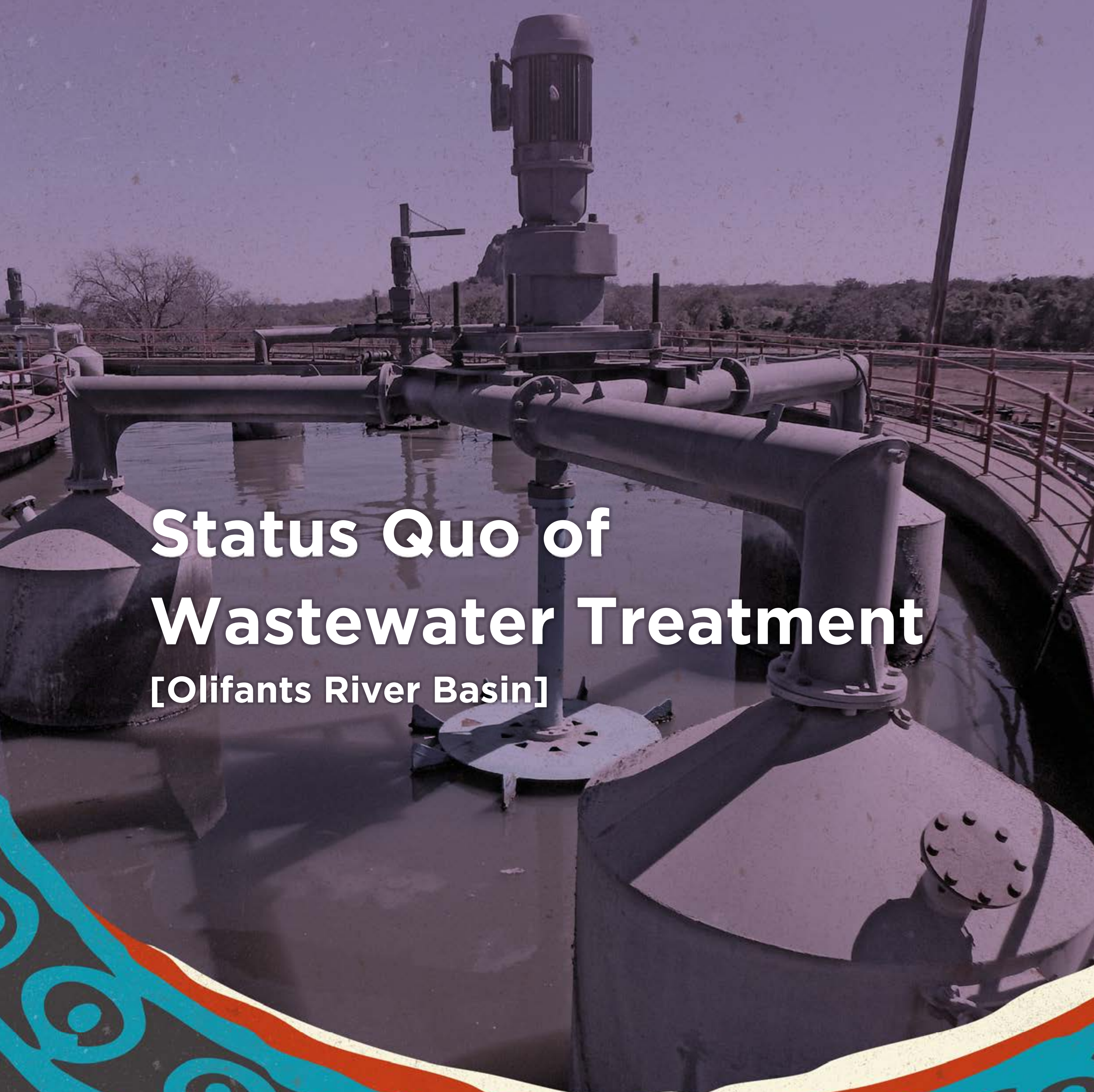

Status Quo of Wastewater Treatment

[Olifants River Basin]

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USAID: RESILIENCE IN THE LIMPOPO BASIN PROGRAM (RESILIM) – OLIFANTS

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Acronyms

AWARD	Association for Water and Rural Development
CRR	Critical Risk Rating
DWS	Department of Water and Sanitation
ORC	Olifants River Catchment
WWTW	Wastewater Treatment Works
WSAs	Water Service Authorities

1 Introduction

This report profiles wastewater treatment in the South African portion of the Olifants River catchment (ORC). Wastewater treatment works (WWTWs) treat water polluted through use and return it to the environment (Mitchell, de Wit, Blignaut, & Crookes, 2014). If wastewater is not properly collected and treated, the effluent discharged into the environment can pose "unacceptable risks to the human health and natural resources" (van der Merwe-Botha & Manus, 2011, p. 1). Preliminary research indicates that many municipalities in the ORC are struggling to adequately treat their wastewater, with concomitant effects on the water quality of the receiving reaches of the Olifants River.

1.1 Purpose

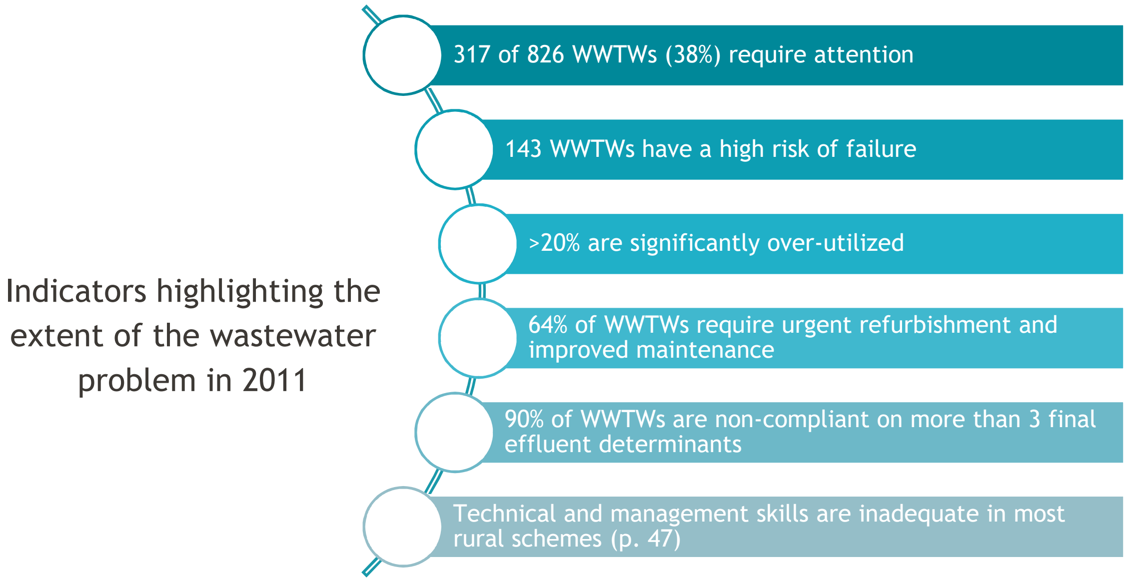
The purpose of this report is to provide an overview of the current status of wastewater treatment in the ORC, based on a spatially-referenced database AWARD compiled to profile operations and performance. This overview fills a major gap in our understanding of the ORC because although WWTWs are considered a key driver, **there is currently no central repository for WWTW information in the ORC**.

Along with a previous report on general wastewater treatment, management, and governance practices, this profile provides the necessary background information for AWARD's support for collective efforts to mitigate wastewater treatment challenges, especially those that impact directly on water quality, through the RESILIM-O programme. RESILIM-O aims to *reduce vulnerability to environmental (climate) change through building improved transboundary water and biodiversity governance and management of the Olifants Basin through the adoption of science-based strategies that enhance the resilience of its people and ecosystems through systemic and social learning approaches*. Following this initial desktop scoping, AWARD will draw systemic linkages between WWTW operations and water quality and assess the challenges that undermine resilience based on field visits and key informant interviews. This analysis will help AWARD decide on which practices and WWTWs to work with on collaboratively-developed plans of action, with priorities, for supporting improved WWTW management in order to mitigate impacts on water resources (especially water quality) in Phase II.

1.2 National Context

As noted by Eales (2011),"the volume of wastewater discharged to rivers nationally is rising rapidly, while the management of treated wastewater discharged by municipalities is generally poor. Just 3% of municipal wastewater treatment works nationally meet the requirements for a Green Drop certificate for wastewater management issued by the Department of Water Affairs" (p.77). Van Zwieten (2014), from EE Publishers, said in her article on *No water, but it's "beyond our control"* that "few Water Service Authorities practice proper management of their water services infrastructure" (p. 1).

> *"There are approximately 1689 water schemes in South Africa. 9% are currently totally dysfunctional at present and lie mainly within the 24 DMs which cover the pre 1994 old homeland areas. Some 48% of schemes are in urgent need of refurbishment. Water treatment and wastewater treatment works are generally in poor condition, with 66% of WWTWs requiring short to medium term intervention, 35% requiring capacity upgrades and 56% requiring additional skilled operating and maintenance staff."*
>
> *Strategic Overview of the Water Sector in South Africa*
> *The Department of Water Affairs (2013)*



2 Methods

This section describes the methods of developing a spatially-referenced database of WWTWs in the Olifants River Catchment and tracking performance measures, such as compliance with effluent discharge standards. The information about WWTWs in the Olifants River Catchment was compiled from several sources.

2.1 Information on the Location of WWTWs

The data on the name and location of WWTWs was compiled from five separate databases, as shown in Table 1 and listed in order of contribution (though there were significant gaps and overlaps in each database, and thus merged as described below). Four of the databases are held at the Department of Water and Sanitation (DWS) and the other is from a private consulting company, which DWS commissioned to compile the data.

TABLE 1: SOURCES OF INFORMATION ABOUT THE LOCATION OF WWTWS IN THE ORC

#	DATABASE NAME	SOURCE	EXPLANATION	REFERENCE AND DATE
1	**Water Services & Local Water Management database**	DWS Chief Directorate: Water Services & Local Water Management database	This database, housed at DWS, is the most comprehensive and includes all types of WWTWs (Public Municipal, Private, Public Works, etc). The WWTWs and Water Service Authorities (WSAs) populate the database on an ongoing basis.	The data was sent via email from Cheryl Schulz, DWS, on 28 October, 2014.
2	**Sewage Treatment Works**	PULA	PULA, a consulting company, compiled a database of WWTWs in South Africa for DWS.	The information was sent by Gundula Blecher, PULA, on 13 March, 2015.
3	**Wastewater Works Green Drop Assessment**	DWS	DWS posts some of the Green Drop information online. This data was entered manually into the database.	https://www.dwaf.gov.za/Dir_WS/GDS/WastewaterWorks/WWList.aspx?em=1&WSACode Retrieved in Oct., 2014.
4	**Final effluent sampling points for the WWTW**	**DWS**	The DWS Provincial Office in Bronkhortspruit provided a sampling report containing coordinates for all the final effluent sampling points for the catchment.	The data was obtained on AWARD's behalf by Ms. Lebo Mosoa, from the DWS Head Office, D: Water Resource Planning System, SD: Water Quality Planning on 27 October, 2014.
5	**Base Information for Targeted Risk-based Regulation**	DWA	The Department of Water Affairs (DWA, as DWS was previously called) published reports in 2008 on municipal wastewater treatment risk profiles with information about the capacity and actual flow received at WWTWs, effluent quality compared to legal discharge standards, and the technical and health/safety skills and compliance to legal requirements for each province. The data was spatially linked for Gauteng and Limpopo.	The reports can be found at: https://www.google.com/search?q=Base+Information+for+Targeted+Risk-based+Regulation&oq=Base+Information+for+Targeted+Risk-based+Regulation&aqs=chrome..69i57.1250j0j7&sourceid=chrome&es_sm=122&ie=UTF-8.

Several other sources of information were included in the search, but had less information and no unique points. For example, the data from Green Drop assessors in the ORC duplicated and was less complete than the other sources. However, speaking to the Green Drop assessors may be useful for the future (For more information, please contact Jonny Nwaila at nwailaj@dwa.gov.za).

2.2 Data Synthesis & Verification

The following steps were followed to merge the data into one database. GIS Mapping completed the data merge in November, 2014.

1. Combine data for WWTW information to one master data base.
2. Where possible convert coordinate points to relevant format required for import to ArcGIS (Decimal Degrees).
3. Import converted points to ArcGIS in Shapefile format (WGS 1984).
4. Overlay Olifants Catchment area boundary polygon.

5. Run selection on points with centroids located in Olifants Catchment area. (Result 129 points).
6. Verification:
   Verify points with 2012 Aerial imagery and determine duplicate points and, where possible, incorrect locations. Of the 129 points, 109 were verified. There are 13 points that are probable, but the coordinates are likely off. 4 points are unable to be verified with aerial imagery and 3 points have no spatial coordinates.
7. Provide Dataset in Shapefile format. Geographic co-ordinate system WGS84.

2.3 Information on the Operation & Performance of WWTWs

Based on the information available, the database on the operation and performance of WWTWs was divided into 11 main components with several elements each. The components and elements are shown in Table 2. The *Overview of Wastewater Treatment in South Africa* provides an explanation of why these elements are important.

TABLE 2: COMPONENTS OF THE DATABASE

#	COMPONENT	ELEMENTS
1	Operator information	Name of the Water Service Authority (WSA), WSA Code, Operator, Operator Type (WSA, Water Service Provider (WSP), Private, Public Works) Owner, and Owner and Owner Type (mainly either Public or Private)
2	Location	Coordinates, Street Address, Local Municipality, District Municipality, and Province
3	Community	Nearby river, source of effluent, name of community, and population served
4	Plant design and capacity	Main Process, Technology for secondary treatment, Design Capacity (Ml/d), Treatment Capacity (Ml/d), Average Inflow (Ml/d) , Flow Amount Exceeding / On and Below Capacity (Ml/d), Operational % in terms of Design Capacity, Average Flow as % of Design Capacity (or % Flow Amount Exceeding Capacity)
5	Staff capacity	
6	Regulations	
7	Green Drop scores	2009 and 2011 score, Process Control, Maintenance and Management Skill, Wastewater Quality Monitoring Programme, Wastewater Sample Analysis (credibility), Submission of Wastewater Quality Results, Wastewater Quality Compliance, Annual Average Effluent Quality Compliance, Wastewater Quality Failures Response Management, Bylaws, Wastewater Treatment Facility Capacity, Wastewater Asset Management, Bonus Scores and Penalties
8	Wastewater Quality compliance	Microbiological compliance, chemical compliance and physical compliance, Ammonia, Chlorine as Free Chlorine, COD - Chemical oxygen demand, E. coli, Nitrates & Nitrites: Health, Electrical Conductivity, Faecal Coliform, Fluoride, Ortho-phosphate, pH, Suspended Solids, Effluent Discharge Standards not met, No. of non-compliance trends for the various discharge parameters, Effluent Failure Rating
9	Discharge	
10	Risk	Critical Risk Rating (CRR), % ITO Maximum Risk Rating, CRR %deviation, Highest Risk area, Risk abatement process, Capital and Refurbishment Expenditure (2010), Description of Projects' Expenditure, Wastewater Risk Abatement Plan (W2RAP)

The database was populated with the data provided in the Green Drop reports and Base Information for Targeted Risk-based Regulation, specifically:

- Department of Water Affairs (2009) Green Drop Report
- Department of Water Affairs (2011) Green Drop Report
- Department of Water Affairs (2012) Green Drop Progress Report
- Department of Water Affairs (2009a) Base Information for Targeted Risk-based Regulation Gauteng Province
- Department of Water Affairs (2009b) Base Information for Targeted Risk-based Regulation Limpopo Province
- Department of Water Affairs (2009c) Base Information for Targeted Risk-based Regulation Mpumalanga Province .

The 2013 Green Drop report has not been released; when it is, it could be incorporated in the database.

Other sources of information about WWTWs include:

1. The WARMS database, which does not have information on the location of WWTWs, does include data on the water quality sites: https://www.dwa.gov.za/iwqs/wms/data/B_reg_WMS_nobor.htm
2. The Water Institute of Southern Africa (WISA), a professional organisation with a mandate to build expertise, share knowledge, and improve quality of life, has collected information on WWTWs by District and Local Municipality. Many of the WWTW listed do not have coordinates. More information is available at: http://www.ewisa.co.za/ewisawaterworks/misc/municipalcontacts/
3. The Middle Olifants Sought Africa (MOSA) profiled 13 WWTWs in the Middle Olifants.
4. Some municipalities have published reports as part of various local and national initiatives, such as Thembisile Municipality (2009) Gap Questionnaire Report

3 Status Quo of Wastewater Treatment in the Olifants River

The AWARD team estimates there are close to 120 WWTWs in the Olifants River Catchment. As shown in Table 3, 129 unique points are included in the database; 109 were verified with aerial photography and another 13 are probable, but the spatial coordinates are incorrect.

TABLE 3: TOTAL NUMBER OF WWTWS IN THE ORC

COMPONENT	#
Total number of WWTWS	**122**
WWTWS included database	129
Verified with aerial photography	109
Probable WWTWS, but coordinates likely incorrect	13
Unable to verify with aerial photographs	4
No spatial coordinates	3

3.1 Operator Information

There is ownership data for 82 of the 122 WWTWs in the ORC, as shown in Table 4. Of the WWTWs with data, 74% are state-owned and the others are privately owned. The majority (80%) of the WWTWs are operated by Water Service Authorities (WSAs). Eight plants in the ORC are operated privately and Water Service Providers.

TABLE 4: OPERATOR INFORMATION

		#	% OF TOTAL WWTWS	% OF TOTAL WITH DATA
OWNERSHIP	State owned	61	50%	74%
	Privately owned	21	17%	26%
	No data	40	33%	
OPERATION	Private	8	7%	9%
	Public Works	1	1%	1%
	WSA	69	57%	80%
	WSP	8	7%	9%
	No data	36	30%	

3.2 Location of WWTWs

Most of the WWTWs in the ORC are in Limpopo Province or Mpumalanga Province. Emalahleni has the most WWTWs out of all the local municipalities in the catchment. Figure 1 shows the location of WWTWs in the ORC.

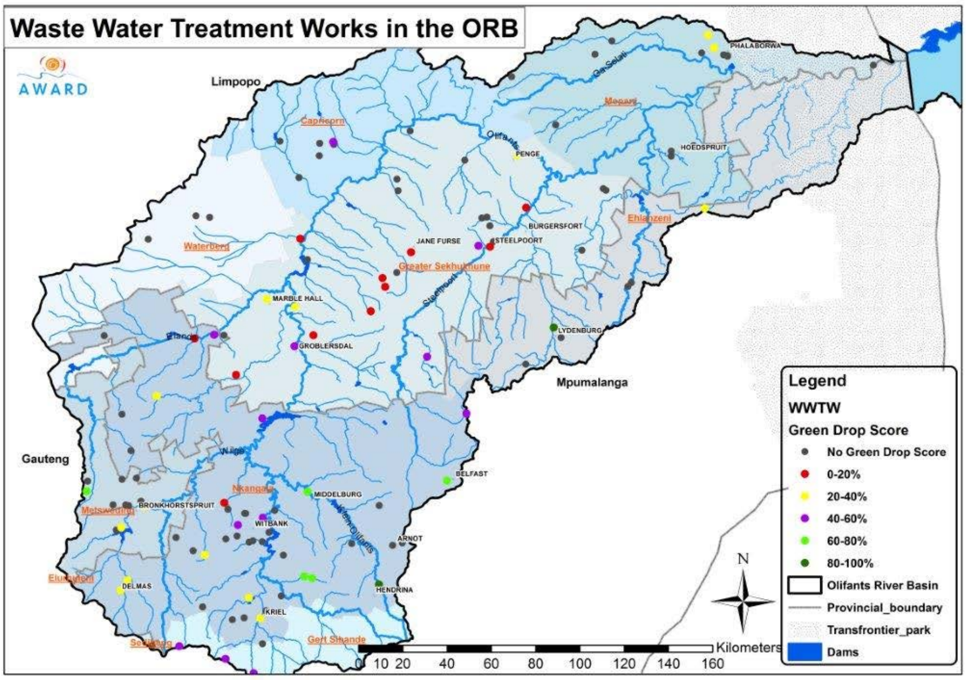


Figure 1: Location of WWTWs in the ORC

Table 5 shows the number of WWTWs, percentage of total, number of Green Drop assessments, and Green Drop scores by Province, District Municipality (DM), and Local Municipality (LM). It is worth noting that only a small sample of WWTWs are assessed within each municipality for the Green Drop assessment. As such, interpreting information about averages must be done with caution. For example, only 2 of the 10 WWTWs in ba-Phalaborwa were assessed and thus the reported Green Drop score may not reflect reality. Similarly, the only WWTW with a Green Drop assessment of the five in Thaba Chweu LM is Lydenburg; as such the reported score may be higher than in reality.

TABLE 5: NUMBER OF WWTWS, PERCENTAGE OF TOTAL, NUMBER OF GREEN DROP ASSESSMENTS, AND GREEN DROP SCORES BY PROVINCE, DISTRICT MUNICIPALITY (DM), AND LOCAL MUNICIPALITY (LM)

		# of WWTW	% of total	# GD assess	GD Score
Gauteng Province		14	11%	3	38,6
DM	LM				
City of Tshwane		**12**	10%	3	38,6
Ekurhuleni		**0**		0	
Sedibeng	Lesedi	**1**	1%	0	
	No data	**1**			
Limpopo Province		60	49%	18	23,6
DM	LM				
Capricorn	Polokwane	**0**	0%	0	
	Lepele-Nkumpi	**4**	3%	0	
Mopani	Greater Tzaneen	**1**	1%	0	
	Ba-Phalaborwa	**10**	8%	2	24,1
	Maruleng	**10**	8%	0	
Greater Sekhukhune	Fetakgomo	**2**	2%	0	
	Greater Tubatse	**10**	8%	4	24,3
	Makhuduthamaga	**7**	6%	4	12,6
	Greater Marble Hall	**3**	2%	3	18,7
	Elias Motsoaledi	**3**	2%	3	37,3
Waterberg	Mookgopong	**3**	2%	0	
	Bela-Bela	**0**	0%	0	
	Mogalakwena	**0**	0%	0	
	Modimolle	**0**	0%	0	
	No data	**7**			
Mpumalanga		52	43%	23	48,2
DM	LM				
Nkangala	Dr JS Moroka	**2**	2%	2	37,8
	Thembisile	**2**	2%	1	34,0
	Victor Khanye	**2**	2%	2	28,6
	Emalahleni	**23**	19%	6	38,7
	Steve Tshwete	**8**	7%	4	74,6
	Emakhazeni	**2**	2%	2	67,4
Gert Sibande	Govan Mbeki	**3**	2%	3	49,5
	Msukaligwa	**0**	0%	0	
	Albert Luthuli	**0**	0%	0	
Ehlanzeni	Thaba Chweu	**5**	4%	1	83,1
	Bushbuckridge	**1**	1%	1	21,3
	No data	**4**			

3.3 Community information

The DWS Water Services and Local Water Management database includes information about the nearby river and community/population served by WWTWs. However, data is only available for **29 plants**. The average size of the community served is 21 063 people.

3.4 Plant design & capacity

There is not much reliable information on plant capacity. The average Design Capacity is 3,2 Ml/d. Sometimes a Treatment Capacity (Ml/d) is also reported.

Only 13 WWTWs have information on average inflow (Ml/d), flow amount exceeding capacity (Ml/d), and flow as percentage of design capacity. The average Average Flow as Percentage of Design Capacity is 107%, although this average is based on very limited data and in the *Base Information for Targeted Risk-based Regulation* when “the design of average flow information was not available” average flow was reported as 151% over capacity. Further information should be collected and examined more carefully, because as Department of Water Affairs (2009c) reported in the *Municipal Wastewater Treatment Base Information for Targeted Risk-based Regulation* “the average flow as a percentage of the design capacity provides a high level overview of problematic works. […] It can be seen that a number of works *operate at design capacity or exceed their design capacity*. In situations where the works’ average flow is close to its design capacity, ongoing event failures of non-compliance can be expected. For this reason, works which operate with *an average flow of 90% or more* would need close supervision and excellent management techniques to ensure compliance.

3.5 Staff capacity

The *Base Information for Targeted Risk-based Regulation* report tracked the class of process controllers and supervisors required by the class of the WWTW, as shown in Table 6.

TABLE 6: CLASS OF OPERATOR AND SUPERVISOR REQUIRED FOR DIFFERENT CLASSES OF WWTWS

<table>
<tr><th>WORKS CLASS</th><th>CLASS OF OPERATOR PER SHIFT</th><th>SUPERVISION*</th><th>OPERATIONS AND MAINTENANCE SUPPORT SERVICES REQUIREMENTS*</th></tr>
<tr><td>E</td><td>Class I</td><td>Class V*</td><td rowspan="5">These personnel must be available at all times but may be in-house or outsourced:
■ Electrician
■ Fitter
■ Instrumentation technician</td></tr>
<tr><td>D</td><td>Class II</td><td>Class V*</td></tr>
<tr><td>C</td><td>Class III</td><td>Class V*</td></tr>
<tr><td>B</td><td>Class IV</td><td>Class V</td></tr>
<tr><td>**A**</td><td>CLASS IV</td><td>CLASS V</td></tr>
</table>

NB. Fluoridation - for any class works, minimum operator classification should be class III

This limited information has not been analysed for general trends, but would show whether the staff was qualified to operate and supervise the plant. The Department of Water Affairs (2009b) summarizes that there is a general non-compliance trend for supervisors, process controllers, and maintenance staff: “high percentages of personnel employed in “skilled’ positions, do not comply with the requirements for supervisors (80%) and process controllers (73%). These numbers, combined with the number of vacancies in these positions, amount to a significant number of positions that are not filled by any form of skill or by inadequate/inappropriate skill. The value of this information is that it places Provincial Government in an ideal position to address this skills gap on an informed, quantified basis, and to formulate a Plan with clear targets, deliverables, timeframes, costs and methodology to address this specific gap, ideally in partnership with LGSETA and ESETA."

3.6 Regulations

The *Base Information for Targeted Risk-based Regulation* also reports compliance and non-compliance on a number of regulations from construction, machinery operation, management, and safety. However this information was only available for 27 plans in the ORC, and many of the entries are "No information". As such, general averages and trends are not reported here.

3.7 Green Drop

The Municipal Green Drop score is a **Performance Indicator** of the overall municipal wastewater business. Nine key performance areas are assessed and weighted (and explained in further detail in the Overview Report):

1. Process Control, Maintenance & Management skills
2. Monitoring Programme
3. Credibility of Sample Analyses
4. Submission of Results
5. Wastewater Quality Compliance
6. Failure Response Management
7. Bylaws
8. Treatment & Collector Capacity
9. Asset Management

The weighted average of the components is calculated for an overall Green Drop score, out of 100. A score of 90 is required for a Green Drop Certificate.
Table 7 shows the total number of Green Drop assessments, average score, and highest and lowest scores in the ORC. It's worth noting that only 45 of over 120 WWTWs in the ORC were assessed in 2011 and much less in 2009. As such, these averages must be interpreted with caution.

TABLE 7: GREEN DROP ASSESSMENT

2011 GREEN DROP ASSESSMENT	
Total number of assessments in the ORC	45
Average green drop score	38%
Highest score	83% (Lydenburg)
Lowest score	6% (Jane Furse)
2009 GREEN DROP ASSESSMENT	
Total number of assessments in the ORC	20
Average	28%
Highest	58% (Lydenburg; KwaZamokuhle/ endrina)
Lowest	6% (Davel; Jane Furse)

Figure 2 shows the average score for the nine components of the 2011 Green Drop assessment. The RESILIM-O program is most interested in **Water Quality Compliance component, which has an average of 11% in the Olifants River Catchment.**

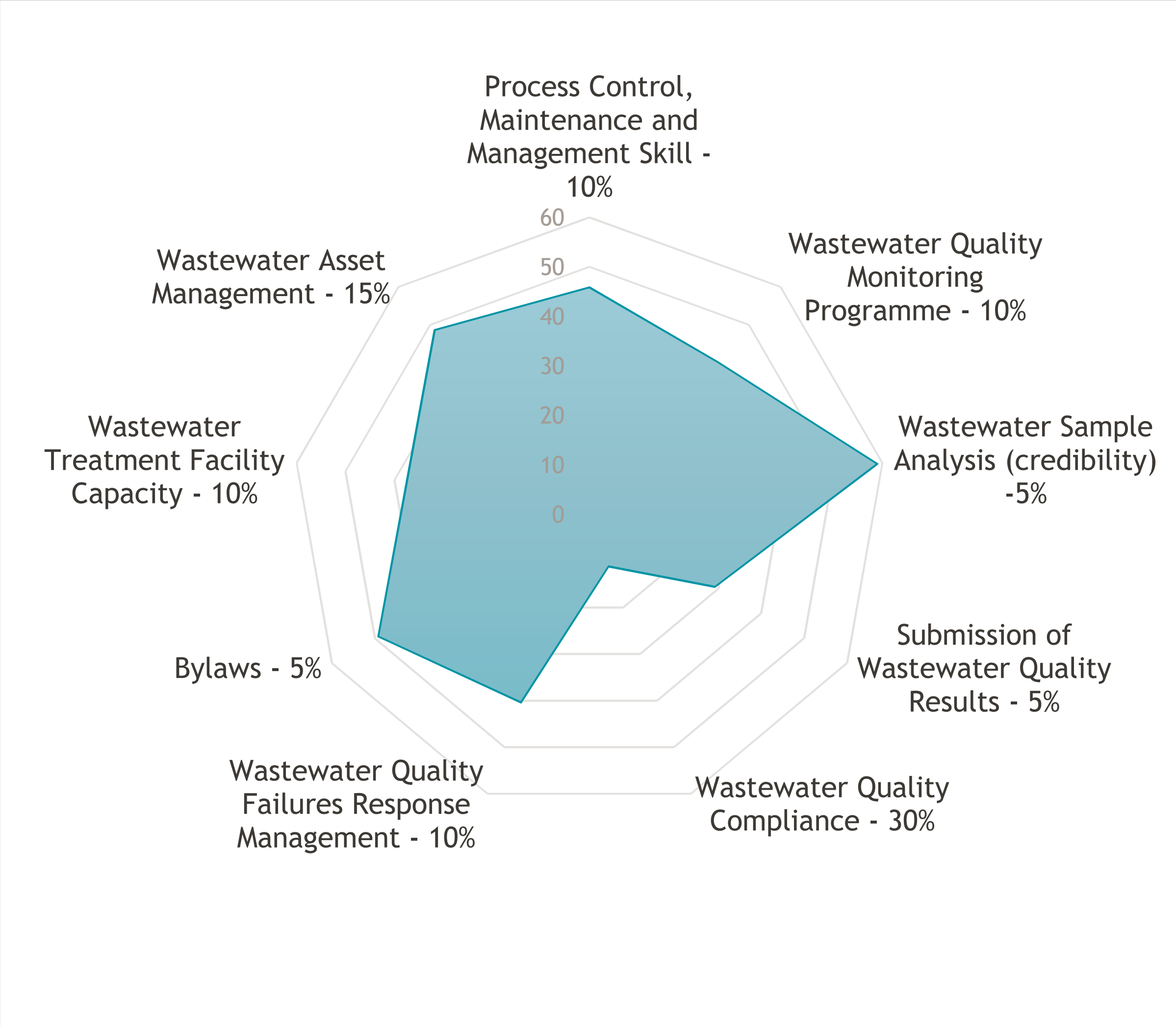


Figure 2: Average Score for Green Drop Components in 2011

3.8 Wastewater Quality Compliance

The discharge of waste water must comply with a number of licence conditions of general authorisations or special limits. These are explained in the Overview of Wastewater Treatment in South Africa report. In many cases these standards are not being met, as shown in Table 8. This means, as Kidd (2011) explains, "that untreated or insufficiently treated effluent is ending up in the country's watercourses." The treated wastewater is generally compliant with chlorine, EC, and pH. Chemical oxygen demand, nitrates, Faecal Coliform, and Suspended Solids are generally not compliant. There is very little information about *E. coli* or Faecal Coliform.

TABLE 8: WATER QUALITY COMPLIANCE

CONSTITUTE OF WATER QUALITY AND LIMIT	COMPLIANT		NON-COMPLIANT		NO MONITORING		NO INFORMATION	
Ammonia (gen limit: 6 mg/l)	5	17,9%	17	60,7%	1	3,6%	5	17,9%
Chlorine as free chlorine (mg/l)	1	100,0%	0	0,0%	0	0,0%	0	0,0%
Cod - chemical oxygen demand (gen limit: 75 mg/l)	8	28,6%	14	50,0%	1	3,6%	5	17,9%
E. Coli (gen limit: 1000 count/ 100 ml)	1	3,7%	3	11,1%	6	22,2%	17	63,0%
Nitrates & nitrites: health (gen limit: 15 mg/l)	16	57,1%	3	10,7%	3	10,7%	6	21,4%
Electrical conductivity (gen limit: 150 ms/m)	18	66,7%	2	7,4%	1	3,7%	6	22,2%
Faecal coliform (gen limit: 1000 count/ 100 ml)	5	18,5%	4	14,8%	6	22,2%	12	44,4%
Ortho-phosphate (gen limit: 10 mg/l)	14	51,9%	4	14,8%	4	14,8%	5	18,5%
pH (gen limit 5.5-9.5 ph units)	19	70,4%	0	0,0%	2	7,4%	6	22,2%
Suspended solids (gen limit: 25 mg/l)	7	25,9%	13	48,1%	1	3,7%	6	22,2%

Generally, wastewater quality compliance is very low. The WWTW at KwaZamokuhle/ Hendrina has reported at 100% compliance. The second highest are at Lydenburg and Ekangala at 60%. The next highest, at Orgies, Lebowakgomo, and Phalaborwa and Lulekani, are only compliant 20% of the time.

3.9 Discharge

A small amount of information about the average discharge and authorization (i.e. licenses and permit numbers) was reported and included in the database. This information is important because, as stated by DWA (now DWS) in the *Base Information for Targeted Risk-based Regulation* that the status of licensing (or permit), although not critically impacting on health or environment, is a legislative requirement, and forms a crucial aspect in water resource planning and allocation.
Due to the numerous other functions that form part of the WSA and Municipalities, it is observed that in ensuring that correct licences and registration of works is applied for and concluded, this activity often receives a lower priority as compared to meeting the basic service demands, etc.

It is recommended that DWA assists municipalities in verifying their registration and licenses. From past experience in this matter, it is cautioned that the support may need to be extended to support the preparation of the license by the WSA, based on the necessary license application document – especially in the cases of lower capacity WSAs (pg 13).

3.10 Risk

The introduction to the 2012 Green Drop Progress Update continues by explaining, "risk is defined and calculated by the following formula:

Cumulative Risk Rating (CRR) = A x B + C + D *where:*

A] Design Capacity of plant which also represent the hydraulic loading onto the receiving water body
B] Operational flow exceeding-, on- and below capacity
C] Number of non-compliance trends in terms of effluent quality as discharged to the receiving water body
D] Compliance or non-compliance i.t.o. technical skills

A CRR %deviation is calculated (CRR %deviation = CRR value/CRRmax X100) to indicate how close the CRR value is to its maximum. For example, 90% CRR %deviation value means the plant has only 10% remaining before the system will reach its maximum critical state (100%).
The average A CRR %deviation in the ORC is 87,5%. The highest CRR %deviations are shown in Table 9.

TABLE 6: CRITICAL RISK RATING AS PERCENTAGE OF MAXIMUM CAPACITY

NAME OF WWTW	CRR % DEVIATION
Marblehall WWTW	95.5%
Klipspruit WWTW Final effluent	95.5%
Delmas	94.1%
Penge WWTW	94.1%
Bronkhorstbaai (Summer Place Package Plant)	94.1%
Botleng	94.1%
Kinross STW	90.9%
Groblersdal WWTW	88.2%
Monsterlus (Hlogotlou) WWTW	88.2%
Nebo ponds WWTW	88.2%

A % i.t.o. Maximum Risk Rating is also reported, though this indicator must be furthered clarified.

4 Implications for Resilience

The poor management of WWTWs in many areas of the ORC is a major driver of change, influencing the ORC-SES in complex and dynamic ways. Of interest to RESILIM-O is the fact that the poor management of WWTWs contribute substantially to deteriorating water quality throughout the South African portion of the ORC mainly through:

- Microbial pollution, such as E.coli and other pathogenic organisms
- Elevated nutrient loads, especially nitrogen and phosphorus
- Discharged suspended solids
- Increased salinity and heavy metal concentrations

The effect of non-compliant effluent discharge ***directly impacts on environmental and human health***. Poorly-treated wastewater carries pathogens and compounds that lead to illness and mortality. For example, there have been sporadic outbreaks of cholera in the area (Kidd, 2011). In addition, poorly-treated wastewater water reduces the ecosystem services on which society depends: abundant nutrients lead to eutrophication and subsequent water quality decreases, for example, threatening water users — such as irrigated agriculture — and aquatic biodiversity. The impacts on health, food, shelter, and livelihoods highlight extensive vulnerability which compromises the resilience of the system. And, as Mitchell et al (2014) explained, "malfunctioning wastewater treatment works (WWTW) is a major cause of the deteriorating water quality in the country and it may be expected to threaten neighbouring countries in the river basins which South Africa shares with its neighbours."

A status quo assessment assists in efforts to understand the social-ecological system, which is a necessary first step to reducing vulnerability. The fact that there was no database was indicative and concerning. Monitoring compliance and enforcing standards is a fundamental element of proper water governance.

Although the categorization of risk in the Green Drop assessment requires further study (and perhaps an alternative method of investigation) the literature does indicate that WWTWS pose serious risks and must be considered. Mitchell et al. (2014) noted the substantial risk linked to the non-improvement in the performance of WWTWs, due to the current excessive load on WWTWs leading to underperformance. Adding additional loads expected due to increases in both income and people, will exacerbate the situation[1]. There is an environmental, social and economic cost of such pollution (Graham et al., 2011:ix-xii). Not only is the economic cost a concern, but also the deteriorating ability of ecosystems to absorb or dilute the effluent loads (although 'dilution is not the solution' must also be remembered). This places the entire water system at high risk when considering systemic linkages in catchments.

[1] *Recent work by AWARD has also modelled the impacts of climate change on the operations of WWTW (see Brochure on Systemic, Social Learning Approaches to Water Governance and Sustainability in the Olifants River Catchment (Limpopo) available on www.award.org.za).*

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The Association for Water and Rural Development

AWARD is a non-profit organisation specialising in participatory, research-based project implementation. Their work addresses issues of sustainability, inequity and poverty by building natural-resource management competence and supporting sustainable livelihoods. One of their current projects, supported by USAID, focuses on the Olifants River and the way in which people living in South Africa and Mozambique depend on the Olifants and its contributing waterways. It aims to improve water security and resource management in support of the healthy ecosystems to sustain livelihoods and resilient economic development in the catchment.

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About USAID: RESILIM-O

USAID: RESILIM-O focuses on the Olifants River Basin and the way in which people living in South Africa and Mozambique depend on the Olifants and its contributing waterways. It aims to improve water security and resource management in support of the healthy ecosystems that support livelihoods and resilient economic development in the catchment. The 5-year programme, involving the South African and Mozambican portions of the Olifants catchment, is being implemented by the Association for Water and Rural Development (AWARD) and is funded by USAID Southern Africa.

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