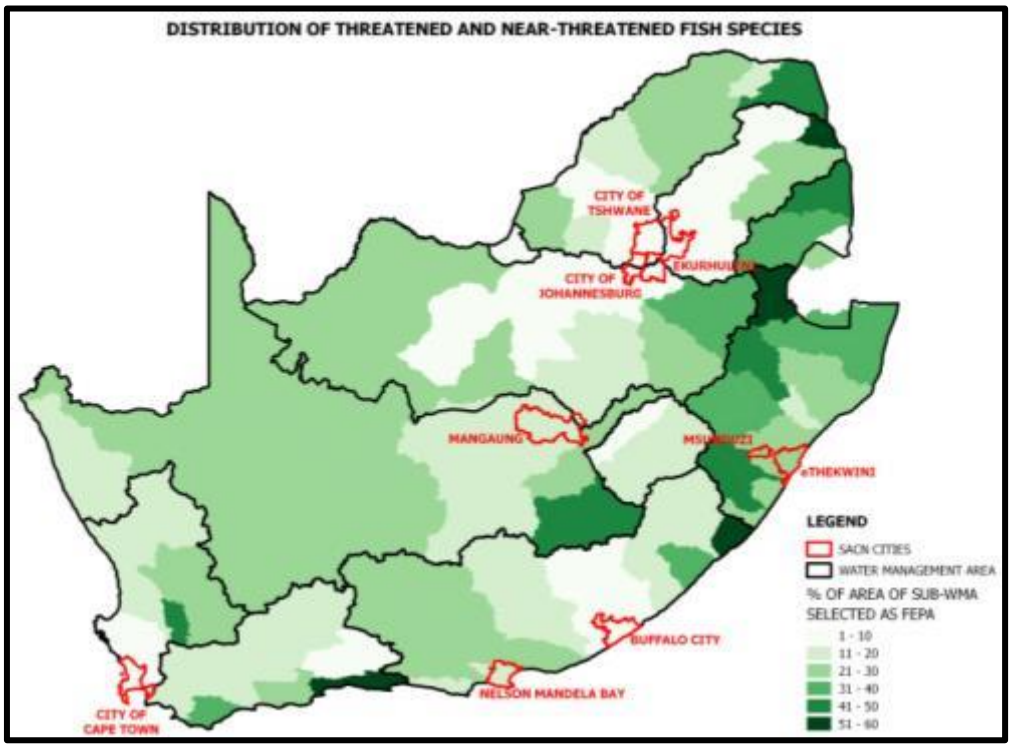

Figure 4:38 - Density of Freshwater Ecosystem Priority Areas

The NFEPA Project also developed maps for different categories on the Freshwater Ecosystem Priority Areas (FEPA) as follows:

i) River FEPA

These are reaches that are currently in a good condition (A or B ecological category). Their FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources.

Although FEPA status applies to the actual river reach within such a sub-quaternary catchment, the surrounding land and smaller stream network need to be managed in a way that maintains the good condition (A or B ecological category) of the river reach.

ii) Wetland or estuary FEPA

These FEPAs were identified using ranks that were based on a combination of special features and modelled wetland condition. Special features included expert knowledge on features of conservation importance (e.g. Ramsar wetland status, extensive intact peat wetlands, presence of rare plants and animals) as well as available spatial data on the occurrence of threatened frogs and wetland-dependent birds.

Estuary FEPAs are the national priority estuaries identified in the National Biodiversity Assessment 2011 (Van Niekerk and Turpie 2011). The recommended ecological category for priority estuaries is listed in Van Niekerk and Turpie (2011).

iii) Wetland Cluster

Wetland clusters were identified as groups of wetlands embedded in a relatively natural landscape. This allows for important ecological processes such as migration of frogs and insects between wetlands.

Wetlands do not have to have FEPA status to belong to a wetland cluster (although clusters with a high proportion of wetland FEPAs were favoured in identifying wetland clusters).

iv) Fish Support Area and associated sub-quaternary catchment

Fish Support Areas were identified as fish sanctuaries in lower than an A or B ecological. Fish Support Areas also include sub-quaternary catchments that are important for migration of threatened or near threatened fish species.

v) Upstream Management Area

These are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas do not include management areas for wetland FEPAs, which need to be determined at a finer scale.

vi) Phase 2 FEPA

Phase 2 FEPAs were identified in moderately modified rivers (C ecological category), only in cases where it was not possible to meet biodiversity targets for river ecosystems in rivers that were still in good condition (A or B ecological category). River condition of these Phase 2 FEPAs should not be degraded further, as they may in future be considered for rehabilitation once FEPAs in good condition (A or B ecological category) are considered fully rehabilitated and well managed.

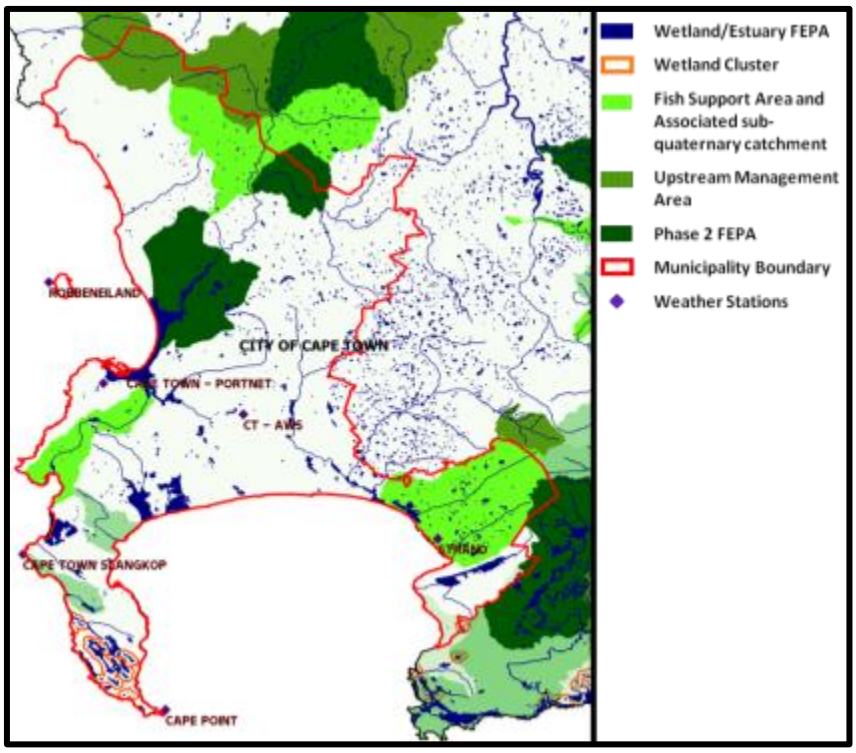

Figure 4:39 - City of Cape Town Freshwater Ecosystem Priority Areas

In **Figure 4.39** can be seen to have significant areas of Cape Town are as considered Fish Support Areas as well as modified rivers (Phase 2 FEPA). Further degraded should be avoided. The Southern most extreme of the city also has some wetlands and wetland clusters that are essential for supporting ecosystem processes such as migration of frogs.

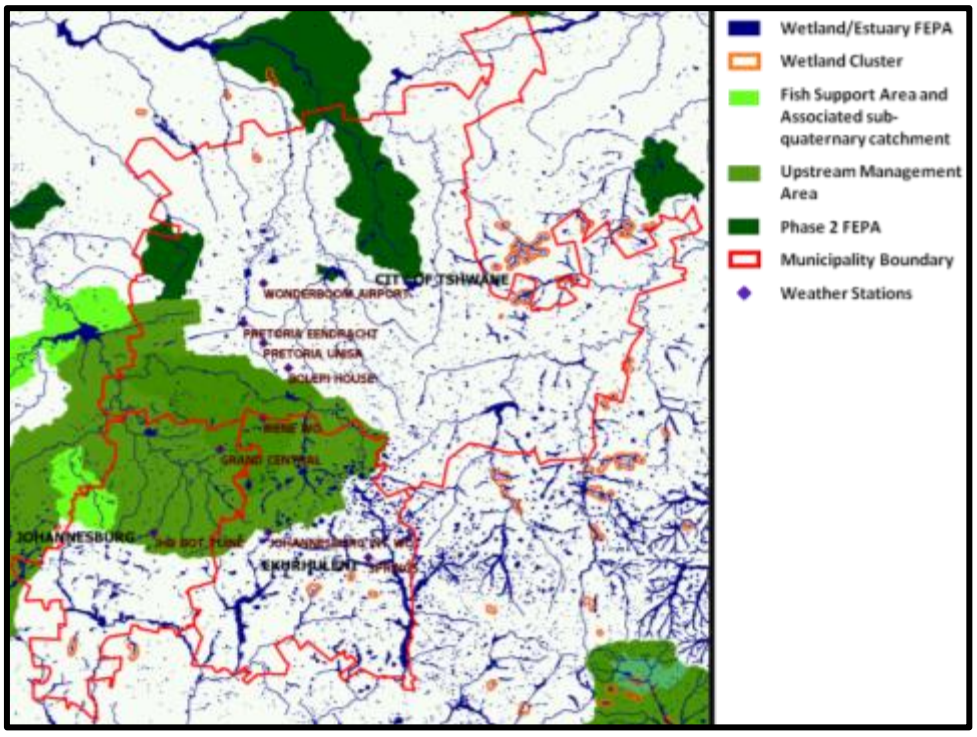

Figure 4:40 - City of Johannesburg, City of Tshwane and Ekurhuleni Freshwater Ecosystem Priority Areas

The Gauteng cities, shown in **Figure 4.40** when compared to other SACN cities are ecologically vulnerable owing to the smaller areas that are considered FEPAs. Of significance is the Upstream Management Area that covers the northern part of the cities of Johannesburg and Ekurhuleni and the southern portion of the City of Tshwane. As recommended by the NFEPA project human activities in this area need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.

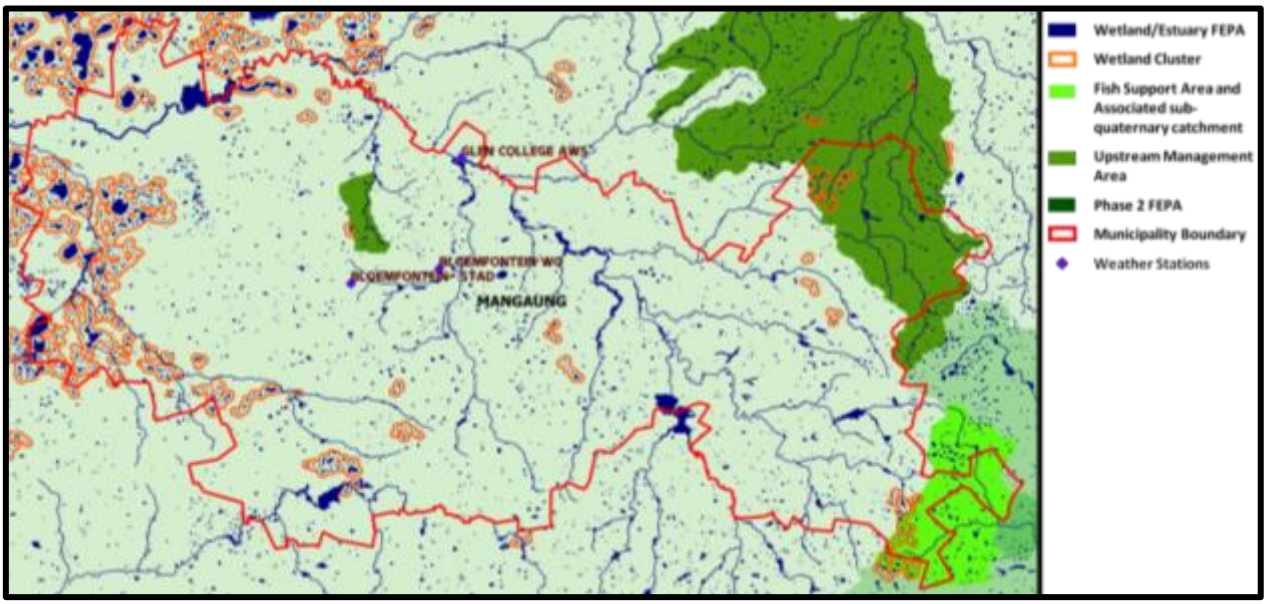

Figure 4:41 - Mangaung Municipality Freshwater Ecosystem Priority Areas

The Mangaung Municipality shown in **Figure 4.41** has a number of wetland clusters in the eastern part making it essential for the support of critical ecological process associated with these clusters.

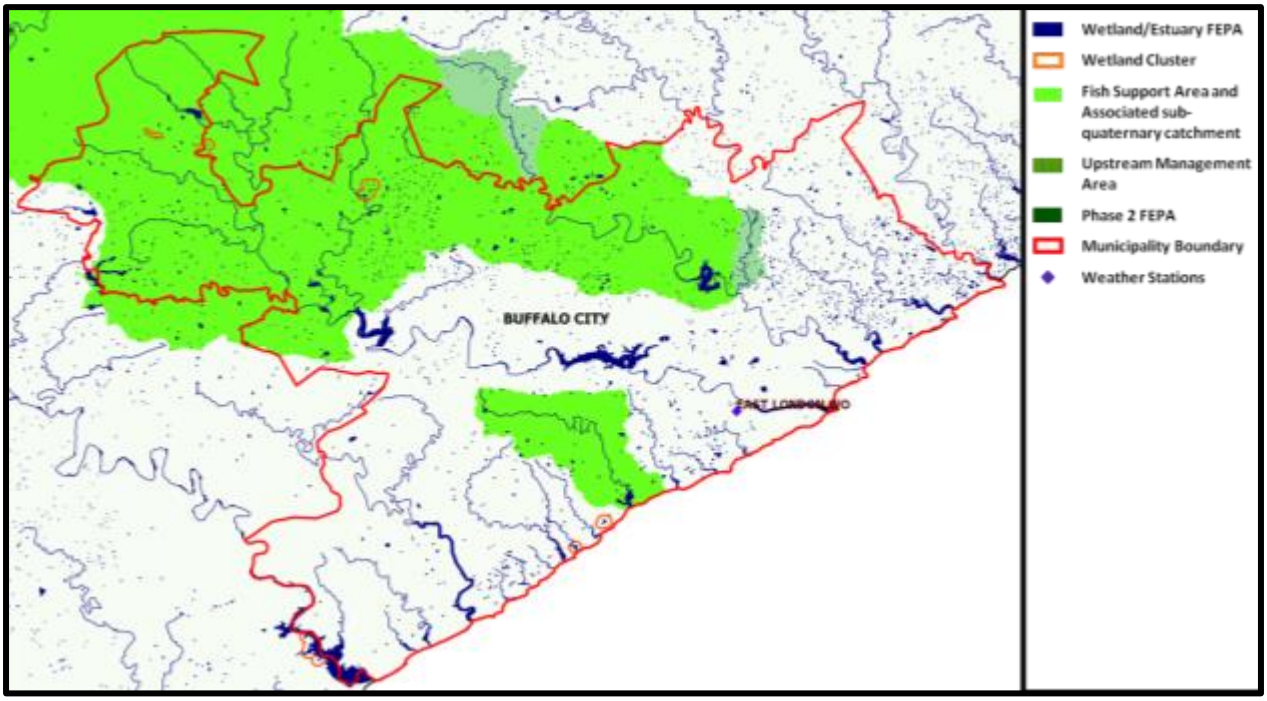

Figure 4:42 - Buffalo City Freshwater Ecosystem Priority Areas

The most significant feature that can be identified in the coastal Buffalo City is the Fish Support Area across the northern parts of the city as shown in **Figure 4.42.** The city also has a few wetlands along the several rivers that end up in the ocean.

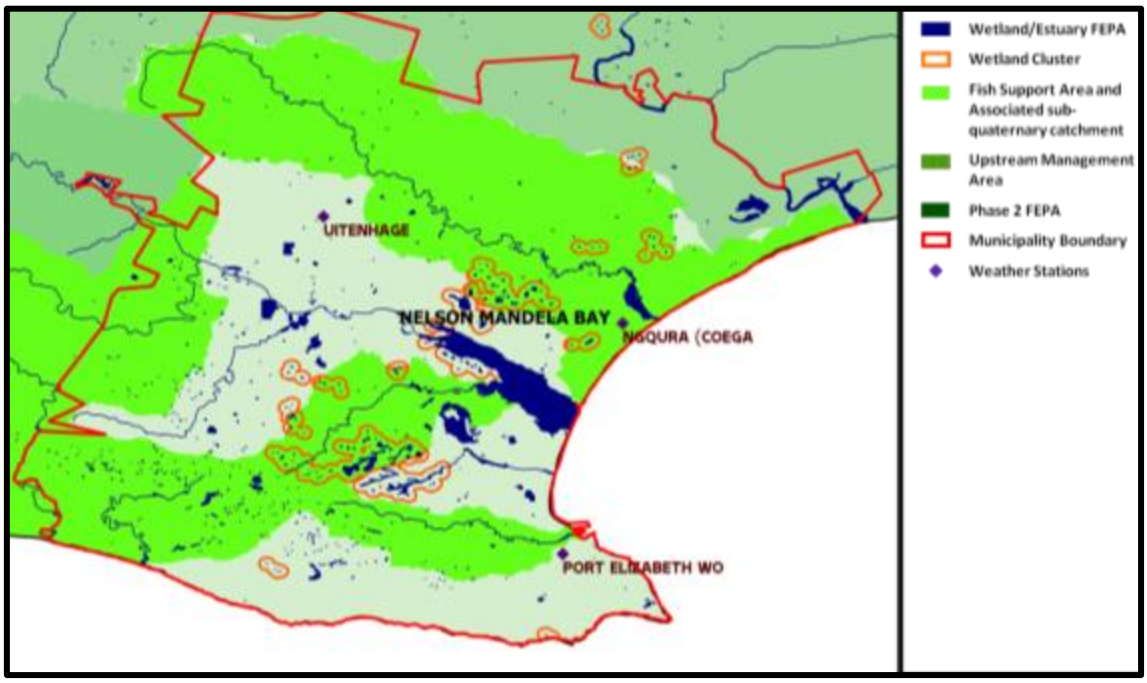

Figure 4:43 - Nelson Mandela Bay Metro Freshwater Ecosystem Priority Areas

The coastal Nelson Mandela Bay Metro shown in **Figure 4.43** supports a range of healthy ecosystems as it has a number of wetlands and wetland clusters and fish support areas. It is essential that for any urban planning for this metro to take this into account.

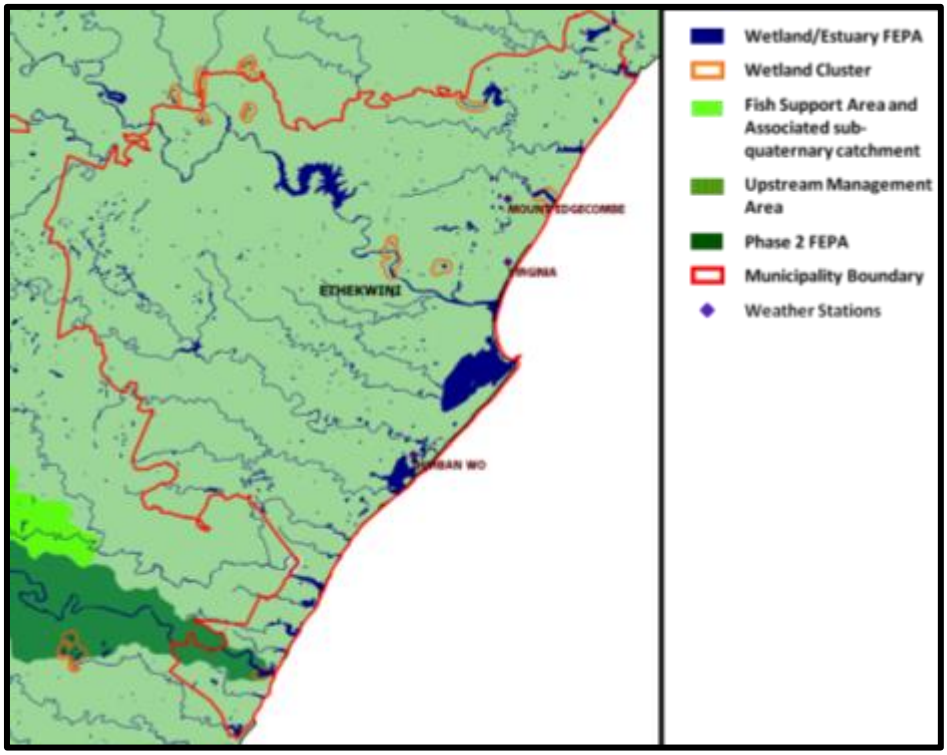

Figure 4:44 - eThekwini Freshwater Ecosystem Priority Areas

eThekwini is largely devoid of fish support areas and rivers that can be rehabilitated to achieve FEPA status (see **Figure 4.44**). A few wetlands and wetland clusters can be identified in the municipality.

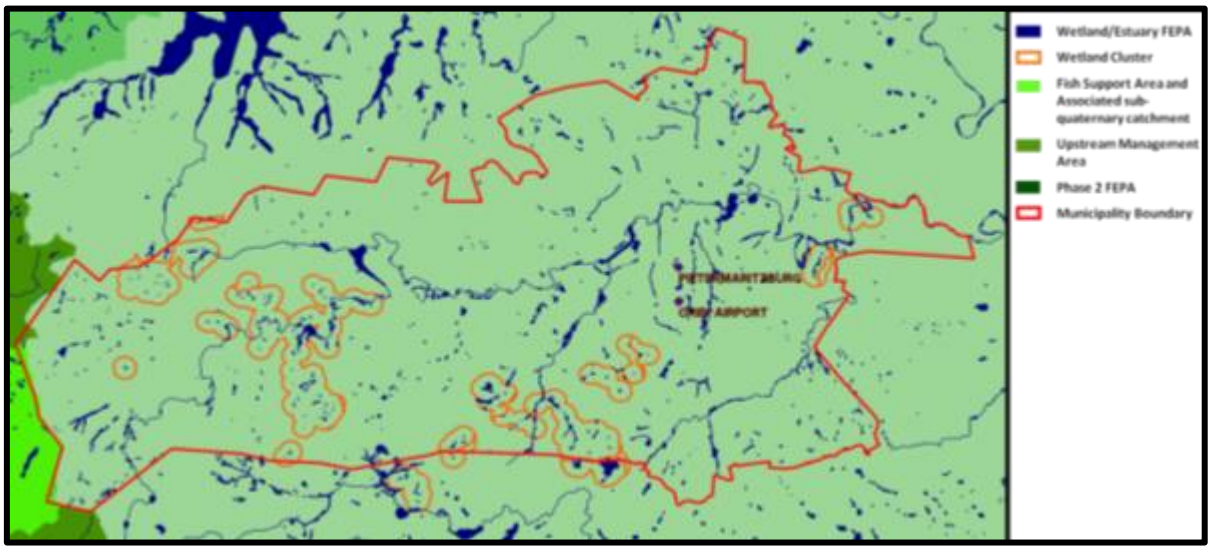

Figure 4:45 - Msunduzi Municipality Freshwater Ecosystem Priority Areas

Msunduzi Municipality (**Figure 4.45**) has a number of wetland clusters and wetlands although it is marked by the absence of other features such as the fish support areas and phase 2 FEPAs.

4.2.1.3 Free flowing rivers

The free-flowing rivers are rivers that flow undisturbed from source to the confluence with another large river or to the sea. These offer considerable social, economic and conservation value, supporting the livelihoods of

people in the respective river catchment especially the poor rural. With none of these existent in the SACN Cities, the benefits of these free-flowing rivers are largely lost to the Cities.

4.2.1.4 Threatened species - Fish

Fish sanctuaries were identified as rivers that are essential for protecting threatened and near threatened freshwater fish that are indigenous to South Africa.

The NFEPA project's goal is to keep further freshwater species from becoming threatened and to prevent those fish species that are already threatened or near threatened from going extinct. In order to achieve this, there should be no further deterioration in river condition in fish sanctuaries and no new permits should be issued for stocking invasive alien fish in farm dams in the associated sub-quaternary catchment. Fish management plans need to be developed for all fish sanctuaries to protect the fish they contain, with priority given to those fish sanctuaries containing critically endangered or endangered fish species. These plans should address issues such as management of a particular stretch of river habitat within the sub-quaternary catchment, the construction of weirs to keep invasive alien fish species to a minimum (following an environmental impact assessment), and managing aquaculture and angling to ensure no further introduction of invasive alien fish species.

Figure 4.46 to **Figure 4:48** present information on the number of threatened or near threatened species for those SACN cities with these species namely Nelson Mandela Bay Metro, Buffalo City and City of Cape Town. Their absence in some cities may be due to the deterioration in river conditions in the respective cities or due to these fish species not be indigenous to the river systems in the respective cities. The presence of these species within the SACN member cities would have implications on the nature of anthropogenic activities cities can authorize in the affected rivers if further deterioration in river condition in fish sanctuaries is to be limited as recommended in the NFEPA Project report. For instance, a moratorium on issuance of permits for stocking invasive alien fish in farm dams may need to be imposed.

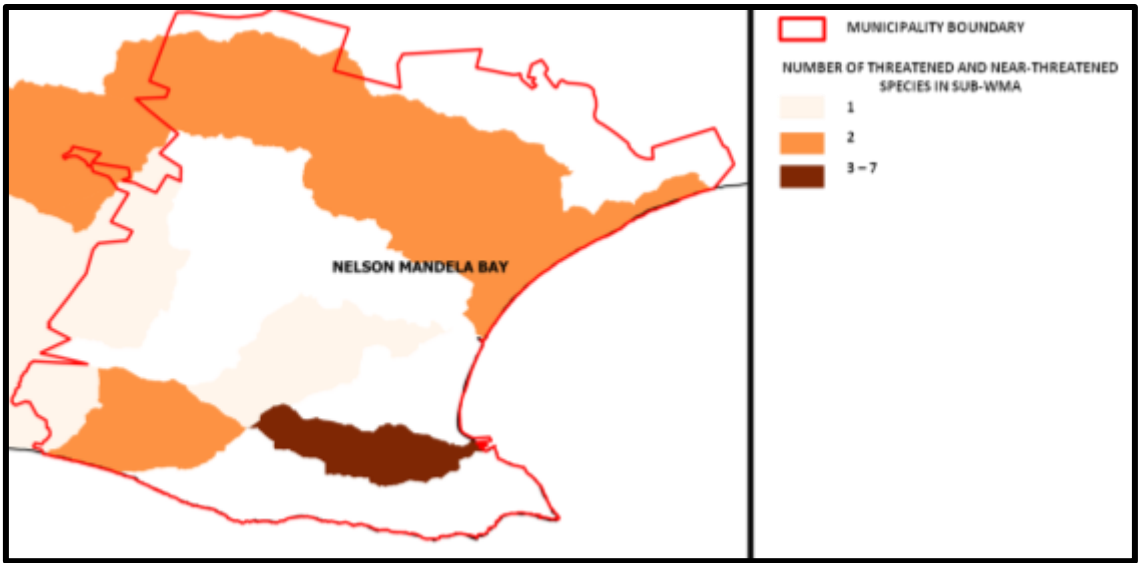

Figure 4:46 - Distribution of threatened and near-threatened Fish Species in Nelson Mandela Bay Metro

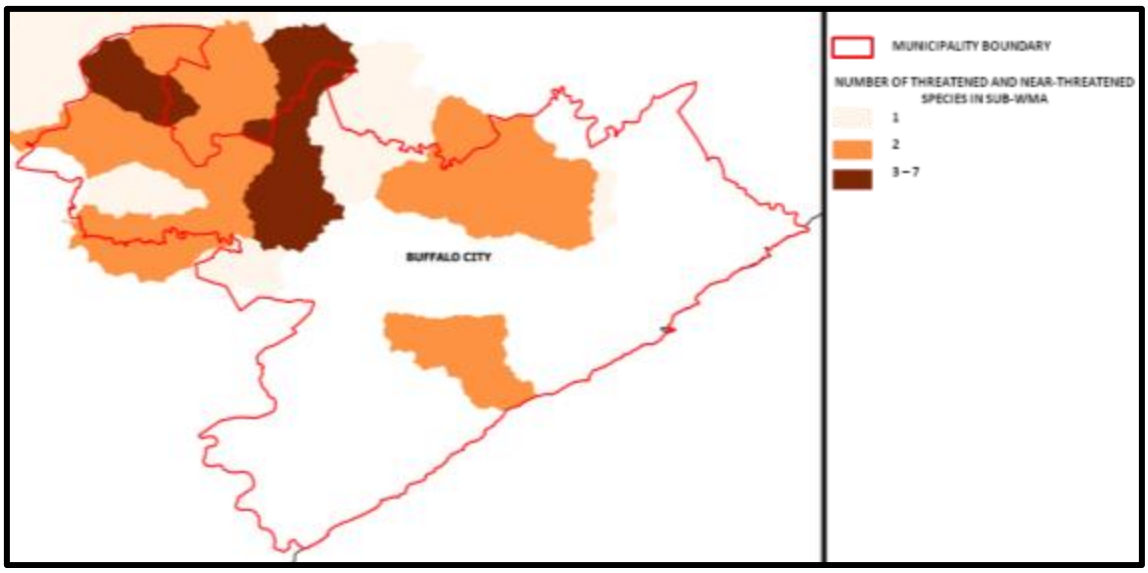

Figure 4:47 - Distribution of threatened and near-threatened Fish Species in Buffalo City

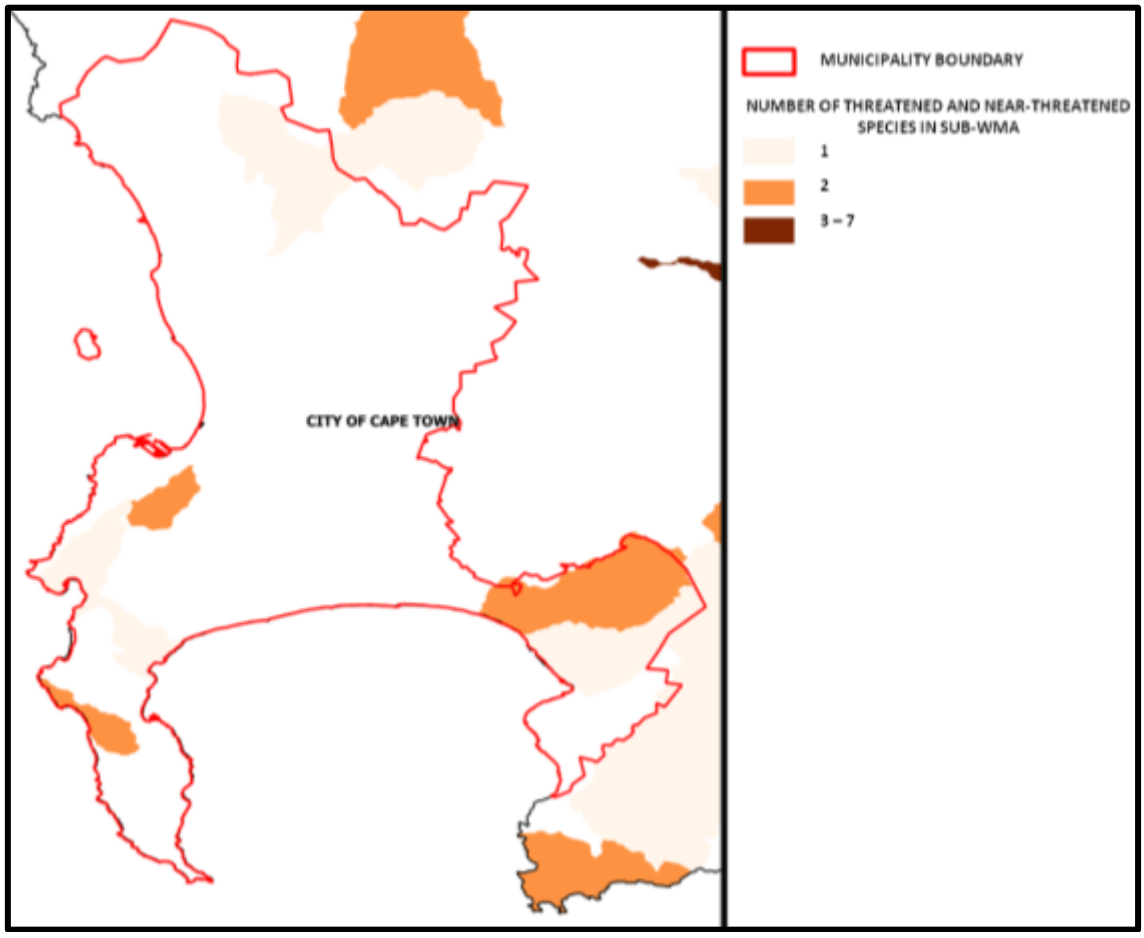

Figure 4:48 - Distribution of threatened and near-threatened Fish Species in the City of Cape Town

4.3 Topic 3: Condition of freshwater resources and impacts on people and infrastructure

The condition of freshwater resources is compromised by among others lack of proper sanitation facilities, rapid increase of un-serviced informal settlements and ageing and overloaded municipal water waste treatment infrastructure. These will more often lead to a rise in faecal pollution. In fact, the 2012 SAEO reports that faecal contamination is increasingly becoming a country-wide problem. This poses health risk to humans as the use of water contaminated with faecal pollution can result in the transmission of water-borne diseases, such as cholera. As such to assess the condition of freshwater resources and likely impacts on people and infrastructure, the following indicators are appropriate

As stated in **Chapter 2**, this topic can be adequately described using 28 indicators. **Table 4.3** shows that only 6 indicators (3 SALGA/WRZ MBI and 3 Desktop Research) have some data.

Table 4-3: Status of indicators for condition of freshwater resources and impacts

No	Measure	SALGA/WRC MBI				DESKTOP RESEARCH			
		Total	MY	PC	NA	Total	MY	PC	NA
5	Waste treatment	3	0	3	0	4	0	1	3
6	Waste collection service	0	0	0	0	4	0	0	4
7	Enforcement of regulations	0	0	0	0	4	0	2	2
11	Awareness and education	0	0	0	0	2	0	0	2
16	Abstraction of water from source	0	0	0	0	9	0	0	9
17	Littering	0	0	0	0	3	0	0	3
18	Dumping of waste	0	0	0	0	2	0	0	2
Total		**3**	**0**	**3**	**0**	**28**	**0**	**3**	**25**

There is no data on indicators of 5 of the 7 measures. Some data was collected on the following measures:

i) Waste treatment

ii) Enforcement of regulations

Waste treatment is discussed under **section 4.1.4** and enforcement of regulation is discussed under **section 4.1.5**. This is with respect to resource availability and its use. These discussions are not repeated here.

With respect to the condition of the water resource and impact on people the following observations can be made.

4.3.1 Waste treatment

The types of waste collection, treatment and disposal systems and how well they are maintained has implications on quality of receiving water. While the information presented in **Figures 4.22** to **4.24** may not provide an adequate description of the existing conditions it is apparent that SACN member cities should improve management of waste.

4.3.2 Enforcement of regulations

The ability of a city to enforce regulations on waste disposal and treatment has a significant impact on condition of the environment and fresh water ecosystems. Human behavior is a critical element in the waste management value chain and its regulation particularly in the economic hubs plays a significant role. There indicators in **section 4.15** can be used to track the financial impacts of enforcement of regulation.

4.4 Topic 4: Condition of water infrastructure and management in the cities

The Department of Water and Sanitation constructs, operates, and maintains the vast amount of the country's bulk water infrastructure networks with cities and municipalities having the oversight for their respective distribution networks, which are essential for economic development and quality of life in our communities. However, cities face a backlog of projects and this is becoming acute especially since the rate of growth of population within cities is fast rising. Serving this growing population requires adequate investment in developing new infrastructure and maintenance of existing infrastructure. The consequences of delaying such investment can be dire as this may only worsen the problem, raise the overall costs and increasing the likelihood of major infrastructure failures. **Table 4-4** provides an idea of the size of bulk water infrastructure in SACN member cities as obtained from the DWA web page: http://www.dwa.gov.za/dir_ws/WSDP/. The information is largely incomplete.

Table 4-4: Bulk water infrastructure management in the cities

SACN City	Number of Schemes	Bulk Pipeline (km)	Reservoirs	Pump Stations	Water Treatment Works	Waste Water Treatment Works
City of Johannesburg Metropolitan	No data	752	91	73	0	6
City of Cape Town Metropolitan	32	0	109	349	10	26
eThekwini Municipality Metropolitan	No data	No data	No data	No data	No data	No data
City of Tshwane Metropolitan	No data	741	134	133	3	10
Ekurhuleni Municipality Metropolitan	No data	7119	66	35	No data	19
Nelson Mandela Bay Metropolitan	No data	No data	No data	No data	No data	No data
Magaung	No data	No data	No data	No data	No data	No data
Buffalo City	No data	No data	No data	No data	No data	No data
Msunduzi	No data	No data	No data	No data	No data	No data

As stated in **Chapter 2**, this topic can be adequately described using 86 indicators. **Table 4.5** shows that 30 of the indicators (20 SALGA/WRC MBI and 10 Desktop Research) have some data.

Table 4-5: Status of indicators for condition of water infrastructure management in the cities

No	Measure	SALGA/WRC MBI				DESKTOP RESEARCH			
		Total	MY	PC	NA	Total	MY	PC	NA
1	CAPEX	8	0	8	0	5	0	2	3
2	OPEX	1	0	1	0	2	0	0	2
3	Technical capacity	3	0	3	0	3	0	2	1
5	Waste treatment	3	0	3	0	4	0	1	3
6	Waste collection service	0	0	0	0	4	0	0	4
7	Enforcement of regulations	0	0	0	0	4	0	2	2
8	Aged infrastructure	0	0	0	0	3	0	2	1
9	Best practice guidelines, procedures standards and tools	0	0	0	0	5	0	0	5

No	Measure	SALGA/WRC MBI				DESKTOP RESEARCH			
		Total	MY	PC	NA	Total	MY	PC	NA
12	Information/data	1	0	1	0	8	0	0	8
13	Inspection and monitoring	0	0	0	0	4	0	0	4
14	CAPEX spend	0	0	0	0	4	0	0	4
19	Planning and implementation	1	0	1	0	14	0	1	13
20	Regulations and procedures	0	0	0	0	12	0	0	12
21	Sales volumes for water	2	0	2	0	5	0	0	5
22	Service tariffs	0	0	0	0	7	0	0	7
23	System blockages and damages	0	0	0	0	2	0	0	2
Total		21	**0**	**21**	**0**	**86**	**0**	**10**	**76**

There is no data on indicators of 6 of the 16 measures. Some data was collected on the following measures:

i) CAPEX
ii) OPEX
iii) Technical capacity
iv) Waste treatment
v) Aged infrastructure
vi) Enforcement of regulations
vii) Information/data
viii) Planning and implementation and
ix) Water sales

The graphs on CAPEX (**Figures 4.6 to 4.15**), OPEX (**Figure 4.16**), Technical capacity (**Figures 4.17 to 4.21**), Waste treatment (**Figure 4.22 and 4.24**), Enforcement of regulations (**Figures 4.25 and 4.27**) have been presented already in **section 4.1** of this report.

The data collected on Information/data and Water sales is presented in this section.

4.4.1 Information/data

Information Management Health Check (SALGA/WRC MBI (2014) is the only KPI presented in this section:

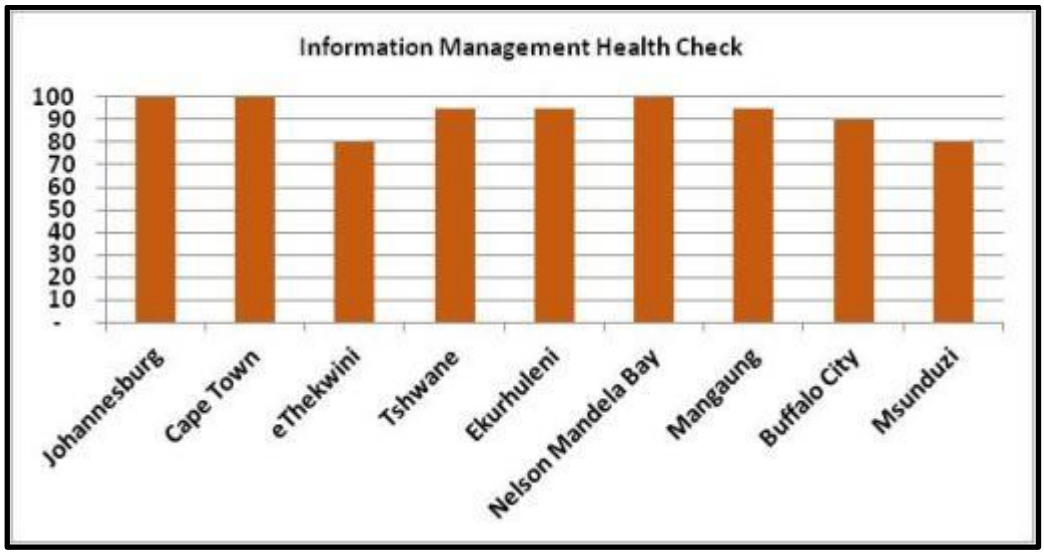

Figure 4.49 – Information Management Health Check - SALGA/WRC MBI (2014)

An adequate information management system is essential for anticipating and putting in place measures to address challenges that may impact on water and wastewater services provision in the cities. Therefore, the cities at the forefront of implementing information management systems can be considered better prepared owing to their ability to collect and process information, making them more sustainable. According to the information presented in **Figure 4.49**, the Cities of Johannesburg, Cape Town and Nelson Mandela Bay lead with respect to information management. This is consistent with the experience of collecting data for this project as for most of the indicators selected these cities have more readily available information.

4.4.2 Planning and implementation

Population growth is the only KPI with data on Planning and Implementation. As pointed out at the beginning of this chapter the cities of Johannesburg and Tshwane have experienced relatively high population growth rates since 2001. Additional infrastructure is required to cater for the increase while maintaining the existing in a suitable condition to provide the expected levels of service. According to the information presented in **Figure 4.50**, the Cities of eThekwini, and Buffalo City lead with respect the heath check on water services planning.

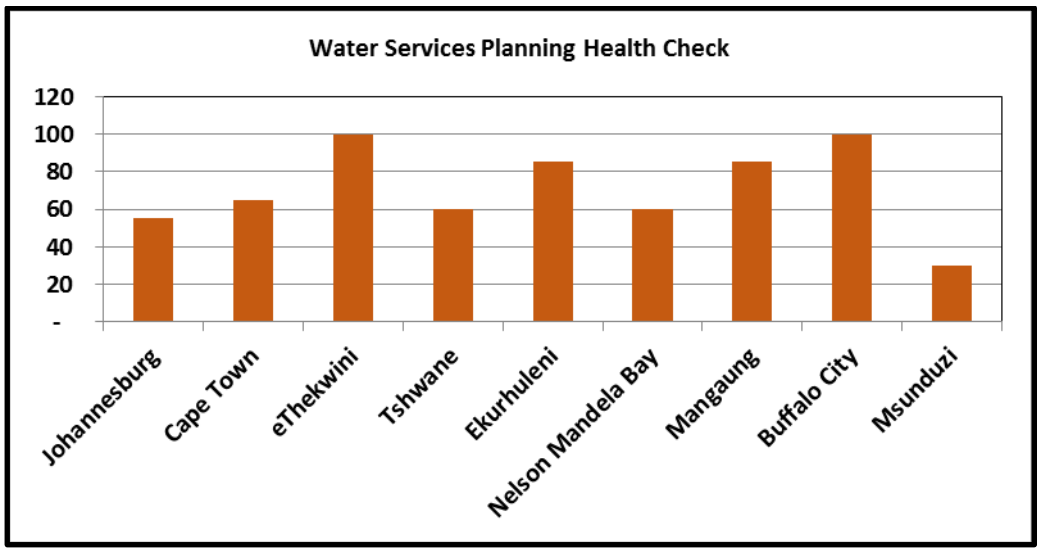

Figure 4.50 – Water services planning health check (%)

4.4.3 Water sales

The following KPIs are presented in this section:

- Income from water services - SALGA/WRC MBI (2014)
- Non revenue water – water loss (%)
- Non revenue water – financial loss (%)
- Non-revenue water by volume (m^3)- SALGA/WRC MBI (2014)
- Non-revenue water (%) - SALGA/WRC MBI (2014)

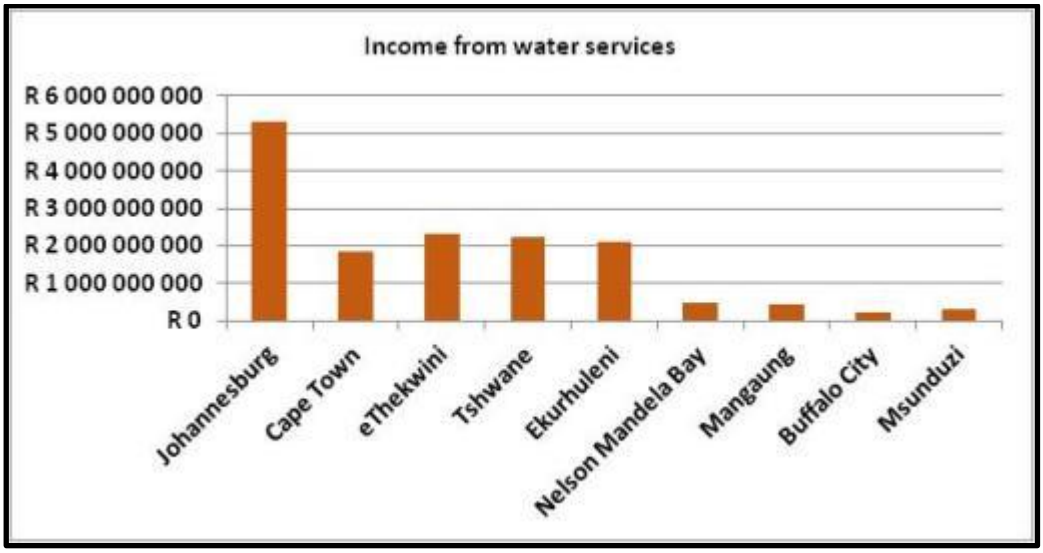

Figure 4.51 - Income from Water Services – water loss (%)

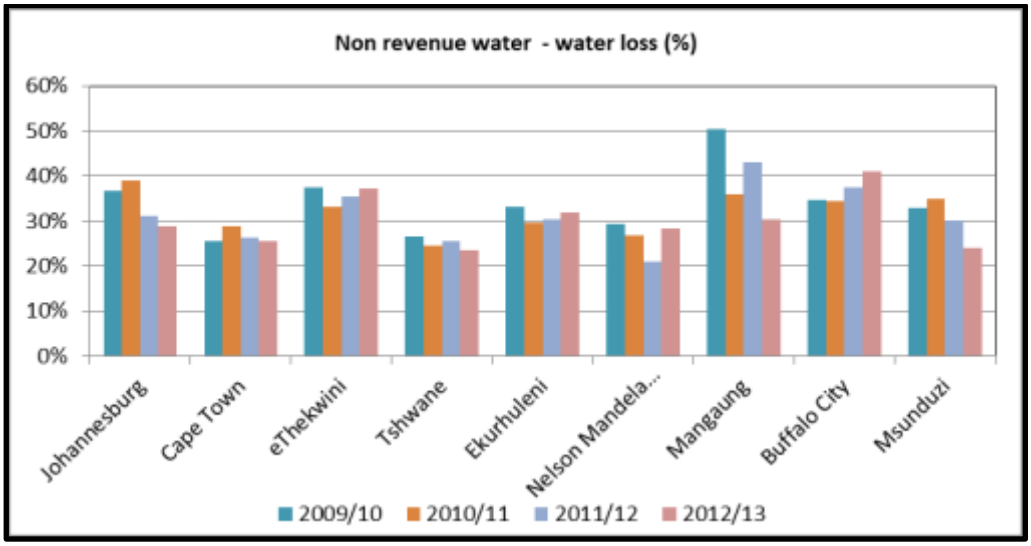

Figure 4.52 - Non revenue water – water loss (%)

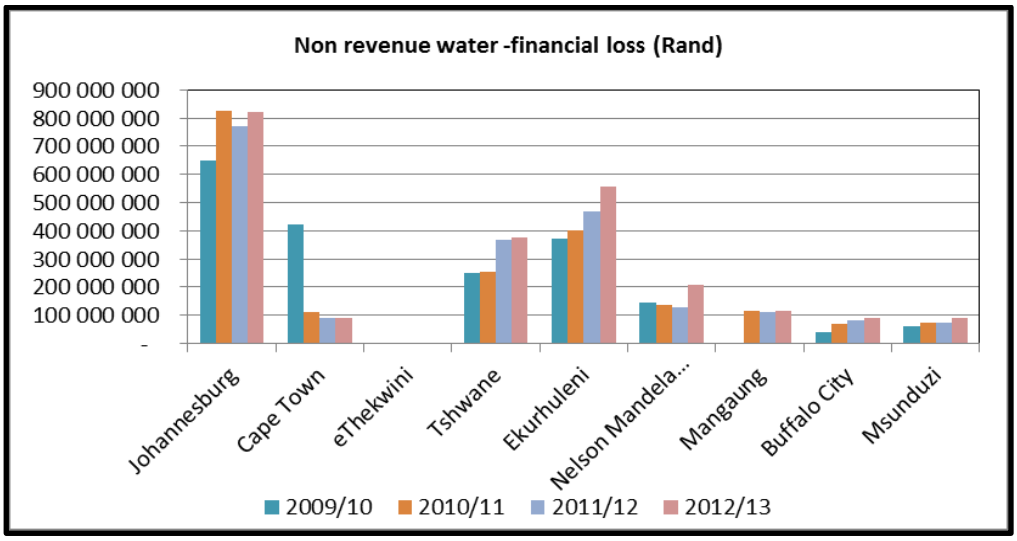

Figure 4.53 - Non revenue water – financial loss (Rand)

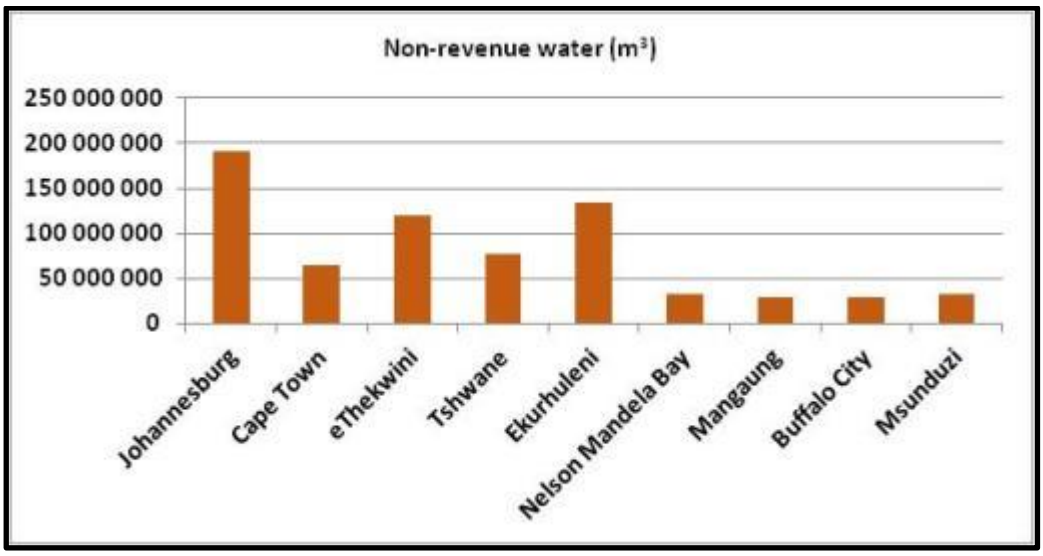

Figure 4.54 – Non-revenue water - SALGA/WRC MBI (2014)

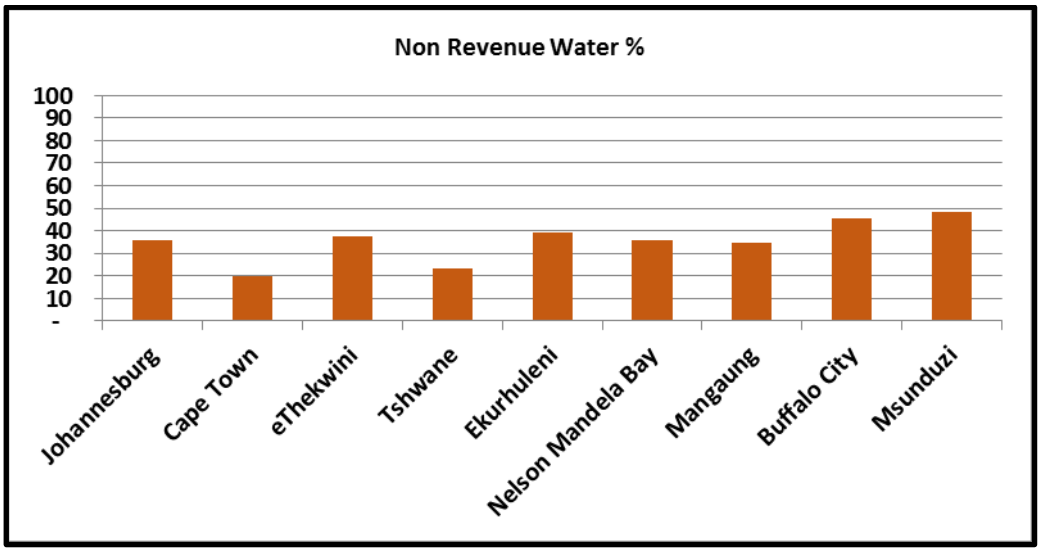

Figure 4.55 – Non-revenue water by volume (%)- SALGA/WRC MBI (2014)

The information presented in **Figures 4.51** to **4.55** allows for an assessment of the respective cities' existing and potential income from water services.

Figure 4.51 reveals that the City of Johannesburg generated the highest income from the sale of water, by far compared to the other cities. The cities of Tshwane and Ekurhuleni are the next in line. It is also apparent that income data for the City of Cape Town is very low compared to the other cities even when population is factored in.

From **Figure 4.52** it is evident that from 2009 the cities of Cape Town, Tshwane, and Nelson Mandela Bay have consistently kept the percentage of water losses to lower than 30% while the Cities of Johannesburg, Mangaung and Msunduzi have demonstrated progressive improvement.

Figures 4.53 and **4.54** indicate potential income that can be raised by addressing non-revenue income. In absolute rand value terms, the City of Johannesburg has the most to benefit from tackling non-revenue water followed by the cities of Tshwane and Ekurhuleni.

The assessment of eThekwini was affected by availability of data.

4.5 Topic 5: Responses to climate change impacts

With the likely climate change impacts for the country's cities including sea-level rise (coastal cities), storm surges, increased frequency and intensity of flood events, high temeperature, water scarcity and increase in air pollutants, it is imperative that Cities are well placed to address these challenges which would otherwise result in phenomena such as erosion and saline intrusion particularly for coastal ecosystems, compromising of the structural integrity of port and other coastal infrastructure, hightened risk of vector –borne diseses, energy consumption for cooling as ambient temperatures rise and reduced water supplies in reservoirs. The following indicators permit us to assess the adequacy of Cities'responses to climate change impacts.

As stated in **Chapter 2**, this topic can be adequately described using 31 indicators. **Table 4.6** shows that only 6 indicators (6 Desktop Research) have some data.

Table 4-6: Status of indicators for responses to climate change impacts

No	Measure	SALGA/WRC MBI	DESKTOP RESEARCH

		Total	MY	PC	NA	Total	MY	PC	NA
1	CAPEX	8	0	8	0	5	0	2	3
2	OPEX	1	0	1	0	2	0	0	2
3	Technical capacity	3	0	3	0	3	0	2	1
4	Monitoring, forecasting and early warning	0	0	0	0	2	0	0	2
8	Aged Infrastructure	0	0	0	0	3	0	2	1
9	Best practice guidelines, procedures standards and tools	0	0	0	0	5	0	0	5
12	Information/data	1	0	1	0	8	0	0	8
24	Climate change scenarios and possible impacts	0	0	0	0	3	0	0	3
Total		**13**	**0**	**13**	**0**	**31**	**0**	**6**	**25**

There is no data for 3 of the 8 measures. Some data was collected on the following measures:

i) CAPEX

ii) OPEX

iii) Technical capacity and

iv) Information/data

The graphs on CAPEX (**Figures 4.6 to 4.15**), OPEX (**Figure 4.16**), Technical capacity (**Figures 4.17 to 4.21**), and Information/data (**Figures 4.49**) have been presented already in **sections 4.1** and **4.4** of this report.

Hydrological and meteorological (HYDROMET) data is important for validating the climate change scenarios. This includes data on streamflow, rainfall, temperature, humidity, winds-peed, direction etc. Apart from streamflow this data is usually collected at weather stations. The South African Weather Services (SAWS) operates a number of weather stations across the country. In this section the stations located within each SACN city are presented. The most relevant KPI for this data is monitoring, forecasting and early warning.

4.5.1 Monitoring, forecasting and early warning

The KPI reported in this section is the weather stations within the SACN cities.

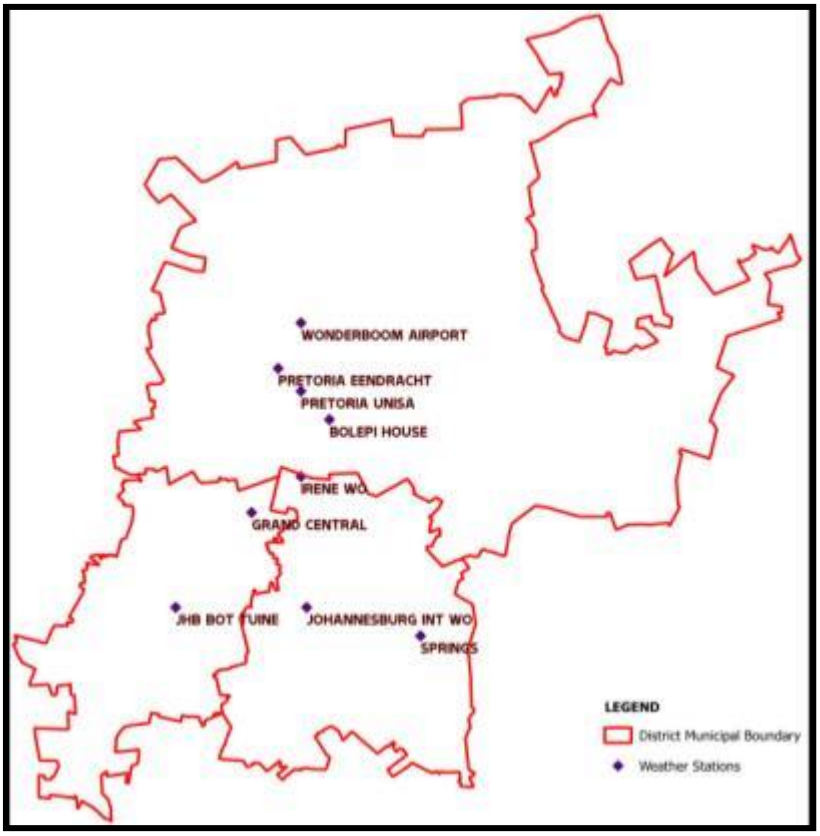

Figure 4:56 - Weather Stations in the Cities of Johannesburg, Tshwane and Ekurhuleni.

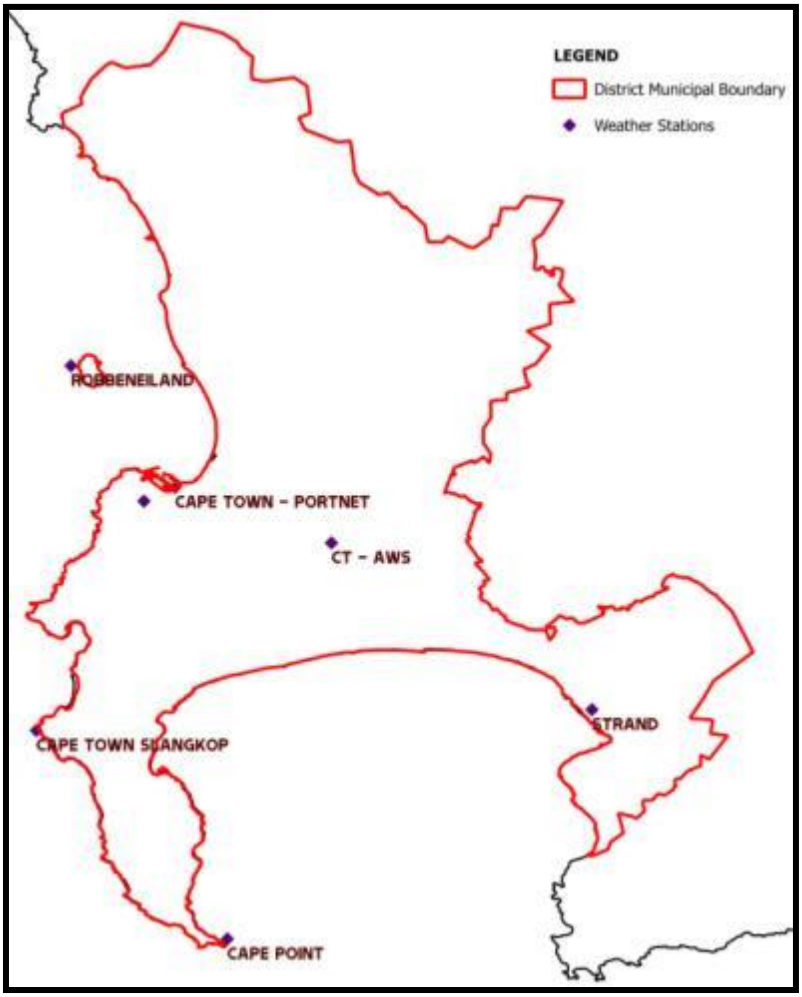

Figure 4:57 - Weather Stations in the City of Cape Town

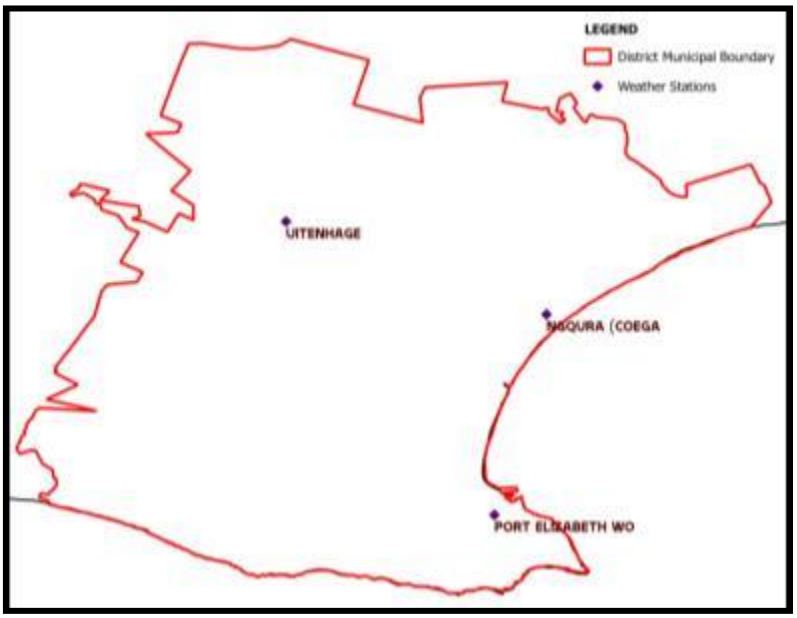

Figure 4:58 - Weather Stations in the Nelson Mandela Bay

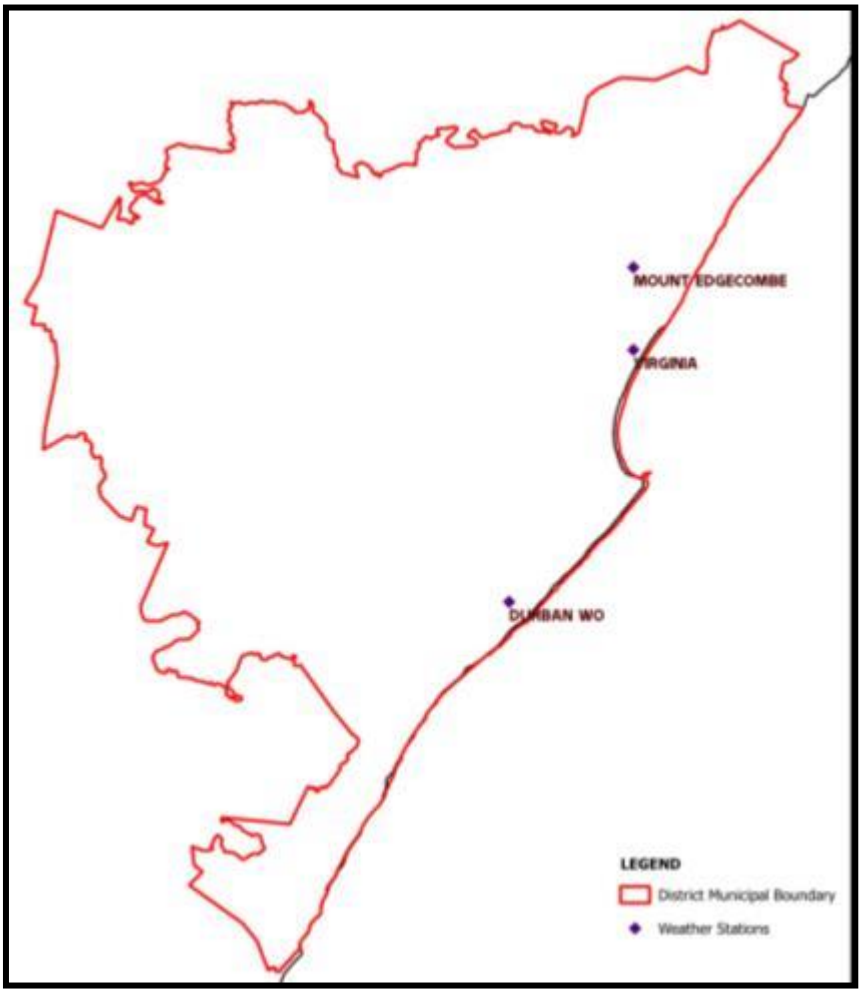

Figure 4:59 - Weather Stations in the eThekwini Municipality

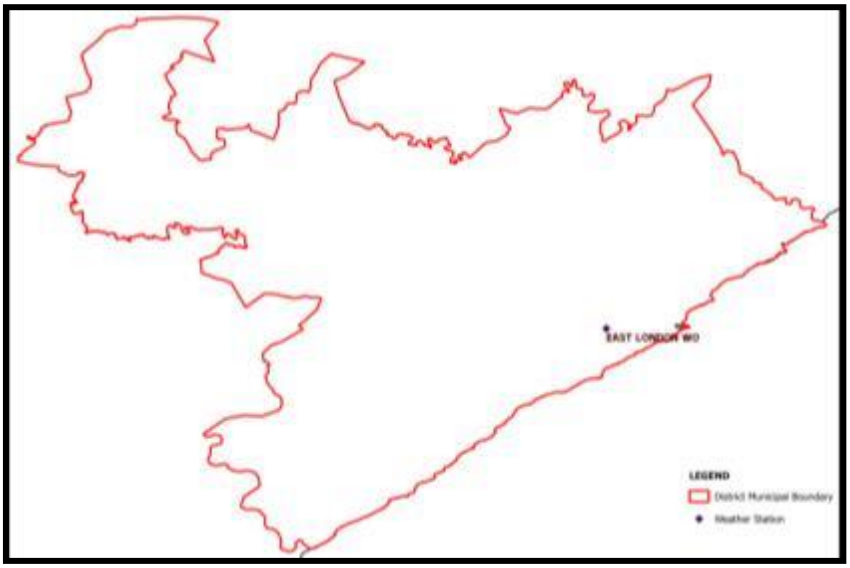

Figure 4:60 - Weather Stations in Buffalo City

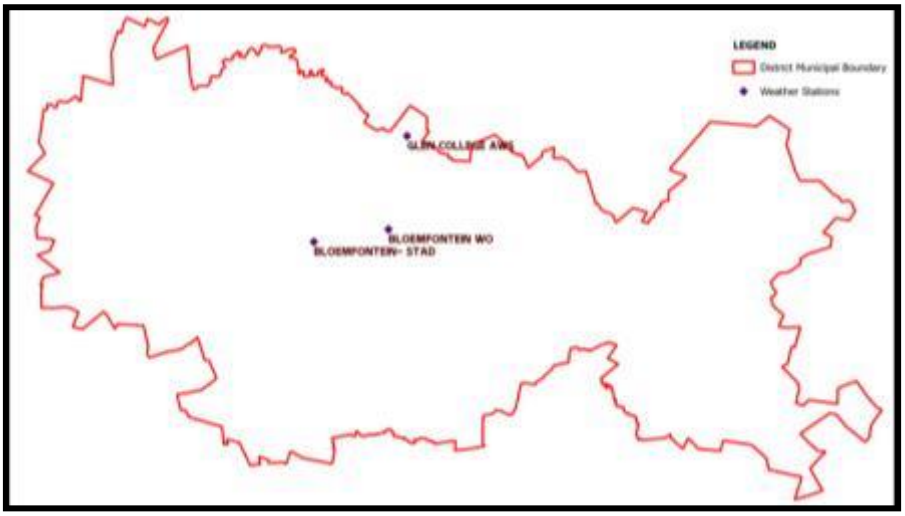

Figure 4:61 - Weather Stations in the Mangaung Municipality

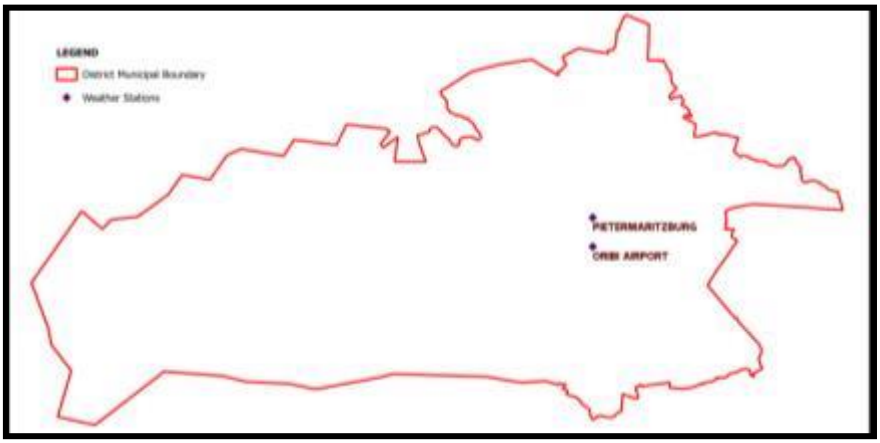

Figure 4:62 - Weather Stations in the Msunduzi Municipality

As can be seen in **Figures 4.53** to **4.62**, all the SACN cities have weather stations with Cape Town having far more than the others. In addition Cape Town has a better geographical spread than the other cities. From **Table 4.7** it is evident that the weather stations may be too far apart to for evaluation of impacts at the scale at which they are felt i.e. at the local level. Cities should work with SAWS to establish more weather stations.

Table 4-7: Number of weather stations per SACN city

SACN City	Spatial Coverage/Area (km^2)	Number of Weather Stations
Johannesburg	1648	2
Cape Town	2446	6
eThekwini	2307	3
Tshwane	6310	3
Ekurhuleni	1979	3
Nelson Mandela Bay	1958	3
Mangaung	6291	3

Buffalo City	2536	1
Msunduzi	635	2

4.6 Topic 6: Revenue management, pricing and budgeting for water supply services, including water loss management

The ability of manage existing and emergent risks in cities largely depends on the financial management skill with fisical displine allowing cities the flexibility to absorb unforseen shocks such as losses due to natural disasters. With water being a significant source of revenue to SACN cities, it is reasonable to suggest that management of water resources and water infrastructure can also be deemed as indicative of the status of fiscal discipline.

As stated in **Chapter 2**, this topic can be adequately described using 16 indicators. **Table 4.8** shows that 12 of the indicators (10 SALGA/WRZ MBI and 2 Desktop Research) have some data.

Table 4-8: Status of indicators for revenue management, pricing and budgeting for water supply services, including water loss management

No	Measure	SALGA/WRC MBI				DESKTOP RESEARCH			
		Total	MY	PC	NA	Total	MY	PC	NA
25	Metering and billing	1	0	1	0	2	0	0	2
26	Non-revenue water	3	0	3	0	6	0	0	6
27	Cost recovery and investment strategy	1	0	1	0	3	0	1	2
28	Pricing of services	2	0	2	0	1	0	1	0
29	Budgeting	3	0	3	0	4	0	0	4
Total		**10**	**0**	**10**	**0**	**16**	**0**	**2**	**14**

The spread of indicators with data makes it possible to make an assessment all the measures. Therefore all measures are discussed in this section.

4.6.1 Metering and billing

Customer Care Health Check is the only KPI presented in this section. It is derived from the DWA Municipal Strategic Self-Assessment (MuSSA) of Water Services survey. It is described as the “Percentage score obtained for Section 16 of the DWA Municipal Strategic Self-Assessment (MuSSA) of Water Services survey based on the following considerations:

- A customer services representative and associated complaints register is in place and linked to the Technical Department to investigate and resolve.
- A functional customer service system is in place to immediately inform customers of service interruption, contamination of water, boil water alert, etc.
- Percentage of the reported water related complaints/callouts are responded to within 24 hours.
- Percentage of the reported wastewater/sanitation related complaints/callouts are responded to within 24 hours.
- Regular awareness campaigns informing customers of water system operation and maintenance (O&M) activities, etc. are conducted.

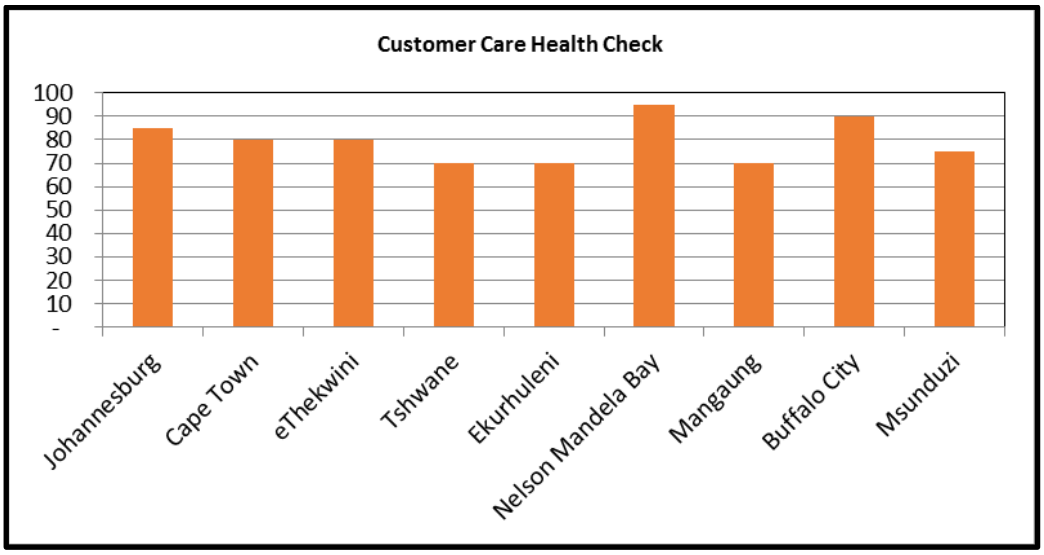

Figure 4.63 – Customer care health check (%)- SALGA/WRC MBI (2014)

From **Figure 4.63** Nelson Mandela Bay Metro is the best performing City on this indicator followed by Buffalo City.

4.6.2 Non-revenue water

The following KPIs are presented in this section

- Non-revenue water (The data is on graphs in Figures 5.42 to 5.45)
- Revenue Water by volume) - SALGA/WRC MBI (2014)
- Revenue water (IWA A20)) - SALGA/WRC MBI (2014)
- Billed authorized consumption (IWA A10) - SALGA/WRC MBI (2014)
- Billed authorized consumption (Litres/capita/day) - SALGA/WRC MBI (2014)
- Billed authorized consumption (m^3/household/month) - SALGA/WRC MBI (2014)

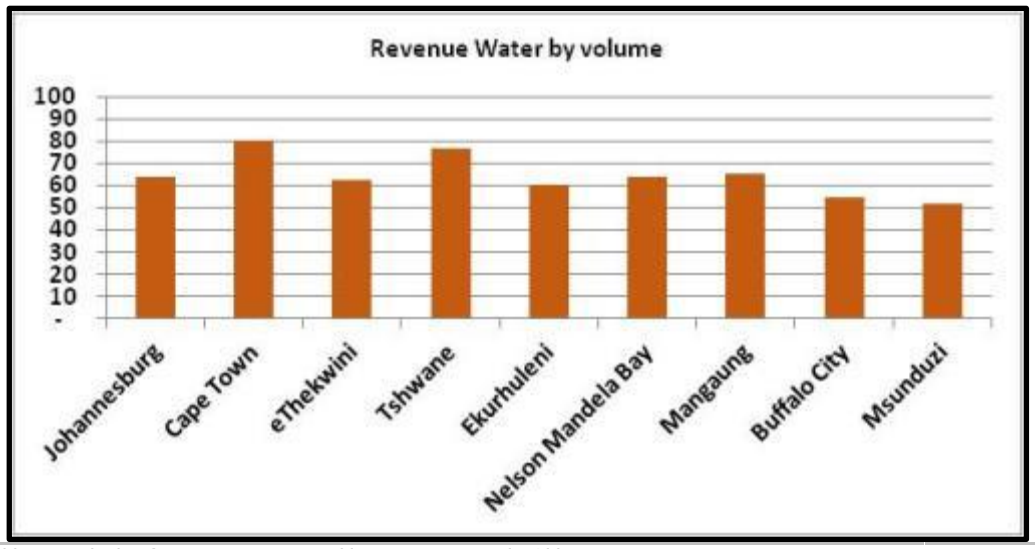

Figure 4.64 – Revenue Water by volume (%)- SALGA/WRC MBI (2014)

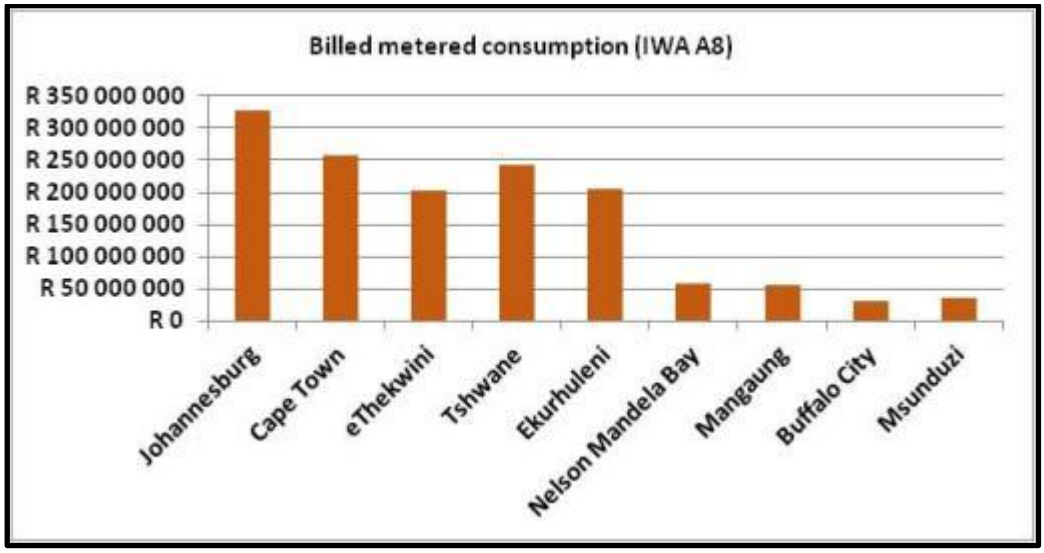

Figure 4.65 – Billed metered consumption (Rands)- SALGA/WRC MBI (2014)

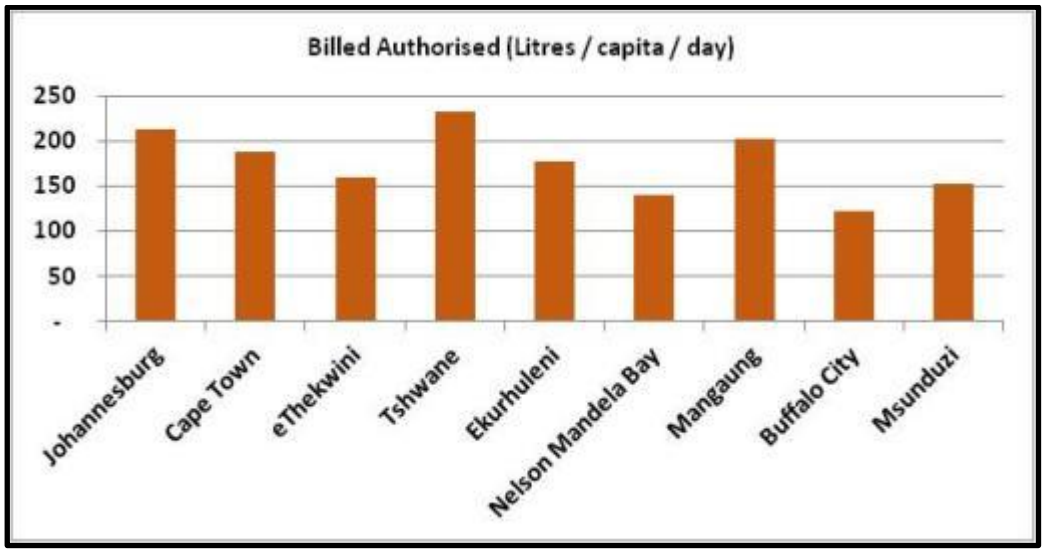

Figure 4.66 – Billed authorized consumption (Litres/Capita/day)- SALGA/WRC MBI (2014)

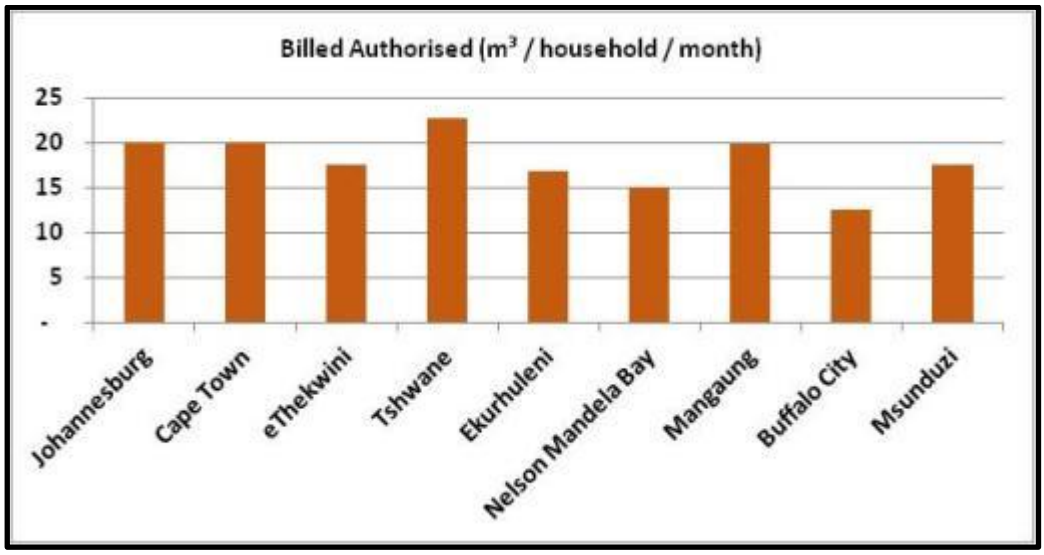

Figure 4.67 – Billed Authorized consumption (m^3/household/month) - SALGA/WRC MBI (2014)

Figures **4.64** to **4.67** can be used to assess revenue management practices at the respective cities. It is clear from **Figure 4.64** that the percentage volume of revenue water ranges from about 50% to about 80%. The City of Cape Town has the highest revenue water followed closely by the City of Tshwane. All the cities need to take steps to improve payment for water services.

Consideration of the billed authorized per capita per day consumption (**Figure 4.66**) and the monthly household consumption (**Figure 4.67**) reveals that the City of Tshwane has the highest unit consumption for both measures.

4.6.3 Cost recovery and investment strategy

The following KPIs are presented in this section:

- Cost of service versus revenue

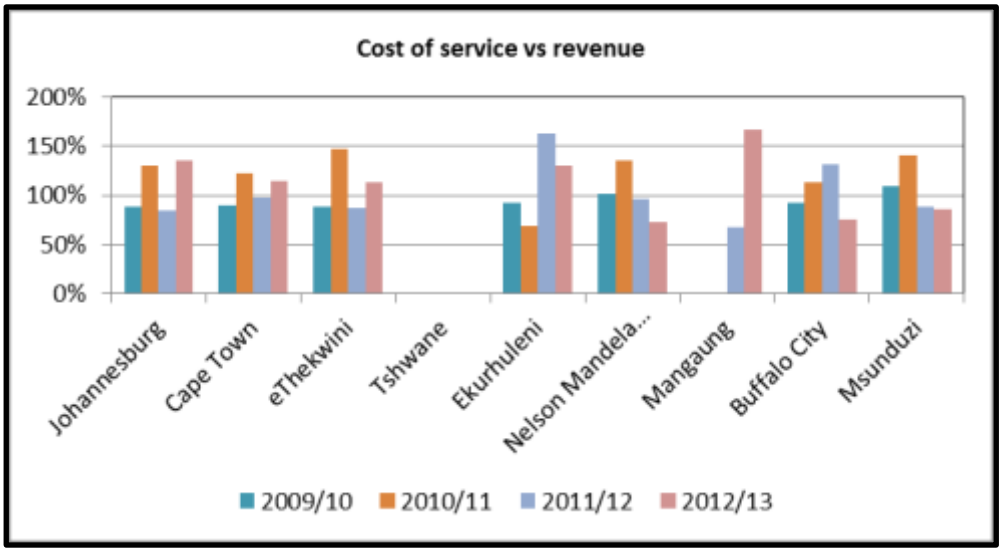

Figure 4.68 – Cost of service Vs revenue

It is apparent from **Figure 4.67** that the cities are facing some challenges on balancing cost of providing water services with the revenue they obtain from providing the service. The City of Cape Town has maintained a tighter balance than the other cities.

4.6.4 Budgeting

The following KPIs are presented in this section:

- Financial Management Health Check - SALGA/WRC MBI (2014)
- Current Ratio for Municipalities - SALGA/WRC MBI (2014)
- Salaries / Operating Expenditure - SALGA/WRC MBI (2014)

Figure 4.69 – Financial Management Health Check (%)- SALGA/WRC MBI (2014)

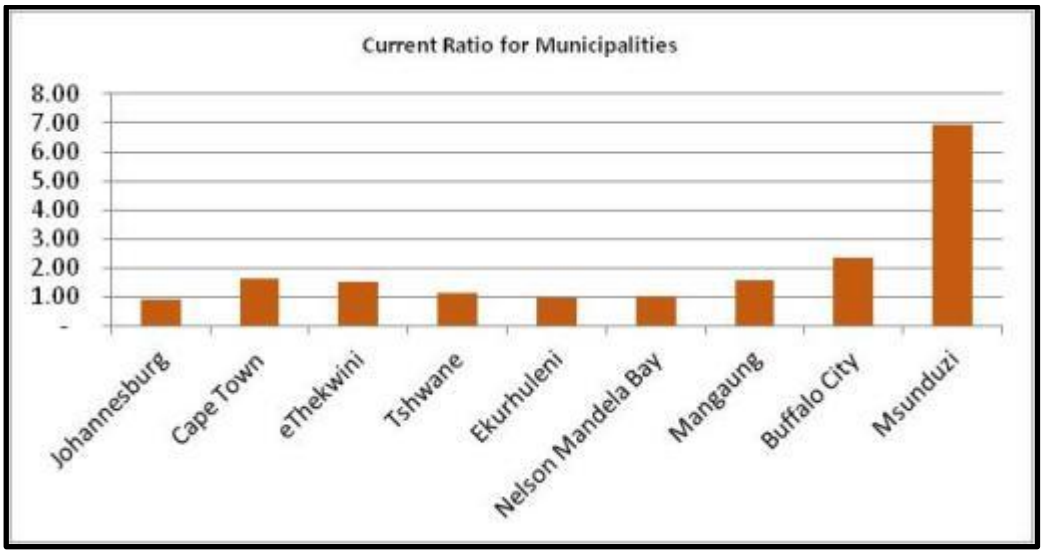

Figure 4.70 – Current Ratio for Municipalities - SALGA/WRC MBI (2014)

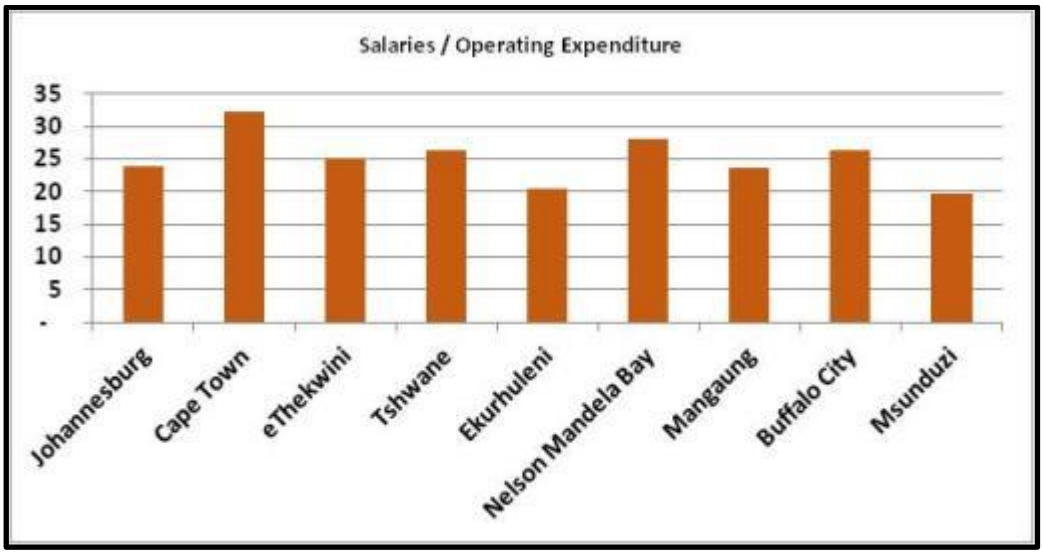

Figure 4.71 – Salaries / Operating Expenditure - SALGA/WRC MBI (2014)

From **Figure 4.69** it is evident that on financial management the City of Cape Town has performed better than the other cities followed by Ekurhuleni and eThekwini. Msunduzi Municipality has a very high current ratio **Figure 4.70**) which may be considered an abnormality as it could sacrifice some of this liquidity for investment in addressing some of its urgent water management challenges. This may also apply to Buffalo City but to a lesser extent. The City of Cape Town, eThekwini and Magaung appear to have a good balance. The higher investment in salaries by the Cities of Cape Town and Nelson Mandela Bay Metro might impact positively on attracting and retaining skilled personnel.

4.6.5 Pricing of services

The following KPIs are relevant for this measure:

- Cost of services vs revenue
- Water services income/population. - SALGA/WRC MBI (2014)
- Water services income/household - SALGA/WRC MBI (2014)

The first KPI is discussed in **section 4.6.3**. The remaining two KPIs are presented in this section.

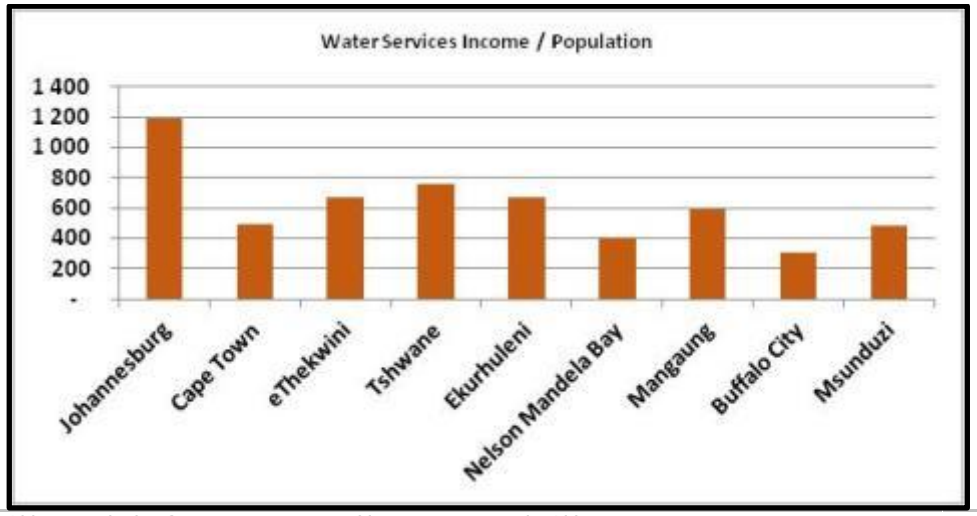

Figure 4.72 – Water Services Income/person (Rand/person/year) - SALGA/WRC MBI (2014)

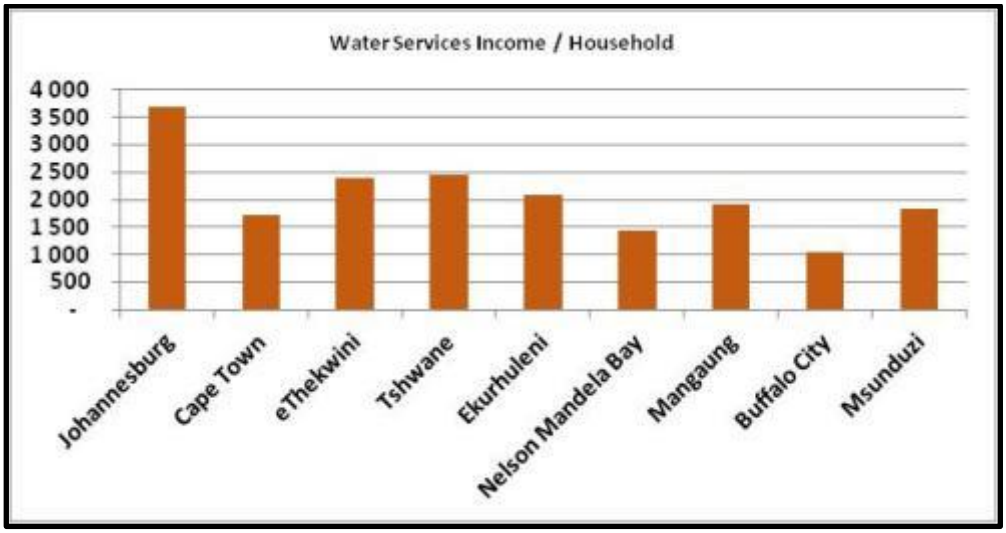

Figure 4.73 – Water Services Income/household (Rand/household/year) - SALGA/WRC MBI (2014)

Income derived by the cities from water services is expressed as Rand per person per year and per household per year respectively in **Figures 5.72 and 5.73**. On both measures, the City of Johannesburg can be seen as charging the most while Buffalo City charges the least. What is interesting to observe is that the income per person or household per year by the City of Cape Town are less than 50% of what the City of Johannesburg. This may reflect the effect higher income from other sectors including industry etc or higher water tariffs. The latter may be supported by the fact that the City of Cape Town has the highest proportion of persons with piped water inside dwelling has achieved higher proportion of metered reticulation. This supports conclusion that the tariffs for water services in City of Cape Town are significantly lower than tariffs imposed by the other cities. On this basis one can say the City of Cape Town has struck the best balance between ensuring their cost of service delivery are covered by the revenue generated and keeping the cost to consumers as low as possible.

4.7 General observations

The indicators for the following measures in **Table 4-9** could not be populated because of lack of "complete" readily available and usable data. This means that is caution should be exercised in coming to conclusions about what the data presented in this report means in terms of the 6 topics and the study objectives.

Table 4-9: Measures and indictors without data

No	Measures	INDICATORS		
		SALGA/WRC MBI	SACN (208)	DESKTOP RESEARCH
6	Waste collection service	0	1	4
8	Aged infrastructure	0	0	3
9	Best practice guidelines, procedures standards and tools	0	0	5
11	Awareness and education	0	0	2
13	Inspection and monitoring	0	0	4
14	CAPEX spend	0	0	4
15	Operation of water supply system	0	1	2
16	Demand versus capacity of infrastructure	0	1	9
17	Littering	0	0	3
18	Dumping of waste	0	2	2
19	Planning and implementation	1	2	13
20	Regulations and procedures	0	0	13
22	Service tariffs	0	1	7
23	System blockages and damages	0	1	2
24	Knowledge of climate change scenarios and possible impacts	0	0	3
Total		**1**	**9**	**76**

With the reservations expressed above, some general observations are presented in this section on the following items:

- performance of SACN cities
- critical information gaps
- opportunities to improve current practice
- key indicators for adoption by the cities

4.7.1 What is the relative performance of the SACN cities from the situation assessment?

What do the indicators say in terms of performance of the cities?

- All cities have improve performance especially on these aspects:
- Some Cities perform better than others and this analysis is presented in section 5 as learning points

For an assessment of resource availability at city level in relation to its fitness for use, this was understood the include the water resource types available to the cities, level of capital expenditure on the infrastructure necessary to abstract, treat and convey the water to the ultimate user, level of operating expenditure, the availability of the technical capacity to support the infrastructure in adequate working condition and the management of the relevant assets. The City of Cape Town emerges as the best performer with respect to

water resource availability owing to the fact that its existing water and wastewater infrastructure is the most adequate hence, its relatively lower infrastructural needs. Along with Nelson Mandela Metro, it also has the highest proportion of households with piped water inside dwellings (as reported in 2010) and along with eThekwini, Mangaung and Msunduzi, leads with respect to percentage number of metered connections. In addition, the City of Cape Town along with eThekwini, Tshwane, Ekurhuruleni, and Nelson Manadela Bay demonstrate the best performance with respect to budgeting for spending on asset management. It is only with respect to technical capacity that 2014 Stockholm Industry Water Award winner - eThekwini Municipality – and Buffalo City edge out the City of Cape Town.

It is worth noting that while operating expenditure for the SACN member cities is closely correlated with the population size within each city, the data on capital spending revealed that Nelson Mandela Bay Metro incurs the most capital expense per person followed by eThekwini and may be a consequence of rapid urbanization and/or huge backlogs that may be getting addressed. It may also be a manifestation of wasteful expenditure unfortunately.

With respect to the condition of freshwater resources and likely impacts on people and infrastructure, the existing wastewater collection and treatment capacity observed especially in the larger metros as well as their comparative ability to attract and keep the technical skill essential for delivery of adequately treated water to the final consumer suggests the freshwater resources are relatively fine and the risks to human health relatively lower at the larger metros. This may be that these metros are economic hubs populated by consumers that are better able to demand and pay for high services levels and support these Cities' revenue streams. This has implications for control of outbreaks and spread of water borne epidemics.

With the Cities of Johannesburg, Cape Town and Nelson Mandela Bay leading on information management aspects, it can be expected that these are best placed to assess the water resources challenges they face and anticipate those yet to manifest themselves. Indeed, the City of Cape Town, from the data obtained, while able to impose a relatively low tariff for water services, has along with the Cities of Tshwane and Nelson Mandela Bay have from 2009 consistently kept the percentage of water losses to lower than 30%. This makes the City of Cape Town the SACN member city whose water services income is least impacted by non-revenue water losses. On the strength of these observations, it can be inferred that the City of Cape Town has the best condition of water infrastructure and by extension it exercises the most adequate management control of these and as such may have lessons to offer in this respect.

Apart from eThekwini, and Buffalo City, SACN member cities need to improve water services planning by a significant margin.

In terms of revenue Management, pricing and budgeting for water supply services, again the City of Cape Town emerges as the best performer. With the highest proportion of persons with piped water inside dwelling and with among the best metered reticulation system, it is perhaps not so surprising that Cape Town closely followed by the City of Tshwane are among the cities that manage the water losses level better and subsequently get paid for most of the water it supplies. What distinguishes the City of Cape Town, however, is that its unit water consumption (per person and per household) figures are not as high as the corresponding figures for the City of Tshwane which has the highest unit consumption for both measures of all the SACN Cities. Moreover when the income contribution per person per year and per household per year respectively are considered, it is observed to have unit income figures that are less than 50% of what the City of Johannesburg derives for both the individual and the household. This supports the earlier conclusion that the tariffs for water services in City of Cape Town are significantly lower than tariffs imposed by the other cities. On this basis one can say the City of Cape Town has struck the best balance between ensuring their cost of service delivery are covered by the revenue generated and keeping the cost to consumers as low as possible.

4.7.2 What are the critical information gaps?

There are some information gaps that impact on the ability to make reliable assessments on the water resources at City level and the sustainability of the existing management.

As expected, data for all the indicators identified was not readily available particularly for the smaller metros that are only beginning to raise the level of performance of their information management systems. While the gaps vary from city to city for the different topics looked at above, it was observed for all cities that there is a lack of adequate monitoring for the indicators for the "Fitness for Use" at city level. The available data was derived from a nationwide project – the NFEPA - conducted at a spatial scale of sub-Water Management Area (WMA) level. This may not be sufficient for city level assessments.

Even when available, the reliability of the data especially that contained in financial reports was brought into question by the adjustments to some entries as illustrated in the **Tables 4.10** and **4.11** - extracts from the Msunduzi Municipality annual budgets for the 2011/12 and 2012/13 financial years respectively. Using the entry against the audited revenue for water as an example, a different value is seen in two budgets. This is not unique to Msunduzi Municipality and the way the team dealt with this was to rely on data mostly from the latest available reports for each SACN member.

Table 4-10: Msunduzi Municipality- 2010/11 Annual Report

Item	Audited Outcomes			Current Year (2010/11)		
	2007/08	2008/09	2009/10	Original Budget	Adjusted Budget	Full Year Forecast
Revenue - 2010/11 Annual Budget						
Water	256 074	265 036	307 001	306 344	430 303	430 303
Waste water	83	1	144 855	2	249 292	249 292
Waste management services	169 438	136 123	65 559	333 325	116 658	116 658

Table 4-11: Msunduzi Municipality- 2011/12 Annual Report

Item	Audited Outcomes			Current Year (2011/12)		
	2008/09	2009/10	2010/11	Original Budget	Adjusted Budget	Full Year Forecast
Revenue - 2011/12						
Water	294 396	307 001	473 549	536 526	358 735	358 735
Waste water	2	144 855	142 223	177 408	151 521	151 521
Waste management services	154 886	65 559	77 360	124 836	123 796	123 796

The likely climate change scenarios for the region paint a grim picture which the cities would be well advised to be already planning to address. However, the research team did not find much evidence at city level that this was being prioritized through the development of specific detailed action plans. This suggests the threats posed by climate change impacts may not currently be regarded a priority compared to the other challenges the cities management may be facing.

4.7.3 What opportunities exist to improve current practice?

The following are the general observations from the information presented in this report:

To sustainably manage water resources in order to support social and economic development of the country, what managers of water resources and infrastructure need to be adequately acquainted with can be broadly grouped into four categories:-

i) An intimate knowledge about their ultimate customer, the consumer of their product namely water and the user of the ecosystem;
ii) An appreciation of the different water resource types available, and,
iii) A healthy appreciation of the existing and any emerging threats to reliability of delivery of this product to the consumer.
iv) The necessary capacity (technical and financial) to address the challenges.

The need for as much knowledge on their customer – the consumer – cannot be overemphasized. Not simply because this improves their ability to undertake their duties as Water Service Authorities as prescribed in the National Water Act, rather that beyond above this duty there are benefits/opportunities that this knowledge presents. Infrastructure and Finance Management and Planning by these Cities for instance are dependent largely on the reliability of revenue projections for which future income from water sales are a component. Moreover, for opportunities to access the more innovative debt financing options such as municipal bonds, availability of reliable data on this customer in as far as population size, population growth rate, migration trends (immigration and emigration into and from the city), economic status and distribution of the population within cities is nearly always essential. Considering the value of this knowledge, the need for adequate monitoring infrastructure and frameworks cannot be overemphasized.

For South Africa, water resources planning, development and management has largely been the preserve of the government department now known as the “Water and Sanitation”, with the role for cities being that of “Water Service Authority”. Unfortunately, for most of its existence, the department has placed considerable priority on the development of surface water resources with reduced emphasis on other water resource options. SACN member Cities could exploit this historical imbalance and implement a program where all the resource types are assessed equitably with a view for implementing a conjunctive use strategy combined with reuse options for non-potable uses.

Cities also need to have an accurate appreciation of the threats they face to enable remedial or mitigating actions to be formulated and implemented. These threats may already be manifesting themselves such as the reality of the acid mine drainage (AMD) problems as well as the salinity reported in the 2012 SAEO in areas such as the Vaal, Crocodile and Olifants River systems which may already be impacting the consumers’ health and may also already be having financial implications for cities such Johannesburg, Tshwane and Ekurhuleni supplied by these river systems through increased water treatment cost increases. The need to also address the existence of several and sometimes conflicting regulations and a multiplicity of local and national authorities with overlapping roles is critical. Finally, the Cities would be well served to anticipate threats that are yet to emerge such as the likely impact of climate change on their performance. The likely climate change scenarios for the region paint a grim picture which the cities would be well advised to be already planning to address. To address these and other threats, the appropriate human resource skills and monitoring infrastructure need to be in place

The livelihoods, socio-cultural comfort of a growing number of people in cities particularly for the poor is likely to depend more on freely available ecosystem system services. However available fresh water biodiversity maps are not clearly mapped in existing studied which imposes some limitations on the information that can be drawn from them.

Fish sanctuaries were identified as rivers that are essential for protecting threatened and near threatened freshwater fish that are indigenous to South Africa. Information on the number of threatened or near

threatened species for those SACN cities with these species namely Nelson Mandela Bay Metro, Buffalo City and City of Cape Town.

Finally, to adequately understand the customer, develop an appropriate plan for conjunctive water resources use and continuously evaluate the threats to sustainable water management, the cities will as a pre-requisite need to have adequate technical capacity in place as well as access to the necessary financial resources. The data presented above reflected the correlation between technical capacity and city performance with the eThekwini Municipality topping in that respect. This technical capacity is critical for the success of infrastructural development programs, resource use efficiency (e.g reduced water losses), improved monitoring, maintenance and operation of the cities' assets. Furthermore, adequate financial resources are also necessary for these development programs to succeed. While the operating expenditure may be covered by revenue generated for sale of services, often this source of revenue is insufficient to also cover capital expenditure. Cities tend to rely on the national government for grants but they may also obtain financing from capital markets for example though selling municipal bonds to support implementation of programs.

4.7.4 What indicators can Cities adopt to facilitate the identification of good practices?

In this section indicators which show good performance are selected for each topic in terms of the **status of reporting** on water resource and its management and **observed performance** based on normalized indicators.

4.7.4.1 Topic 1: Resource availability at city level in relation to its use

The following KPIs were identified:

- Households with piped water inside dwelling
- Capital Investment per person per year in water infrastructure (Rand/person/year) - SALGA/WRC MBI (2014)
- Capital Investment per person per year in water and wastewater infrastructure (Rand/person/year) - SALGA/WRC MBI (2014)
- Capital Investment in water infrastructure (Rand) - SALGA/WRC MBI (2014)
- Capital Investment in water and wastewater infrastructure (Rand) - SALGA/WRC MBI (2014)
- Number of people with access to water - SALGA/WRC MBI (2014)
- Access to water - SALGA/WRC MBI (2014)
- Percentage number of metered connections - SALGA/WRC MBI (2014)
- Number of households per connection - SALGA/WRC MBI (2014)
- Operating Expenditure (Rand) - SALGA/WRC MBI (2014)
- Blue Drop – KPA 2: Process control, maintenance and management skill, water supply
- Technical Management Skill Level Health Check - SALGA/WRC MBI (2014)
- Technical Staff Skill Level Health Check - SALGA/WRC MBI (2014)
- Technical Staff Numbers Health Check - SALGA/WRC MBI (2014)
- Access to sanitation - SALGA/WRC MBI (2014)
- Drinking Water Quality Health Check - SALGA/WRC MBI (2014)
- Total Number with access to different Sanitation types- SALGA/WRC MBI (2014)
- Spending on asset management vs budget
- Depreciated capital cost
- Current replacement cost
- Blue Drop – Water supply asset management audits
- Green Drop – Water supply asset management audits
- Infrastructure Asset Management Health Check - SALGA/WRC MBI (2014)

4.7.4.2 Topic 2: Fitness for use of water (water quality)

No specific KPIs were identified for this topic as some of the KPIs for topic 1 are sufficient for this topic as reflected in **Tables 5.3 and 5.4**

4.7.4.3 Topic 3: Condition of freshwater resources (ecosystems) and impacts on people and infrastructure

The following KPI were identified:

- Access to Sanitation - SALGA/WRC MBI (2014)

4.7.4.4 Topic 4: Condition of water infrastructure and management in the cities

The following KPI were identified:

- Information Management Health Check - SALGA/WRC MBI (2014)
- Income from Water Services – water loss (%)
- Non-revenue Water - SALGA/WRC MBI (2014)
- Non-revenue Water by volume (%)- SALGA/WRC MBI (2014)

4.7.4.5 Topic 5: Responses to climate change impacts

No KPIs were identified for this topic

4.7.4.6 Topic 6: Revenue management, pricing and budgeting for water supply services, including water loss management.

The following KPI were identified:

- Revenue Water by volume (%)- SALGA/WRC MBI (2014)
- Billed metered consumption (Rand)- SALGA/WRC MBI (2014)
- Billed authorized consumption (Litres/Capita/day)- SALGA/WRC MBI (2014)
- Billed Authorized consumption (m^3/household/month) - SALGA/WRC MBI (2014)
- Non-revenue Water by volume (%)- SALGA/WRC MBI (2014)
- Current Ratio for Municipalities - SALGA/WRC MBI (2014)
- Salaries / Operating Expenditure - SALGA/WRC MBI (2014)
- Water Services Income/person (Rand/person/year) - SALGA/WRC MBI (2014)
- Water Services Income/household (Rand/household/year) - SALGA/WRC MBI (2014)

5 Water Management in SCAN member Cities: City Perspectives

One of the aims of SACN is to encourage the exchange of information, experience and best practices on urban development and city management. To this end a summary of the findings of this study is presented in this chapter. The summary has been arranged to provide a summary of the status of water management in the cities and selected case studied and provide an indication of what cities can lead from each other. In addition, **Table 5.1** can be used to pick out the indicators where certain SACN cities performed well.

5.1 SACN Cities City Perspectives

In this section, a brief discussion on each of the eight member cities of the SA Cities Network (SACN) is done. The discussion draws on and summarizes, for each city, the findings from the analysis of the data collected as part of this study and is meant to give the reader general idea of the state of water and its management in the respective cities.

5.1.1 City of Johannesburg

The data obtained suggested that city of Johannesburg is investing in extending and maintaining its water and wastewater infrastructure with the latest available investment figures indicating levels exceeding by more than 100% the investment levels of the closest SACN member city. On a per capita basis, however this level of investment, at just over R100.00 per person, is only the third highest of the SACN members. This is indicative of the challenges imposed by the growing population on a city at the core of the economic engine of the country. It is therefore not surprising that even its operating expenditure per capita is the highest among the SACN member cities. This level of expenditure may explain in part the city's performance on such measures as the proportion of the city's dwellers with access to flush toilet kind of sanitation and drinking water quality where the assessment done in this study found it to among the better performers and therefore less vulnerable to outbreaks of water-borne epidemics.

The study found the City's water management to be competent with a positive trend observed with respect to water loss management, infrastructure asset management as judged by the SALGA/WRC MBI and the fact that the city's income from sale of water services is the highest. This suggests an appreciable combination of adequate levels of financial and technical skill. Improved management becomes critical especially when the size of the water and wastewater infrastructure is already extensive and is still being extended to address the water and sanitation backlogs. It is essential that the growth in technical skill levels continue to match the growth in infrastructure and while this would result in a rise in budget allocation to staff salaries, it will ensure that the value from city's water and wastewater infrastructure is maximised.

The city achieved a good score with respect to information management practices as judged by the SALGA/WRC MBI. Having an adequate information management system is essential for supporting management decision making particularly when city is the forms of the country's economic hub.

However challenges remain and these include the negative impact on freshwater ecosystems of activities such as mining which may be responsible for instance for the salinity observed in the Vaal, Crocodile and Olifants River systems. Treatment costs associated with water in these systems would as a necessity rise if the water quality is to meet user/use requirements.

Another challenge the study found was with respect to the pricing of the city's water services, in some years the revenue generated was less than the cost of the water service however there is no trend which can be used to suggest that a better pricing mechanism is being put in place. It may be that the levels of non-revenue water need to be watched critically.

The study also observed consumer debt levels that are not consistent with sustainable financial management of the city. The city will, as a priority, has to improve collection of payments due for services rendered to consumers.

5.1.2 eThekwini Metropolitan Municipality

Assessment of information on the state of water and its management in the eThekwini Metropolitan Municipality revealed a number of positives first among which is the level of capital investment in water and waste water infrastructure which on a per capita basis is second only to that of the Nelson Mandela Bay Metro. It was also found that the city enjoys a metered connection coverage of 100% and the highest technical skill capacity level among the SACN cities. It is possibly on the account of its technical skill capacity that it reported a per capita operating expenditure level that is second highest among the SACN members. With such infrastructure spending and technical capacity, the city is well placed meet the challenge of serving a growing population as it has the capacity to improve water use efficiency through improved monitoring, billing and revenue collection and to improve operation and maintenance of infrastructure which would result in improved service levels due to a reduction of downtime as well as leakages and blockages within the systems. It is also reflected in Blue Drop Assessments which suggests that the management of the water treatment works is on average acceptable and the the quality of the drinking water supplied consistent with the required standards. This may have contributed to its being recognized with the 2014 Stockholm Industry Water Award.

The data assessed also suggests that the Financial Management practices of the eThekwini Municipality are adequate. The current ratio it maintains suggests that the municipality maintains an adequate level liquidity. The city has also demonstrated considerable skill in budgeting for the management of assets as reflected in the low variance of actual spending levels from the corresponding budgeted amount.

Finally, the city is demonstrating monitoring capacity through its compliance with the objectives of the Green drop assessment as reflected in the trend showing improved wastewater management audits.

However, the city still needs to address some challenges which the assessment undertaken in this study revealed. These include:

The eThekwini municipality falls within a sub-Water Management Area with over 10% of its area considered Freshwater Ecosystem Priority Area (FEPA) as per the National Freshwater Ecosystem Priority Areas (NFEPA) project. The project also indicated the presence of wetland clusters. This means that the municipality in implementing its development programs has to be mindful of the need to maintain the FEPA status so as to ensure humans continue to derive eco-systems services and those important ecological processes such as migration of frogs and insects between wetlands are not threatened. Safeguarding the ecosystem would require a paradigm shift if it is to be included in the development agenda. This would also likely require that additional appropriately skilled professionals join the city's management ranks. The city's state of finances suggests it has the capacity to acquire these skills without greatly compromising its liquidity through an increased wage bill.

5.1.3 City of Tshwane

The data obtained suggested that City of Tshwane still has more to do for its water and wastewater infrastructure to be considered adequate. On a per capita basis, the level of investment is about R60.00 per person per year yet the proportion of the connections that is metered still falls below the benchmark of 100% for metered connection. Other measures such as the percentage of household with piped water inside dwelling also suggest it is on par with the other large cities and likely facing the same issues associated with extending services to informal settlements that spring up in these urban areas due to the economic opportunities in the cities that attract their residents. However, investment in improved infrastructure needs to be prioritized as this has implications regarding how effectively it can maintain the comparatively low non-revenue water levels it currently records.

With respect to operating expenditure, the level of spending is on par with the rest of the SACN member cities. In addition, its management of consumer debt levels came across as sufficient as it has the lowest consumer debt on its books reflecting a capacity to enforce regulations. This is also reflected in the income levels derived from the sale of water services.

The data analyzed in the study suggests that the technical capacity can be increased to bring it closer to the skills levels in the other larger SACN members without unduly sacrificing its liquidity. This is essential if the backlogs especially in the informal settlements are to be addressed. In addition, there needs to be a strategy to address the likely impacts of economic activities on freshwater ecosystems of activities such as mining which may be responsible for instance for the salinity observed in the Vaal, Crocodile and Olifants River systems. It is inevitable that treatment costs associated with water sourced from these systems would as a necessity rise if the drinking water quality is to meet the requirements.

It however has to be commended for the considerable skill in budgeting for the management of assets as reflected in the low variance of actual spending levels from the corresponding budgeted amount.

5.1.4 Ekurhuleni Metropolitan Municipality

Ekurhuleni Municipality is within the Gauteng Province and faces the same challenges as the cities of Johannesburg and Tshwane with regard to the threats posed by anthropogenic activities such as mining on the water sources the municipality depends on. It also is faced with the challenge of extending services to the informal settlements that are mushrooming to accommodate economic migrants from rural areas. Consumer debt associated with water services, wastewater services and refuse collection suggests a failure by the municipality to collect payment for the services it extends to consumers. This is not consistent with sustainable financial management and has implications for the equitable access to water for all in the municipality

The data collected for this study also suggests there is a need to raise the technical capacity as the indications are that this are lower for the municipality when compared to its peers in Gauteng. Addressing this issue may be key to improving the capital expenditure to levels essential to support economic growth. This is because this study found the municipality's per capita investment level in its water and wastewater infrastructure is lower than its peers in Gauteng. The inadequacy of the water infrastructure is reflected in the volume of non-revenue water experienced by the municipality. Therefore with the right technical capacity level, some of these issues can start getting addressed.

The operating expenditure level in contrast to the capital expenditure is consistent with the rest of the SACN cities and its asset management spending is prudent with the actual spending matching the budget figure. This is also reflected in the Blue Drop assessments that point to good water supply asset management and the SALGA/WRC MBI health check.

The municipality also has wetland clusters located within its boundaries which are essential ecological processes to take place. This means that the municipality in implementing its development programs has to be mindful of the need to maintain these wetlands in their pristine state. Safeguarding these ecosystems would require a paradigm shift if it is to be included in the development agenda. This would also likely require that additional appropriately skilled professionals join the city's management ranks. The city's state of finances suggests it has the capacity to acquire these skills without greatly compromising its liquidity through an increased wage bill.

As with the other cities, the above issues constraint the municipality's ability to properly budget as achievement of the revenue projections gets compromised by technical capacity limitations, and a high proportion of non-revenue water. The consequences of these were observed in the data that was obtained and analysed. For instance, the cost of water service provision for the municipality has exceeded the revenue generated from water services; a condition that is not sustainable.

5.1.5 Nelson Mandela Bay Municipality

Among the smaller members of the SA Cities Network, Nelson Mandela Bay's performance with respect to water resource availability is the most commendable. The data analysed indicates the municipality is investing on a per capita basis the highest amount on capital investments for water and wastewater infrastructure This explains why it has a relatively high proportion of people with access to water within dwelling as opposed to the other small municipalities. In fact it has the highest proportion of houses with piped water inside dwelling as well as flush toilets (connected to the sewage system) of the eight SACN members. The study also found that it has a metered connection level of 100% and this makes it well suited to implement adequate water monitoring and billing practices thereby managing its levels of non-revenue water. The consumer debt levels are relatively lower suggesting prudent financial management practices. This is future reinforced when the actual spending figures are compared to the corresponding budget allocations. This bodes well for asset management and indeed is reflected by the high scores the municipality achieved in that aspect of the green drop assessments in 2012. The variation is very minimal. However, it may have to its technical staff capacity as the data suggested there was room for improvement in that' aspect. This would ensure sustainable water resource availability essential for supporting economic development.

The municipality also falls within sub-Water Management Area with over 10% of its area considered Freshwater Ecosystem Priority Area (FEPA) as per the National Freshwater Ecosystem Priority Areas (NFEPA) project. The project also indicated the presence of wetland clusters and fish support areas. This means that the municipality in implementing its development programs has to be mindful of the need to maintain the FEPA status so as to ensure humans continue to derive eco-systems services and those important ecological processes such as migration of frogs and insects between wetlands are not threatened. Safeguarding the ecosystem would require a paradigm shift if it is to be included in the development agenda. This would also likely require that additional appropriately skilled professionals join the city's management ranks. The city's state of finances suggests it has the capacity to acquire these skills without greatly compromising its liquidity through an increased wage bill.

From the data obtained under the SALGA/WRC MBI the municipality could improve on drinking water quality. The human health risks arising from any compromise in water quality are well known and potentially expensive.

With respect to water infrastructure management, the analysis indicates that this is adequately done by the municipality and may be responsible for the non-revenue water levels being consistently lower than 30%. This is consistent with the capital and operating expenditure levels it maintains and probably explains how the municipality manages to ensure water services costs are covered by the revenues raised through supply of water

5.1.6 Mangaung Municipality

With respect to water resource availability Mangaung Municipality's capital investment levels are comparable to the rest of its peers. Moreover it has a 100% level for metered connections. This bodes well for ensuring water availability in the municipality to meet the growing population's needs. Observing that it has the lowest proportion of households with piped water inside dwelling, it needs to anticipate a growth in demand as more individual become affluent and acquire the means to acquire such water supply systems. Also the proportion of households with no access to sanitation is significant. This is reflected in the drinking water quality assessment which suggests that there is room for improvement. The human health risks arising from any compromise in water quality are well known and potentially expensive. The municipality would also need to boost the technical skills capacity levels as these would be essential to grow and offer operational and maintenance support to growing infrastructure network.

The municipality also falls within a sub-Water Management Area with over 10% of its area considered Freshwater Ecosystem Priority Area (FEPA) as per the National Freshwater Ecosystem Priority Areas (NFEPA) project. The project also indicated the presence of wetland clusters and fish support areas. This means that the municipality in implementing its development programs has to be mindful of the need to maintain the FEPA status so as to ensure humans continue to derive eco-systems services and those important ecological processes such as migration of frogs and insects between wetlands are not threatened. Safeguarding the ecosystem would require a paradigm shift if it is to be included in the development agenda. This would also likely require that additional appropriately skilled professionals join the city's management ranks. The city's state of finances suggests it has the capacity to acquire these skills without greatly compromising its liquidity through an increased wage bill.

With respect to its financial management practices, it became evident from the data analysed that the municipality's budgeting skills need to be improved. This would go a long way in addressing situations where actual spending on asset management is greatly in excess of the corresponding budget allocation.

With respect to asset management, the analysis indicates that this is adequately done by the municipality and may be responsible for the non-revenue water levels being consistently lower than 30%. This is consistent with the capital and operating expenditure levels it maintains and probably explains how the municipality manages to ensure water services costs are covered by the revenues raised through supply of water

5.1.7 Buffalo City Municipality

With respect to water resource availability Buffalo City's capital expenditure on its water infrastructure is the lowest of the SACN members. While the corresponding expense for wastewater infrastructure is comparable to its peers, it can be suggested that Buffalo could do better. With the level of coverage for metered connections below the benchmark level of 100%, the municipality is not well placed to manage the levels of non-revenue water and the associated revenue loss. It should also anticipate a rise in demand for water the lowest proportion of households with piped water and sanitation inside dwelling rises and would be well served to have a strategy of boosting the technical skills capacity levels as these would be essential to grow and offer operational and maintenance support to growing infrastructure network. The data analyzed suggests that while the technical skills levels are adequate, the numbers of such skill staff are not optimal. As a priority it needs to ensure the drinking water quality improves as the SALGA/WRC MBI data suggests that there is room for improvement. The human health risks arising from any compromise in water quality are well known and potentially expensive.

With respect to its financial management practices, consumer debt for water and wastewater services as well as refuse collection are showing an upward trend suggested laxity on the municipality's side. This should be addressed as a priority as it would help the municipality move closer to a financially sustainable status. Moreover it would also result in further improvements in the already acceptable level of asset management by the municipality. Improved asset management supported by an adequate level of capital expenditure would help it increase the amount of revenue water from the current levels thus making services provision more sustainable.

The municipality also falls within a sub-Water Management Area with over 10% of its area considered Freshwater Ecosystem Priority Area (FEPA) as per the National Freshwater Ecosystem Priority Areas (NFEPA) project. The project also indicated the presence of wetland clusters and fish support areas. This means that the municipality in implementing its development programs has to be mindful of the need to maintain the FEPA status so as to ensure humans continue to derive eco-systems services and those important ecological processes such as migration of frogs and insects between wetlands are not threatened. Safeguarding the ecosystem would require a paradigm shift if it is to be included in the development agenda. This would also likely require that additional appropriately skilled professionals join the city's management ranks. The city's state of finances suggests it has the capacity to acquire these skills without greatly compromising its liquidity through an increased wage bill.

5.1.8 Msunduzi Municipality

With respect to water resource availability Msunduzi municipality's infrastructure is the least developed of the SACN members. Moreover its capital expenditure on a per capita basis would need to be raised if the infrastructural capacity is to be improved. With a relatively low proportion of households with piped supply inside dwelling, it is likely that the revenue per unit of water supplied in the city iis lower than for those cities with a high prpotion of dwellings with piped supply. Increased capital expenditure would be necessary to remedy this situation. Related to this, the municipality can expect a rise in demand for water the lowest proportion of households with piped water and sanitation inside dwelling rises and would be well served to have a strategy of boosting the technical skills capacity levels as these would be essential to grow and offer operational and maintenance support to growing infrastructure network. It, however can be commended for the level of coverage for metered connections currently at 100%, This makes it well placed to manage the levels of non-revenue water and the associated revenue loss. The data analyzed suggests that while the technical skills capacity is not optimal.

With respect to its financial management practices, the level of revenue water can be raised especially since the capacity to monitor is present through the adequate coverage of metered connections. Msunduzi seems to be improving tits management of the cost of service delivery as this has been lower than the revenue it generates from service provision. This probably explains the high score by SALGA/WRC MBI with respect to financial management. The per capita income from water services is comparable to that of its peers but could be raised especially if the programmes for extending access to water and sanitation services are oprioritized. Moreover, the current-ratio it maintains suggests very high liquidity levels which may not be necessary particularly when the challenges of addressing its water and sanitation requirements are still outstanding.

The municipality in implementing its development programs however needs to mindful of the eco-system health that support the livelihood of the poor and the biodiversity. Safeguarding the ecosystem would require a paradigm shift if it is to be included in the development agenda. This would also likely require that additional appropriately skilled professionals join the city's management ranks. The city's state of finances suggests it has the capacity to acquire these skills without greatly compromising its liquidity through an increased wage bill.

5.2 Case Studies: Successful Water Management.

Those SACN member cities whose water management practices that have achieved recognition and may also offer lessons to the rest are presented in this section. These are Cape Town, eThekwini and Ekurhuleni. The specific achievements are described here.

5.2.1 City of Cape Town

The City of Cape Town's Water & Sanitation Department has received a number of awards in recognition of its potable water quality, such as the Platinum Award for having excelled in the Blue Drop Awards Programme for four years in succession; Certificates of Excellence from the Water Institute of South Africa WISA (for seven of its eleven Wastewater Treatment Works) and a score of 98.14% for the quality of its drinking water. It also has received four other Blue Drop Awards as the Bulk Provider to areas in the Stellenbosch and Drakenstein Local Municipalities. The recognition of the City of Cape Town's performance is consistent with the conclusions drawn from the assessments undertaken in this project.

5.2.2 eThekwini Municipality

eThekwini Water and Sanitation is a unit of the eThekwini municipality is the 2014 winner of the Stockholm Industry Water Award, for its transformative and inclusive approach to providing water and sanitation services. It is responsible for the provision of water and sanitation services in the municipality, extending access to

piped water to 1.3 million additional people in greater Durban area and 700,000 people have been provided with access to toilets in the past 14 years while maintaining financial sustainability.

In addition to successfully providing basic services to a large and diverse population, eThekwini Water and Sanitation is at the forefront of exploring technical and social solutions. One example is a mini hydro-power project: instead of using pressure reducing valves in pipes running down steep hillsides, the company is installing mini turbines using the excess pressure to generate electricity for the city's low tension grid. The eThekwini municipality is also pioneering solutions to convert urban wastewater challenges to agricultural opportunities as well as harvesting rainwater.

5.2.3 City of Ekhuruleni

The City of Ekhuruleni's level of service for water is approaching 100%. According the Census 2011 results, it's currently above 95% with an estimated 11 311 households with no access. The City has, since inception of the Blue Drop assessments, been in the top-10 achievers nationally and this led to its being awarded a platinum award on the strength of its consistence over this period. It also obtained the number one position in South Africa during the last assessment, in partnership with Rand Water. However, the city still requires considerable investment to eliminate capacity, upgrades and obsolescence backlogs.

A total of 7 293 WCM meters out of the expected 20 000 installation target for the 2012/13 Financial Year are now in place and the plans to have the meters uploaded to the Venus finance database and on-going as this will facilitate reading and billing and will therefore assist in the determination of the water balance and reduce non-revenue water as consumption in informal settlements needs to be offset against revenue received from the equitable share for free basic water.

5.3 Lessons SACN cities may have to offer

In this section, the discussion presented focuses on the lessons the respective SACN cities may have to offer each other as well as other municipalities in the country.

For an assessment of resource availability at city level in relation to its fitness for use, this was understood the include the water resource types available to the cities, level of capital expenditure on the infrastructure necessary to abstract, treat and convey the water to the ultimate user, level of operating expenditure, the availability of the technical capacity to support the infrastructure in adequate working condition and the management of the relevant assets. The Nelson Mandela Bay Municipality has the highest proportion of households with piped water inside dwellings (as reported in 2010). In addition, Nelson Mandela Bay Municipality along with municipalities of eThekwini, Tshwane and Ekurhuleni demonstrate the best performance with respect to budgeting for spending on asset management. This could be a reflection of impact of the on-going capital expenditure this municipality is committing to infrastructure development. The data analysed indicates the municipality is investing on a per capita basis the highest amount on capital investments for water and wastewater infrastructure.

With respect to attracting and keeping adequate technical capacity the 2014 Stockholm Industry Water Award winner - eThekwini Municipality – demonstrated the best performance. Technical capacity is what underpins the success or failure of the various roles the municipality such as asset management, implementation and monitoring of capital projects as well as operation and maintenance. Therefore other cities could look to eThekwini Municipality for strategies on how to build their respective technical capacity. These may not be directly replicable but could be adapted to suit the respective municipalities.

With the Cities of Johannesburg and Nelson Mandela Bay leading on information management aspects, it can be expected that these are best placed to assess the water resources challenges they face and anticipate those yet to manifest themselves. Their contrasting size (population size, water and sanitation infrastructure

size) may offer lessons for municipalities of different sizes as well as the opportunity to identify common themes essential for adequate information management for municipalities of all sizes.

Finally for municipalities looking to improve their capacity regarding revenue Management, pricing and budgeting for water supply services, the City of Tshwane may have the most to offer by way of what other municipalities can adapt to improve their financial management practices.

Table 5-1: What can SACN member cities learn from each other?

No	Measure	SACN Member City									Indicator
		1	2	3	4	5	6	7	8	9	
1	CAPEX			A							Water and waste water infrastructure
		A									Investment in water infrastructure
				A			A				Capital investment per person
			A				A				Water supply infrastructure reaching citizens
			A	A				A		A	Metered connections
			A								Capital requirements
			A								Access to water and sanitation services
2	OPEX	A		A		A					Per capita expenditure on OPEX
3	Technical capacity			A					A		Technical capacity
4	Monitoring, forecasting and early warning			A						A	Ecosystem services and Freshwater Ecosystem Priority Areas
		A			A	A					Managing pollution from anthropogenic activities etc
			A				A		A		Fish Support Areas
				A			A	A		A	Wetland clusters
			A				A		A		Threatened or near threatened fish species
			A								Weather stations
5	Waste treatment	A	A			A	A				Access to flush toilets
								A		A	Use of ventilated improved pit (VIP) latrines
		A	A	A							Drinking water quality
7	Enforcement of regulations				A		A				Consumer debt
10	Asset management		A	A	A	A	A				Variance on budget
		A	A			A					Current replacement value
			A				A				Carrying value for water and wastewater infrastructure
		A				A				A	Completion of water supply management audits
				A							Completion of waste water asset management audits
		A		A							Infrastructure asset management health checks
			A								Operation and maintenance
12	Information/data										Completion of bulk water infrastructure data
		A	A				A				Information management and availability
21	Sales volumes for water	A			A	A					Income from the sale of water
25	Metering and billing						A		A		Customer care health check
26	Non-revenue water		A		A		A				Water losses to lower than 30%
		A						A		A	Progressive improvement
		A			A	A					Most to benefit from tackling non-revenue water
			A		A						Revenue water
					A						Revenue per capita per day and per household per monthly
			A								Cost of providing water services vs revenue from services
			A								Cost of service vs revenue to keep cost to consumers low
			A	A				A			Current ratio
			A				A				Level of salaries vs operational costs
Total		**12**	**19**	**12**	**8**	**8**	**12**	**5**	**4**	**6**	

1=Johannesburg, 2=Cape Town, 3=eThekwini, 4=Tshwane, 5=Ekurhuleni, 6=Nelson Mandela Bay, 7=Mangaung, 8=Buffalo City, 9=Msunduzi

6 Key Role-Players in Water Management at City Level

Who are the key role players in the city's performance and what are their roles?

The following entities directly contribute to the municipal programmes through supporting the planning, design, implementation, operation and maintenance, monitoring and evaluation to ensure effective delivery of water and sanitation services:

- National departments and their regional or provincial counterparts:
  - Department of Water and Sanitation
  - Department of Environmental Affairs
  - National Treasury (NT)
  - Department of Public Works (PW)
  - Cooperative Governance and Traditional Affairs (COGTA)

  These are generally directly involved in the making of policy, co-ordination, planning, development, implementation, monitoring, reporting or auditing of various facets of water resources management. Amongst these role-players a number of structures also exist for policy making, planning, co-ordination, monitoring and reporting purposes.

- Water Service Authorities

  Water Service Authorities are those municipalities tasked with ensuring access to water services as prescribed in the National Water Act. They may perform the functions of a Water Service Provider, or form a joint venture with another water services institution to provide water services. In providing water services, water services authorities must prepare a water service development plan (WSDP) to ensure effective efficient, affordable and sustainable access to water services. The WSDP should be in line with the catchment management strategy of that water management area. The plan provides a linkage between water services provision and water resources management.

- Water Service Providers

  Water service providers are those entities that provide water services in accordance with the constitution, the Water Services Act and by-laws of the respective water services authority and in terms of any specific conditions set by the water services authority in a contract.

- Water Boards

  Water Boards report to the Department of Water and Sanitation and are tasked with operating some, bulk water supply infrastructure, some retail infrastructure and some wastewater systems. Some boards also provide technical assistance to municipalities. Through their role in the operation of dams they also play an important role in water resource management. This undertaking may include some or all of the following activities:
  - Provision of management services, training and other support services to other water services institutions, in order to promote co-operation in the provision of water services,

- Supply of untreated or non-potable water to end-users who do not use the water for household purposes,
- Provision of catchment management services to or on behalf of the responsible authority,
- Supply of water directly for industrial use, accepting industrial effluent and acting as a water services provider to consumers,
- Provision of water services in joint venture with water services authorities, and
- Implementation of water conservation functions.

- South African Local Government Association (SALGA)

  The South African Local Government Association (SALGA) is an autonomous association of 278 municipalities which acts as the sole representative of local government in interfacing with parliament, the National Council of Provinces (NCOP), cabinet as well as provincial legislatures. Its roles include developing capacity for municipalities providing advice and support especially on policy analysis, research and monitoring, knowledge exchange and support to members.

- Gazetted Research Organizations include the Water Research Commission, Agricultural Research Commission and similar water research entities

  The role of these institutions derives from the fact that the status of the water resources in a changing, dynamic environment requires adaptive management and technical responses informed by sound information derived from adequate investment in water research and development. This way a proactive approach to address society's current and future needs for water-related problem-solving initiatives is ensured. They generally aim to develop and support a water-related knowledge base in the country which when done right can be both representative and sustainable, with all the necessary competencies and capacity vested in the corps of experts and practitioners within academia, science councils, other research and government organisations (central, provincial and local) which serve the water sector.

- Private Research and Consulting Firms

  The private sector gets involved in various aspects of supporting the planning, design, implementation, operation and maintenance, monitoring and evaluation of water management in cities as researchers, consultants and contractors to national government departments, municipality and parastatals. These provide the flexibility of testing/trying out unproven potentially transformative management approaches, ideas and technologies that government entities may be constrained or have reluctance to experiment with.

Who are the most important role players to involve in the reporting process?

The Department of Water and Sanitation (DWS) is the main role player on reporting performance on water management in the country. The DWS is charged with administering the National Water Act, Act 36 of 1998 (NWA, 36, 1998). In terms of Section 151 (1) of the NWA (36, 1998), no person may use water otherwise than as permitted under this Act, fail or refuse to give data or information, or give false or misleading data or information when required to give information under this Act, fail to register an existing lawful water use when required by a responsible authority to do so and fail to register a dam with a safety risk. There is general concern about the deteriorating condition of the hydrological and meterolological monitoring systems which are managed by that the DWS and the South Africa Weather Services (SAWS). The Water Quality Management System and Water use Registration and Management System (WARMS) administered by the

DWAS also need a lot of attention. The DWS also coordinated the Municipal Strategic Self-Assessment (MuSSA) of Water Services survey. The lack of multi-year data needs should be addressed. Most of the data required for measuring performance on water management resides with municipalities and water users. There are various initiatives underway to encourage voluntary disclosure and self-assessment by these role players.

What influence and interest do stakeholders have in improving city performance?

Poor performing municipalities tend to have poor data. Municipalities should therefore take steps to improve their performance if the status of data is to improve. As the custodian of water DWA should take a lead in assisting municipalities to improve their performance on water management. However, as there are many issues involved here including standardization, resourcing and validation of data, the Ministry of Cooperative Governance and Traditional Affairs (CoGTA), the South African Local Government Association (SALGA) need to endorse and coordination interventions. Having performance measures in place can help to identify causes of problems but without the will and ability to fix them, the problems may persist or get worse. This brings in the twin issues of political will and capacity to deliver on sustainable water management. All stakeholders need a unified approach on skills, standards and accountability. As this is directly related to financial resources the involvement of National Treasury is critical as it has carrot and stick to make this happen.

7 Way Forward

The impact pathway used on this study helped to define the important KPIs required to monitor and review the performance of SACN Cities on water management. This report provides data from readily available reports and provides an assessment of the performance of the cities based on the 6 topics considered by SACN. The sources of data include the SALGA/WRC MBI, the DWS Blue Drop and Green Drop Assessments, the DWS Municipal Strategic Self-Assessment (MuSSA) of Water Services survey, Annual Financial Reports and Annual Reports. However, available data is not adequate. This report should be shared with stakeholders to solicit their views and obtain commitment to providing additional data for future assessments. These stakeholders include important stakeholders and role players such as SALGA, WRC, the SACN Cities, the various water and waste management utilities, the DWS and SWAS. The success stories identified in this report should be shared. Lastly SACN should adopt the Spreadsheet tables developed on this study as a monitoring tool.

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APPENDIX A: INDICATORS FROM THE SALGA/WRC BENCHMARKING PROJECT

No	SALGA/WRC CODE	Indicator
1	FM21	Capital Investment (water) / Population
2	FM23	Capital Investment (water & wastewater) / Population
3	G118	Capital investment in water infrastructure
4	G120	Capital investment in water and wastewater infrastructure
5	F133	Access to water: Total number of people
6	SD104	Access to water: Piped (tap) water inside dwelling/institution (%)
	SD105	Access to water: Piped (tap) water inside yard (%)
	SD106	Access to water: Piped (tap) water on community stand: distance less than 200m from dwelling/institution (%)
	SD107	Access to water: Piped (tap) water on community stand: distance between 200m and 500m from dwelling/institution (%)
	F122	Access to water: Piped (tap) water on community stand: distance between 500m and 1000m (1km) from dwelling /institution
	SD109	Access to water: Piped (tap) water on community stand: distance greater than 1000m (1km) from dwelling/institution (%)
	F124	Access to water: No access to piped (tap) water (%)
7	SD101	Connections Metered (%)
8	SD103	Household per connection
9	G121	Operating Expenditure
10	B151	Technical Management Skill Level Health Check
11	B152	Technical Staff Skill Level Health Check
12	B153	Technical Staff Numbers Health Check
13	F125	Access to sanitation: No sanitation (%)
	SD112	Access to sanitation: Flush toilet (connected to sewerage system) (%)
	SD113	Access to sanitation: Flush toilet (with septic tank) (%)
	SD114	Access to sanitation: Chemical toilet (%)
	SD115	Access to sanitation: Pit toilet with ventilation (VIP) (%)
	SD116	Access to sanitation: Pit toilet without ventilation (%)
	SD117	Access to sanitation: Bucket toilet (%)
	F132	Access to sanitation: Other
14	F134	Access to Sanitation: Total number of people
15	D100	Drinking Water Quality Health Check
16	D101	Wastewater & Environmental Safety Health Check
17	C100	Infrastructure Asset Management Health Check
18	D134	Operations and Maintenance of Assets Health Check
19	C106	Information Management Health Check
20	D133	Water Services Planning Health Check
21	WDM23	System input volume / Population
22	WDM24	System input volume / Households

No	SALGA/WRC CODE	Indicator
23	E100	Customer Care Health Check
24	WDM4	Non - Revenue Water by volume (IWA Fi46)
25	WD22	Revenue Water by volume
26	A20	Revenue water (IWA A20)
27	A21	Non-revenue water (IWA A21)
28	A8	Billed metered consumption (IWA A8)
29	A10	Billed authorised consumption (IWA A10)
30	G117	Income from water services
31	FM24	Water Services Income / Population
32	FM25	Water Services Income / Household
33	FM1	Financial Management Health Check
34	FM19	Current Ratio for Municipalities
35	FM20	Salaries / Operating Expenditure

APPENDIX B: INDICATORS IN STATE OF CITIES REPORTING: GOOD PRACTICE GUIDE AND TOOLKIT (SACN, 2008)

INDICATOR No	INDICATOR
1	Water demand (kl per capita / day)
2	% of wastewater discharge not treated
3	Annual tonnes waste disposed to land-fills per capita
4	% of solid waste recycled
5	% unaccounted-for water in last fiscal year
6	% of final effluent quality compliance (flow weighted)
7	Sewer blockages per 100km of pipe per year
8	% of households without water on site (i.e. in dwelling or yard)
9	% of households with VIP toilet or less
10	% of households without weekly refuse collection
11	% revenue collected vs revenue billed
12	% change in assessment rates
13	Total municipal revenue per capita
14	Percentage of capital charges to total operational expenditure
15	Ratio of capital expenditure to operational expenditure
16	% of total operational expenditure spent on maintenance
17	Total city ecological footprint in square km
18	Municipal investment in construction
19	Monitoring drinking water quality
20	Monitoring effluent discharge

APPENDIX C: COMPREHENSIVE LIST OF INDICATORS

INDICATOR No	INDICATOR
1	Population
2	Audited expenditure on water services (R)
3	% of households with piped water inside dwelling
4	Audited expenditure on operating water supply system (Million R)
5	Blue Drop - KPA 2: Process control, maintenance and management skill, water supply
6	Green Drop - KPA 1: Process Control, Maintenance and Management Skill, waste water
7	Actual spending on asset management vs budget
8	Rainfall patterns for main source of water for last five years vs average of last 30 years
9	Per capita water consumption per category of users
10	Yield from water source vs water demand
11	Capacity of water supply treatment works vs water demand
12	Capacity of water pump stations vs pumping requirements
13	Length of water distribution network per area covered (km/sqkm)
14	Number of service reservoirs per km of network
15	Length of wastewater network per area covered (km)
16	Capacity of wastewater pump stations vs pumping requirements
17	Capacity of wastewater treatment plants vs treatment requirements
18	Carrying value of water network (R)
19	Carrying value of waste water network (R)
20	Average age of infrastructure
21	Depreciated replacement cost
22	Current replacement cost
23	GDP per person (Rand)
24	Average water supply operating pressure (kPa), IWA
25	Water infrastructure leakage index ,IWA
26	Number of water service interruptions, IWA
27	Blue Drop - Water supply asset management audits
28	Green Drop - Wastewater asset management audits
29	By-laws enforcement
30	Budget for enforcement of regulations
31	Cumulative consumer debt - water services (R)
32	Cumulative consumer debt - waste water services (R)
33	Burst frequency index, days without water supply, days to repair reported leaks
34	Number of mains failures in assessment period (SALGA/WRC MBII)
35	% of non-revenue water across supply chain vs income from water sales
36	Volume of water supplied vs volume of water sold

INDICATOR No	INDICATOR
37	Municipal rates for sanitation
38	Budget for sanitation
39	Green Drop - Flush toilet connected to sewerage %
40	Green Drop - Waste water compliance with license conditions
41	Non revenue water - water loss (%)
42	Non revenue water -financial loss (Rand)
43	Green Drop - Wastewater asset management audits
44	Green Drop - KPA 1: Process control, maintenance and management skill, waste water
45	Green Drop - WWT OPEX
46	Green Drop - WWT Asset Management
47	Budget for research and development
48	Budget for awareness and educational activities
49	Best practice guidelines, procedures, standards and tools
50	Number of households (HH)/buildings with rain water harvesting tanks vs total HH/buildings
51	Total water reuse
52	Total groundwater use
53	Total capacity of dams within city
54	Total water supply to city vs demand
55	Households served (waste collection) vs total no of households
56	Number of households within informal settlements
57	Average waste collection frequency
58	Type of waste collection service provider
57	Average waste collection frequency
59	Type of waste collection service provider
60	Number of street cleaners/km
61	Number of street bins/km
62	Illegal dumping tonnages
63	No of illegal dumping sites
64	CAPEX for monitoring
65	OPEX for Monitoring
66	Number of monitoring personnel
67	CAPEX for water as % of total City budget
68	Budget for water supply
69	DWA RPMS - KPI 11: Water use efficiency
36	Volume of water supplied vs volume of water sold
70	Revenue collected vs cost of supply
71	Unbilled authorised consumption
72	Apparent losses IIWA A18)
73	Real losses (IWA A19)
74	Water tariff
75	Average water charges for direct consumption (IWA G57)

INDICATOR No	INDICATOR
76	Demand vs historical, current and projected supply
77	% of Water supply CAPEX Budget spend
78	% of Sanitation CAPEX Budget spend
79	Average payment period for invoices
80	Total time to procure
81	Time to appoint service providers
82	Time to contract service providers
83	Annual update of supplier databases
84	% of appointments from supplier data base
85	% of appointments from advertising
86	% of projects finished on time
87	% of projects extended
88	Average extension period/Average contract period
89	Average extension budget/average budget
90	Maintenance period for projects
91	% households served with water
92	OPEX for water as % of total City budget
93	Expenditure on water supply
94	Expenditure on wastewater
95	Budget for sanitation
96	Water and sanitation total expenditure
97	Water and sanitation Opex expenditure
98	Water and sanitation Capex expenditure
99	Flooding incidents
100	Period to fix reported leaks
101	GIS System and coverage
102	Percentage completeness of database
103	DWA RPMS - KPI 10: Strategic Asset Management
104	Number of lives lost
105	Number of injuries
106	Number of flooding incidents
107	No of dwellings below approved flood line
108	Number of settlements with/without flood zone maps
109	Burst frequency index, days to repair reported leaks
110	Blockage index
111	Number of way leave applications
112	Reports on incidents of damaged infrastructure
113	SALGA/WRC MBII - Actual maintenance costs vs. current replacement cost
114	Continuous staff improvement activities undertaken
115	No of course attended per staff members per year
116	Total training Budget

INDICATOR No	INDICATOR
110	Blockage index
117	No of curb inlets vs length of stormwater system
118	Expenditure on stormwater management
119	Damaged infrastructure
120	Use of downscaled climate forecasts
121	Application local knowledge system climate forecasts
122	Number of rainfall stations in city
123	Number of weather stations in city
124	Existing mitigation and adaptation measures
125	Number of customers paying vs customers served (%)
126	Number of billing complaints
127	Number of metered customers vs number of customers paying
128	Unbilled authorised consumption (IWA A13)
129	Number customers with meters vs number of customers supplied
130	Bulk system losses
131	Inflow vs outflow water balances for reservoirs
132	Water loss customer meters vs district meters
133	Cost of service vs revenue
134	% of subsidies spend
135	Factors considered in pricing service
136	Perceived risks from customers
137	Perceived risks by Service Providers
138	OPEX and CAPEX budgets for WW, WS and SW vs requirements
139	Budgets for WW, WS and SW vs expenditure
140	Cost of maintaining acceptable levels of service
141	Cost of climate change mitigation
142	Water loss management Budget