The contribution of WRC research to sustainable municipal wastewater and sanitation services

Report to the
Water Research Commission

by

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The biggest issue is taking all the research and making it operational. How do you operationalise research? How do you bring it into the daily activities and utilise whatever knowledge that you gain from the research?

That is where we lack, we lack the implementation of research.

Neeran Maharaj, Scientific Services Manager, City of uMhlatuze

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Executive summary

Local government is a key stakeholder of the Water Research Commission (WRC). It is therefore critical for the WRC to get insight into how its research products rate in terms of awareness, uptake and impact in the municipal environment and hence the contribution that these products make to sustainable wastewater and sanitation services.

The study aimed to:

- Give the WRC insight into the factors that shape the use of research-based knowledge in the municipal environment;
- Give the WRC insight into the uptake and impact of its research products in wastewater and sanitation services; and
- Identify success stories and map opportunities.

A better understanding of the knowledge needs, knowledge sources and knowledge use of municipal officials will also add value to the actions of all sector partners and municipalities to improve and sustain water and sanitation services.

This document reports on the primary research, which comprised qualitative interviews with 108 municipal officials working in wastewater and sanitation services and 70 self-completed questionnaires. The purposeful sample of 22 municipalities represented all nine provinces and included six Metros, seven B1, four B2, four B3 and one C2 municipality. The details of the sampling criteria appear in the report.

A tool was developed to analyse the correlation/interaction between municipalities' performance journey and the way that they engage with knowledge in terms of knowledge needs, knowledge gaps, knowledge sources and knowledge use.

The study confirmed a correlation between performance and engagement with knowledge.

On the upper end of the performance journey, municipal officials in wastewater and sanitation departments of Metros and well-performing smaller municipalities (B1 and B2) tend to:

- Be aware of their own knowledge gaps and strategies to improve. These include agreements with tertiary institutions;
- Practise mentorship and knowledge sharing;
- Have a vision and the drive to improve (to be the best in the world [eThekwini]; be on the forefront; achieve a Green Drop; or to improve consistently);
- Be a source of knowledge for other municipalities;
- Be aware of the WRC and its knowledge products. Uptake is a function of context and the exposure that the individual has had to the researchers and research-based knowledge.

On the low end of the performance journey, municipal officials in struggling wastewater and sanitation departments tend to:

- Define their knowledge gaps in terms of operational or maintenance problems that they are unable to solve;
- Have limited knowledge sharing;

- Drive to survive and keep their plants more or less functional. This also becomes a mind set and a comfort zone: *We are doing well, but not really, because our focus is on short term solutions.*
- Focus their attention on innovative solutions to deal with operational challenges, for example to bypass broken infrastructure or to keep old equipment running.
- Have a low awareness and use of the WRC and its research products.

It was furthermore found that that engagement with knowledge in municipal wastewater and sanitation services is influenced by the interplay of a range of factors in both the institutional and the individual domains.

A research organisation such as the WRC will have to address both domains in its marketing and research strategies to improve uptake and achieve impact.

Unfortunately, awareness of the WRC and its research products is particularly low in LMs and DMs. Without awareness there can be no uptake.

In most cases, awareness of the WRC, and even use, is championed by individuals. Only in eThekwini and in Ekurhuleni (ERWAT), the institution and its particular knowledge culture drive the use of research-based knowledge.

The WRC is well-respected among municipal officials who are familiar with the organisation. Unfortunately, there are also a number of misconceptions about the WRC, and perceptions that the WRC products are not practical, or ''too academic''.

The research found that different levels of municipal officials differ in their self-reported use of WRC research. Uptake in wastewater and sanitation is limited to a handful of research reports that are used over and over again.

The final chapter outlines the opportunities for the WRC and its sector partners to follow up on the findings of the report. It also makes several specific recommendations for the marketing and research strategies of the WRC and other research organisations that are active in the local government space.

Six priority actions are recommended.

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List of abbreviations

CMA	Catchment Management Agency
CogTA	Cooperative Governance and Traditional Affairs
CRR	Critical Risk Ratings
CSIR	Council for Scientific and Industrial Research
DM	District Municipality
DWS	Department of Water and Sanitation
EDC	Endocrine Disrupting Chemical
IWMI	International Water Management Institute
LM	Local Municipality
MILE	Municipal Institute of Learning
MoU	Memorandum of Understanding
PC	Process controller
PCR	Polymerase Chain Reaction
PPP	Public Private Partnership
R&D	Research and Development
SALGA	South African Local Government Association
WISA	Water Institute of Southern Africa
WRC	Water Research Commission
WSA	Water Services Authority
WSP	Water Services Provider
WWTW	Wastewater Treatment Works
W_2RAP	Wastewater Risk Abatement Plan

1 Introduction

1.1 CONTEXT

At a workshop in March 2014, the Water Research Commission (WRC) and the International Water Management Institute (IWMI) grappled with the challenges of how to enhance the uptake and impact of its research products (reports, articles, briefs, guidelines, etc.). Making the findings of research projects available is unfortunately no guarantee that the target audience is aware of their existence, or that they will be taken up, or used to sustain good wastewater and sanitation services.

Local government is a key stakeholder for the Water Research Commission. Over the years the WRC has produced many reports that focus on wastewater and sanitation management at municipal level with the aim of supporting good, sustainable services in local government.

In 2014, an analysis of the WRC's statistics of online users of knowledge products over the past five years found that municipalities did not feature among the top five user categories. On the other hand, the same study cited very positive examples of municipal officials' uptake of WRC research, which also implied impact:

> *I have recently downloaded 'Guidelines for the Utilisation and Disposal of Wastewater Sludge, all five volumes in order to address sludge management in my workplace and make informed decisions with expressions of interests submitted to the municipality.*
>
> *The City is looking at water services to backyard dwellers and used the report to identify applicable legislation so that we could update our bylaws.*

It therefore remains a challenge for the WRC to understand in more depth:

- What are the knowledge areas relevant to sustainable wastewater and sanitation management? What contribution has the WRC made in each of these knowledge areas?
- What do municipal officials working in wastewater and sanitation services at different levels perceive to be their knowledge needs?
- What methods do they use to search for knowledge and how do they apply the knowledge that they have found?
- Are municipal officials aware of the WRC and its research products?
- Do any of the WRC research products cross the pathways of their knowledge needs, knowledge searches and knowledge use? If yes, which products, and how have they been used?
- Are there any success stories of uptake of WRC research that also illustrate a positive impact on sustainable wastewater and sanitation services?
- How can the WRC further contribute to better wastewater and sanitation services and assist municipalities to become more sustainable in this regard?

It was hypothesised that the answers to these questions will give the WRC insight into how their research products rate in terms of awareness, uptake and impact in the municipal environment and hence the contribution that these products make to sustainable wastewater and sanitation services.

For the purpose of the study, knowledge was defined as "information processed by individuals". "Knowledge comprises ideas, facts, expertise and judgments that are relevant for the performance of the individual, the team, and the organisation"[1]. Research-based knowledge includes research findings, evidence and theoretical and empirical insights gained from using research findings.

1.2 THE AIMS OF THE STUDY

The study aimed to achieve the following:

- To give the WRC insight into the uptake and impact of its research products in wastewater and sanitation services;
- To enable the WRC to understand the factors that shape the use of research in the municipal environment; and
- To identify success stories and map opportunities.

1.3 DELIVERABLES

The study produced the following deliverables:

1. A literature review (on the CD at the back of the report)
2. An annotated overview of wastewater and sanitation research reports that the WRC has produced
3. Primary research
    1. Sample of Water Services Authorities to be visited
    2. Discussion guide(s) and questionnaire
    3. Fieldwork report (on the CD at the back of the report)
    4. Summaries of qualitative interviews
    5. Summary of questionnaire findings
4. A knowledge sharing event at the WISA (Water Institute of Southern Africa) Biennial Conference in May 2016 which included a short video (workshop report and video on the CD at the back of the report); and
5. **This report** on the primary research, which comprised qualitative interviews with 108 municipal officials working in wastewater and sanitation services and 70 self-completed questionnaires.

1.4 METHODOLOGY

A purposeful sample of 27 WSAs (water services authorities) was drawn for the project. This sample was representative of all nine provinces, the three types of municipalities (Metros, Local Municipality (LM) and District Municipality (DM)) and the different classes (B1, B2, B3 and C2).

Other selection criteria were the following:

1. The sample was based on the Green Drop scores and the Cumulative Risk Rating scores in the PAT 2010, 2012 and 2014 reports. The sample included good and improved performance

[1] Definition adapted from Wang & Noe (2010) as discussed in literature review.

WSAs, but also included some of the weakest performers (such as Madibeng LM, Uthungulu DM and Kouga LM).

2. The selected WSAs are representative of different WSA-WSP relationships, different knowledge and innovation cultures and different relationships with the WRC.
3. The sample considered also the size of the population that these WSAs serve, it is therefore slanted towards cities and B1 municipalities.
4. Lastly, the sample included municipalities with interesting scenarios, for example Beaufort West, which re-uses wastewater for drinking purposes and Mogalakwena LM, which delivers treated wastewater to a Lonmin mine, the company that has upgraded their wastewater treatment plant.

22 municipalities responded and were visited. The details of the selection criteria and the visits are discussed in the fieldwork report.

In-depth qualitative interviews were conducted at different post levels in the wastewater and sanitation departments. For Metros, interviews were requested at the following levels:

- Executive Manager: Wastewater and Sanitation;
- Manager: Sanitation;
- Engineering: one of the engineers or project managers;
- Technician or draughtsman: maintenance and/or operations;
- Scientist/analyst; laboratory manager;
- Plant manager/superintendent; and
- Process controller (two people).

For the smaller municipalities, interviews were requested at the following levels:

- Executive Manager: Wastewater and Sanitation;
- Engineer responsible for water and sanitation OR the technician (operation and maintenance) OR the laboratory manager;
- Plant manager/superintendent of the main wastewater treatment plant; and
- Process controller on the plant.

After the initial contact with the WSAs, follow-up emails and/or telephone conversations confirmed the dates and times of the municipal visits.

The interviewer team combined many years of experience in interviewing, fine interpersonal skills, intelligence and multilingual skills. The field of wastewater and sanitation was new to most of the interviewers; one full day was set aside for the briefing. They also received literature that they had to work through before they went into the field.

Because the interviewers were multilingual, many of the interviews could be conducted in the home language of the respondent. A few of the interviews took place entirely or partially in an African language or Afrikaans. The rest of the interviews were conducted in English.

Four interviews were requested from the smaller municipalities (LM and DM); a minimum of eight interviews from the Metros. Bela-Bela LM, Thaba Chweu LM, Rustenburg LM, Madibeng LM and Beaufort West LM were unable to provide the requested number of interviewees. eThekwini, Mbombela LM, the City of uMhlatuze LM, the City of Johannesburg, the City of Tshwane, Sol Plaatje LM and Tlowke LM, on the other hand, made more interviewees available than were requested.

The table below sets out the interviews conducted at each WSA:

Table 1: List of the number of interviewees per WSA

Province	Water Services Authority	Number of interviews
Eastern Cape	Kouga LM	4
	Nelson Mandela Bay	4
Free State	Metsimaholo LM	4
Gauteng	Ekurhuleni	8
	City of Johannesburg	8
	City of Tshwane	9
KwaZulu-Natal	City of uMhlatuze LM	5
	Uthungulu DM	4
	eThekwini	9
Limpopo	Mogalakwena LM	4
	Bela-Bela LM	3
Mpumalanga	Thaba Chweu LM	2
	Mbombela LM	5
North West	Tlokwe LM	6
	Rustenburg LM	3
	Madibeng LM	3
Northern Cape	Sol Plaatje LM	5
	//Khara Hais LM	3
Western Cape	George LM	4
	City of Cape Town	8
	Mossel Bay LM	4
	Beaufort Wes LM	3
	Total:	108

The interviews were individual and face-to-face. The discussion guide (submitted as part of Deliverable 2) that was used in the interviews varied according to the interviewee's position and role within the municipality. See Appendix B on the CD at the back of this report for an explanation of the interviewing methodology and the discussion guides. In some of the interviews, pictures were taken (with permission) of examples of where the municipalities have applied and used research-based knowledge.

The interviews were recorded and filed. Only two municipalities did not want to be recorded (Metsimaholo LM and Sol Plaatje LM). This was probably due to serious service delivery problems that they were experiencing.

After each interview, a summary was written. The interviewers received a summary template that they had to use for the summaries. A few selected interviews were also transcribed. See Appendices C and D on the CD at the back of the report for examples.

It should be noted that the municipalities selected their best officials at the different levels for the interviews. This might have skewed the findings slightly towards uptake. **The data is qualitative, but in some instances the responses from the 108 interviews have been quantified to illustrate trends.**

The interviews discussed the following knowledge aspects:

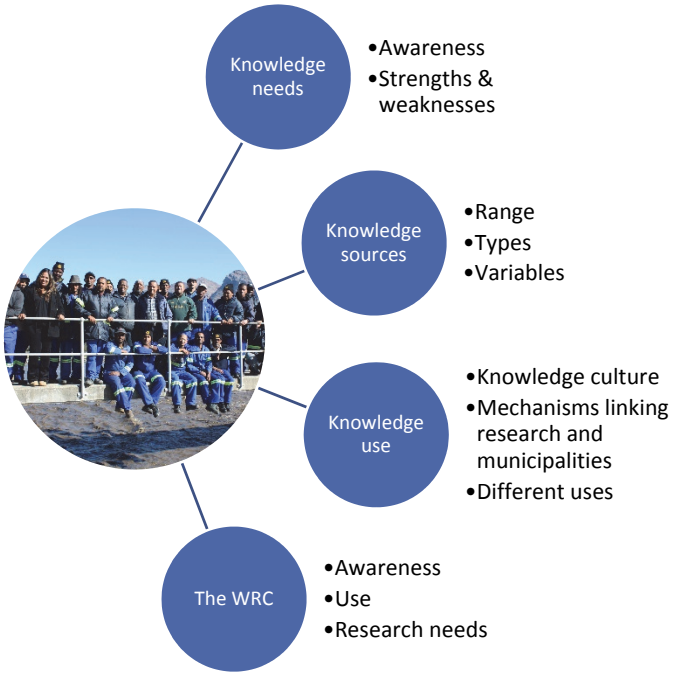

Figure 1: Knowledge aspects discussed in the municipal interviews

1.5 TOOL FOR ANALYSIS

A tool was developed to analyse the interaction between municipalities' performance and the way that they engage with knowledge.

The tool was based on the performance road map below[2]:

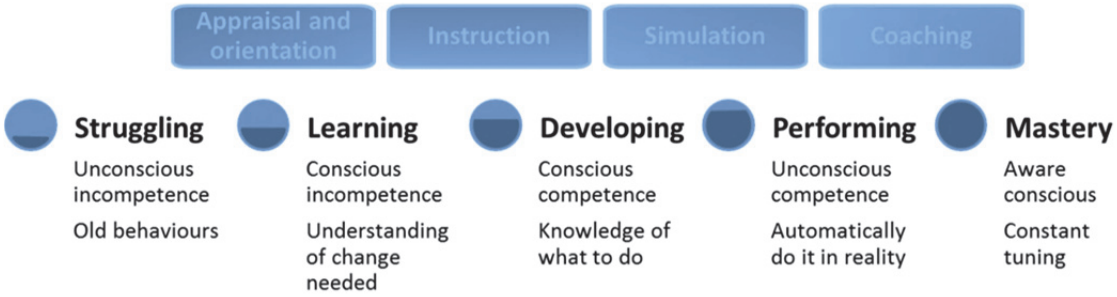

Figure 2: Performance journey map

The sample municipalities were categorized into the five performance categories of the map, based on their performance in the following:

- ✓ The Green Drop Scores of 2013 and 2011;
- ✓ The Critical Risk Ratings (CRR) of the 2014, 2012 and 2010 PAT reports;
- ✓ The WSA League of the 2014 Municipal Benchmarking Initiative; and
- ✓ Our interpretation based on the visit and interviews.

The table below shows the performance of the visited municipalities.

[2] Source: Dr Valerie Naidoo

Table 2: List of municipalities visited and the performance criteria that were used to plot them on a performance journey map

#	Municipality (WSA)	Class	WSA League 2014 (MBI)	Green Drop Score 2013	Green Drop Score 2011	Critical Risk % (CRR) 2014	Critical Risk % (CRR) 2012	Critical Risk % (CRR) 2010	Our interpreta-tion based on the visit and interviews
Eastern Cape									
1	Kouga LM	B3	Weaknesses identified	53%	36%	76%	87%	75%	struggling
2	Nelson Mandela Bay	Metro	Top performer	65%	81%	52%	55.6%	61.8%	top performer; decline in Green Drop score
Free State									
3	Metsimaholo LM	B2	Show potential	69%	62%	79.4%	64%	71%	top performer in province; consistent
Gauteng									
4	Ekurhuleni	Metro	Top performer	84%	79%	73%	63%	62%	top performer; innovative; R&D
5	City of JHB	Metro	Top performer	86%	91%	49.7%	46%	49%	top performer
6	City of Tshwane	Metro	Top performer	82%	64%	69.2%	72%	61%	top performer
KwaZulu-Natal									
7	City of uMhlatuze LM	B1	Top performer	85%	83%	38.8%	41%	38%	top performer
8	Uthungulu DM	C2	Weaknesses identified	26%	68%	86%	100%	69%	struggling; under administra-tion
9	eThekwini Metro	Metro	Top performer	91%	91%	47.1%	46%	46%	top performer; innovative; R&D
Limpopo									
10	Mogalakwena LM	B2	Showing potential	84%	26%	86.4%	49%	88%	learning /best progress
11	Bela-Bela LM	B3	Showing potential	44%	17%	78.4%	69%	80%	struggling/ progressing
Mpumalanga									
12	Thaba Chweu LM	B3	Weakness identified	80%	81%	64.4%	24%	45%	struggling; lost manager
13	Mbombela LM	B1	Showing potential	83%	86%	58%	47%	49%	good performer

North West									
14	Tlokwe LM	B1	Top performer	93%	97%	37%	37%	36%	top performer
15	Rustenburg LM	B1	Showing potential	63%	76%	58.4%	35%	65%	consistent
16	Madibeng LM	B1	Weakness identified	44%	7%	71.2%	61%	78%	struggling/ best progress
Northern Cape									
17	Sol Plaatje	B1	Top performer	56%	76%	76.2%	67%	74%	declining; crisis at WWTP
18	//Khara Hais LM	B2	Weakness identified	61%	36%	66.4%	49%	46%	learning/ progressing
Western Cape									
19	George LM	B1	Top performer	85%	91%	49.2%	35%	35%	top performer
20	City of Cape Town	Metro	Top performer	89%	87%	49.3%	49%	49%	top performer
21	Mossel Bay LM	B2	Top performer	79%	89%	47.7%	43%	43%	top performer
22	Beaufort West LM	B3	Top performer	80%	90%	36.8%	29%	29%	top performer/ isolated/ old technology

Legends:

B1 = Local municipalities with a large town or city as its urban core
B2 = Local municipalities with a medium town or towns as its urban core
B3 = Local municipality with a small town or towns as its urban core
C2 = District municipality that is also a Water Services Authority

% Deviation = CRR/CRR(max) TREND	
	90 – 100% Critical risk WWTPs
	70 - <90% High Risk WWTPs
	50-<70% Medium risk WWTPs
	<50% Low Risk WWTPs

Based on their performance, the municipalities were placed into the five categories of the performance journey map. eThekwini and ERWAT were put into the Mastery category for their knowledge culture and the emphasis that they put on innovation, and research and development.

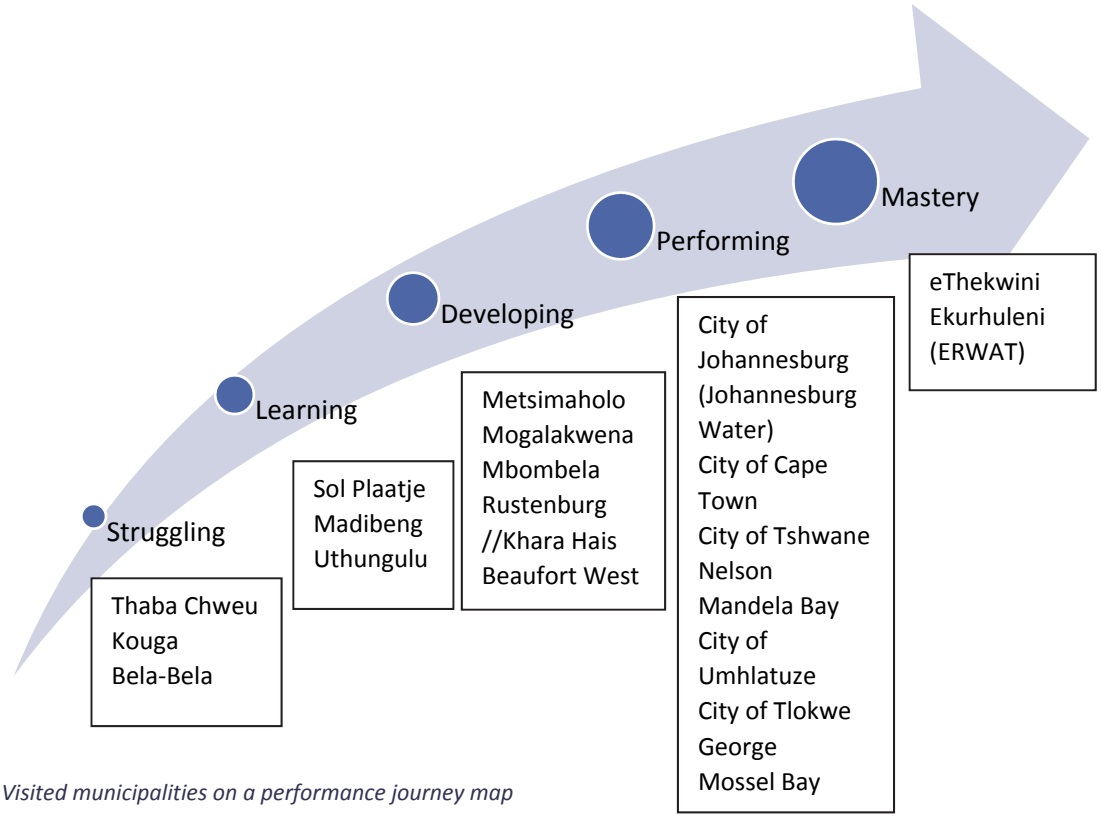

Figure 3: Visited municipalities on a performance journey map

The findings for each municipality in terms of the discussed knowledge aspects were subsequently analysed and mapped onto the performance journey. It should be noted that the performance journey is not discrete achievement points; it is a continuum. Therefore, for some aspects, five categories were too many and too narrow, and findings would cluster around a weak performing and a well performing position.

Chapter 2 discusses the findings of the study.

2 Findings

2.1 Overview of the chapter

The findings of the study are discussed in five sections. Under each section, implications of the findings for the WRC and its sector partners have been highlighted.

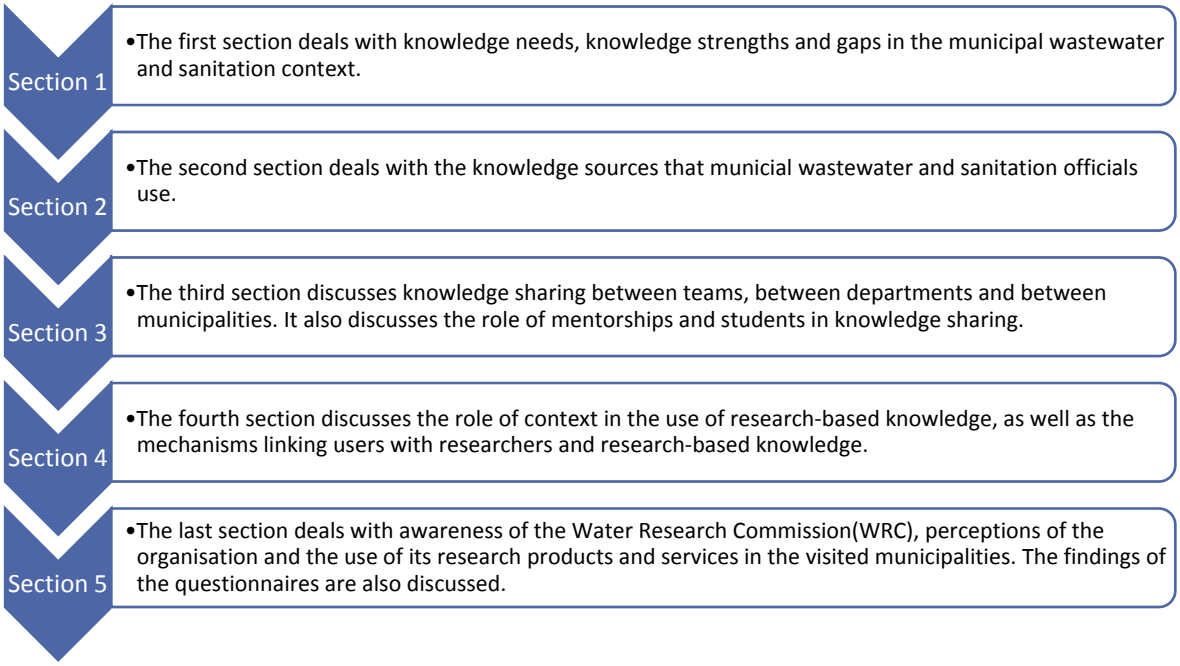

Figure 4: Overview of the findings

2.2 Knowledge needs and knowledge gaps

2.2.1 Articulating knowledge needs

Officials from municipalities in the better performing categories can generally articulate their knowledge needs well. Knowledge needs shift away from knowledge to solve operational crises to meeting regulatory requirements and improving performance. In top performing Metros, such as eThekwini and Ekurhuleni (ERWAT), knowledge needs include a research and development agenda.

Officials from weak performing municipalities do not always know what they need to know; hence the need for someone to come to them and tell them:

> *If they can visit our plant and we check from point A to the last point. Then they can advise us improve here, here we are on the right track, improve this and this and this.* (Senior process controller, Thaba Chweu).

Their knowledge needs focus on trying to avert a crisis; moving from one breakdown or failure to the next. In this quest, they rely heavily on their own ability to try and find solutions:

> *You just get thrown in to do your own thing.*
>
> *We run the plant as we see fit*. (two different interviews, Uthungulu DM)

Compartmentalisation or "tunnel'' knowledge seems to be common, even in the better performing municipalities. The people working in operations would lack the basic knowledge of maintenance, and vice versa. Officials would complain that their teams do not understand the purpose or the broader context of their work. Incident registers are empty, because "*people do not know the purpose of records. They fear them. They think they will be in trouble if they record a failure"* (Process Manager, Uthungulu DM). Process controllers may be able to do their tasks, but they lack understanding of why they have to monitor and test effluent, for example. Laboratory analysts would do laboratory tests, but be unable to interpret the results for operational implications.

The study did not find evidence that customers drive knowledge needs in wastewater services, but they do in sanitation services in Metros such as the City of Cape Town and eThekwini. Liaising with communities in informal settlements is complex and challenging.

> *We need guidelines on effective community engagement.* (Manager, Sanitation and Reticulation, City of Cape Town).

2.2.2 Knowledge strengths

Respondents were asked what they consider to be their knowledge strengths. The interviewers also asked respondents up to plant manager level what they consider to be the knowledge strengths of their team.

For most respondents, their perceived field of expertise is linked to their training background, further studies, their career experience, a special interest or a positive mentoring experience.

Below are three testimonies of how individual knowledge developed through a positive mentoring experience:

> *My approach in life had been to ask questions. That is how I was taught by my managers.* (Plant manager, Mogalakwena LM)

> *He is someone who motivates you to do better in your job. He pushes you to open up your mind to find (solutions). He will also work through the challenges with you. He encourages people to try even if they might get something wrong.* (Process controller, City of Tshwane of her plant manager)

> How did you know you could use bioreactor profiling to solve the nitrification problem? *My professor at the University of Pretoria, At Pretorius, had this unique combination of engineering and microbiological knowledge. He told us about this. I actually have not seen that kind of knowledge in a text book, although it is common sense.* (Acting Director: Wastewater treatment, City of Tshwane*)*

2.2.3 The value of experience (tacit knowledge)

Experiential (tacit) knowledge is highly valued and respected in the wastewater and sanitation environment. Explicit knowledge as found in text books and research reports is apparently not enough to know how to run a wastewater treatment plant. The quotes below illustrate a common approach:

> *Getting to know your plant and your unique problems come with time and experience and working closely with other team members, especially "the old hands". I've learnt to ask the old guys, because they usually know.*
>
> *We learn by trial and error.* (Plant manager, Tshwane Metro)
>
> The plant had an incident with foam and bulking and the team came up with a solution of chlorinated spray. They create new ideas all the time through knowledge and experience. (Engineer: operation and maintenance, City of Cape Town)

In many municipalities officials have no other choice but to follow this approach as the example below from KwaZulu-Natal illustrates:

> The City of Umhlatuze LM is the Water Services Authority (WSA); Mhlathuze Water Board is the Water Services Provider (WSP). The running of the plants is subcontracted to Mhlathuze Water Board and operations staff work for the Water Board. The plant staff and their seniors find themselves sandwiched between the LM and the Water Board. The Water Board expects them to perform and set their KPIs; compliance is a key performance indicator. On the other hand, the LM fails to support them with the required plant upgrades and refurbishment and repairs. As a result, they rely heavily on intuitive modelling (*''tricks of the trade''*) and experimentation to optimize effluent quality and, if all else fails, they would dose extra chlorine. (Interview summary, City of Umhlatuze)

In a context where experience is very highly valued, some officials are dismissive of the value of research-based knowledge:

> *You just ask July Jacobs for help, because July knows everything about the plant. It is not necessary to do research.* (Process controller, Beaufort West. July has never heard of the WRC.)

But the research team also found examples that illustrate how research-based knowledge and experiential knowledge can be successfully integrated in a work environment:

> *I encourage the process controllers to investigate.* The plant manager is dedicated to give his team sufficient guidance and practical experience on the plant. *If I pick up something on the plant, I would say, ok, I give you 8 or 9, or 14 days, find out what is wrong. This forces them to apply academic knowledge or do further research. I don't give them the answer; I stimulate creative, deductive thinking.* (Plant manager, Rustenburg LM)

In a work environment where tacit knowledge is highly valued, knowledgeable individuals with many years of practical experience are highly respected and influential. The late Shaun Deacon and Gert Saayman are legendary. Neels Windt, Chris Swartz, July Jacobs, Anderson Mancotywa, Ben Nell, Sabelo Mkhize are some of the names that were mentioned repeatedly in a municipality. The influence of many of these people stretches far beyond their own municipalities.

The extract from an interview with a young engineer who was mentored by Shaun Deacon illustrates how such an influential individual had combined research-based and tacit knowledge and applied it in the municipal environment, and the immense influence this has had:

He researched biogas to energy and looked at the German and US examples to see how they could be adapted for local circumstances. He also researched the best way for Johannesburg to deal with sludge: Belt presses, solar drying, etc.

He standardised equipment, processes and design guidelines across plants. For example, all plants use Archimedean screw pumps instead of centrifugal pumps (massive, expensive to run). He also developed the Johannesburg process manual.

He was also instrumental in establishing a solution-driven culture. This rubbed off on people like Rob Boyd. (The interviewee gave the example of a problem that they had with scum on the reactors and how Rob solved the problem by turning the mixers off for short periods per day. The scum stuck together and would float away to the next chamber.)

Unfortunately, the knowledge of these individuals often disappears when they retire. With one exception, the research team did not find any formal mechanism to document knowledge gained through experience. Informal knowledge transfer takes place through interaction with colleagues.

When asked what he will do with his knowledge, an experienced consultant to the new Kouga plant answered:

I'm gonna die with it… (he laughs)… *I transfer the knowledge to the guys I work with.*

The example below illustrates the typical absence of succession plans:

We are six engineers with many years' experience – a well-oiled machine with lots of knowledge. It's not an attractive industry and knowledge is important so we count on the experience of the team. If these guys had to leave, it would be disastrous – there is no succession plan (Engineer: operation and maintenance, City of Cape Town).

When Shaun Deacon was close to retirement, Johannesburg Water introduced a formal mentorship programme. One of the participants remembers the experience as follows:

The mentorship programme was established to ensure that skills transfer has taken place when Shaun Deacon will be retiring. A group of participants were identified. Each week, they would have two workshops at head office and two workshops on site.

The mentorship programme covered the full wastewater process, from start to end. Ideally, it should have been two years. It had to be discontinued when Shaun got ill.

One of the outcomes of the mentoring programme was a paper: "Enhancement of biogas to energy". Shaun was the main author and five of the participants in the mentoring programme contributed.

In addition, Shaun wrote articles for Water and Sanitation to capture some of his experience.

I took notes meticulously; I also grabbed screen shots. So, yes, I would be able to write up and publish what I have learnt (if he had the time).

2.2.4 Knowledge gaps

The study found that knowledge gaps differed according to post levels and responsibilities. Differences are not discrete; they occur on a continuum. For the sake of the report, however, we will distinguish between four positions or levels:

1. Senior management
2. Middle management: Technician/engineer/laboratory manager
3. Plant managers
4. Process controllers

It should be noted though that the categorisation is approximate; it does not match municipal positions exactly. There is no standard organisational structure for wastewater and sanitation departments. Each municipality has its own structure, positions and titles. In fact, Koos Wilken of ERWAT recommended that the WRC undertakes a study to investigate the optimal organisational structure for wastewater and sanitation!

The categorisation also does not match qualifications and skills levels. For example, a senior process controller in a Metro could be better qualified than a plant manager in a small municipality.

2.2.4.1 Senior management

The responsibilities and hence the knowledge needs of senior wastewater and sanitation managers tend to shift away from technical matters to management issues. Many have never had management training and regard this as a major knowledge gap and knowledge need. Some senior managers have done an MBA; others consider upskilling.

When asked what knowledge he needs, the Director: Water and Sanitation of //Khara Hais responded as follows:

> *Financial management – budgets, etc.: There are specific legislation and rules. Most training that Treasury, for example, offers, is aimed at people with a financial background; they are not aimed at technical people like me.*
>
> *Human resource management: The technical people have the largest teams; I have 270 people working under me, at large distances. HR management is a larger need for the technical manager than it is for the HR manager of the municipality. Discipline, motivation, giving instructions, dispute resolution – these make up the major part of interaction with employees.*
>
> *Conflict management: Every day there is room for conflict between you and your managers, your team members, the MM, the Council, the public. You have no idea how many angry people I have had in my office! I have never received any training in conflict management; I had to learn it myself. Many of my employees do not yet have these skills; they tend to end up in a verbal confrontation with a member of the public.*

2.2.4.2 Laboratory analysts

In a number of municipalities, laboratory managers and analysts identified knowledge of plant operations as a knowledge gap. Analysts can do the necessary tests and compile results, but many lack the knowledge to interpret these results to make recommendations as to how operations can be improved to prevent compliance failures.

The laboratory analyst from Tlokwe added another perspective:

> *Chemists might have a knowledge gap in microbiology. Also, the chemists do not understand contamination in the same way that a microbiologist might do. For this reason, many municipalities outsource their microbiological tests.*

2.2.4.3 Technicians/engineers

Technicians and engineers expressed major knowledge gaps and knowledge needs in the following areas:

- New developments (research and development): new solutions, new materials, new apparatus
- What are other municipalities implementing in terms of technology? What are they piloting? What are the challenges and the outcomes?
- Specific solutions for technical problems
- Exposure to research (the discipline and the value that it adds).

2.2.4.4 Plant managers

Most of the plant managers that the research team talked to are highly dedicated and passionate about their plants.

Plant managers in the LMs and DMs tend to be complacent about their knowledge. They would say that they know everything on the plant.

> *Ek ken die plant soos die palm van my hand. (I know the plant inside out)* (Plant manager, Sol Plaatje)

> *I never get stuck. (*Plant manager, Mogalakwena)

If there are problems, they either blame the process controllers or complain that they are not getting support from senior management. They also tend to be critical of their own process controllers as unmotivated, unskilled and irresponsible and do not admit a lack of management skills.

Plant managers "operate in silos" was a term used. As a result, their knowledge tends to be plant-specific.

> *''Each of us sweeps his own front yard. I keep mine spotless." (Plant manager, Tshwane)*

However, there are exceptions. In the City of Cape Town, the plant managers share information and assist each other to solve problems. They meet every Friday at a different plant; they then also have a ''walk through'' the plant where they advise (and even criticise) the relevant plant manager.

The City of Umhlatuze was the only municipality encountered where plant managers (superintendents) are rotated through the plants. The operations manager has identified knowledge loss as a risk and brought in the rotation after a team building session where the reasons and advantages were explained and discussed.

2.2.4.5 Process controllers

Most municipalities have two types of process controllers: the ones with some qualification in the wastewater field (explicit knowledge) and the ones who have been trained on the job, many with

years of experience (tacit knowledge). The plant managers acknowledge that qualifications and experience are needed on a wastewater treatment plant.

> *This is a hands-on industry*. (Plant manager, Tshwane)

Most plant managers are well aware of the challenges to manage these two types of process controllers. For example, the plant manager of Johannesburg Water insisted that we interview two process controllers, representative of the two types, together so that we could see how they complement each other.

Insufficient technical skills are a major challenge on many wastewater plants. Many municipalities are actively improving the skills of their process controllers through accredited courses, the training that DWS (Department of Water and Sanitation) offers, WISA's process controllers' training and Recognition of Prior Learning (RPL) programmes.

An engineer consulting for Kouga LM points out that process controllers also need skills to apply technical knowledge: *This is a self-help system. They must also show initiative.*

The very basic skills with which some of the process controllers start their careers in wastewater is illustrated by the following quote:

> *It is the first time I see a treatment plant, so I don't know of the new technology on the other plant* (Process controller, Kouga, previously a labourer passing tools to the foreman)

Many respondents pointed out lack of knowledge to do proper maintenance:

> *However, when our aerators are not working properly, it becomes a problem because we don't have the knowledge internally. We still need to get a proper maintenance team; however, we need a proper budget and the maintenance plan to go with it.* (Plant manager, Thaba Chweu)

Training and skills development in under-staffed municipalities create a catch 22 situation when management takes process controllers off the plants for training:

> *When the process controllers go for training, they have to leave the plant with limited back-up, when they come back there are gaps because there has not been proper monitoring.*
>
> *But, if we don't receive training, then we get left behind in, for example, how to improve the plant operation; new technology versus old methods.*

2.2.4.6 Specific self-identified knowledge gaps

The table below lists technical knowledge gaps that respondents identified per municipality. **Sludge management, reclamation and recycling, maintenance and energy saving are the main topics.** There does not seem to be any correlation between technical knowledge gaps and performance. The same knowledge gaps are listed across performance categories.

Table 3: Self-identified knowledge gaps of Metros

Metros	**Self-identified knowledge gaps**
City of Cape Town	• Sanitation for the informal sector • Sustainability models for water and sanitation tariff structures • Reuse of effluent and by-products • How to engage with communities • Knowledge gaps at the bottom: *Learning the job takes 2 to 3 years, so introducing new people is a problem as the younger generation wants to escalate very quickly through the ranks*
City of Tshwane	• Preventative maintenance and actions • Technical audit process: what to do if performance of a specific process is not up to the required or specified standard • Sludge handling remains a problem; they rely heavily on research done by the WRC
Ekurhuleni (ERWAT)	• Reclaiming valuable substances from wastewater • Sludge – *we produce large volumes and we do not know what to do with it. It is expensive to get rid of* (microbiology lab manager, ERWAT).
eThekwini	• As the metro has a large number of sanitation facilities, faecal sludge is a major challenge. • They need to be at the forefront of the latest technology; research and development (R&D) is critical.
City of Johannesburg (Johannesburg Water)	• Main risk of the municipality is non-compliance; plants cannot deliver wastewater to the standard that their licences require. • New ways in which to use biogas in WWTWs (wastewater treatment works) • The function of bioreactors to remove nitrates and phosphates
Nelson Mandela Bay	• Different kinds of pump stations, the maintenance that they need, capital outlay, comparison of performance • Stormwater ingress: formal mechanisms to investigate; what has worked in other municipalities.

Table 4: Self-identified knowledge gaps of performing LMs

Performing LMs	**Self-identified knowledge gap**
Beaufort West	Seasonal foam
George	Sludge treatment
Mossel Bay	• Seasonal foam • Cleaning of the sludge dam • Oil, petrol and diesel in the wastewater • Valves in the network system
Tlokwe	Experienced officials who retired left a knowledge gap
Umhlatuze	Abattoir waste and septic sewage. *We don't have systems in place. There's no common documentation storage.*

Table 5: Self-identified knowledge gaps of learning and developing municipalities

Learning and developing municipalities	**Self-identified knowledge gap**
//Khara Hais	Seasonal leaks in the network
Madibeng	Removal of phosphates and nitrates
Mbombela	• Corrosion protection • Dealing with contaminants • Biological processes and how they can be impacted by contaminants • Ferric chloride • Sludge
Metsimaholo	• The recycling of final effluent to reduce the usage of potable water • Maintenance management
Mogalakwena	• They struggle with poor quality groundwater (class 4), they could develop affordable technology to purify this water. • Their filters need to be serviced; they don't have the knowledge or training to do it. • Knowledge about package plants • The town is supplied by boreholes. Their GSM system is not very effective; they have to monitor the reservoir levels manually. The service provider does not want to give them information. They need knowledge about what happens in boreholes with water pressure. • They need information on what they can do with dry sludge (they have drying beds). Nobody wants to buy it. • *For heavy rain periods, preventing water from moving across our borders,* they need catchments to prevent this water from going into these water rich regions. • Ways to give industries like mines and agriculture grey water instead of the clean water.
Rustenburg	• Guidance is needed on how to have an efficient, knowledge sharing relationship between the municipality and WWTW (which is operated by an external contractor). • More information is required on flow measurements, the bacteria in activated sludge and the chemical reactions of sludge. • Risk management: the municipality and WWTW are subject to political unrest due to its close proximity to the townships and the two mines, Anglo Gold and Impala. • It is often difficult for small WWTWs to implement WRC products; guidance is required in this regard.
Sol Plaatje	The management skills and actions to turn dysfunctionality around

Table 6: Self-identified knowledge gaps of weak performers

Weak performers	Self-identified knowledge gap
Bela-Bela	• How to deal with a water crisis • How to manage your supply chain • How to manage the Council so that you get the budget you need
Kouga	*We have many estuaries in Jeffreys Bay. In terms of the new legislation, you need a management plan. But we do not have the knowledge to put out a tender or a ToR for this.* How do you remove iron and manganese from groundwater
Thaba Chweu	• Preventative maintenance • Maintenance guidelines • New products/ Potential solutions to the problems they have • General mechanical skills • Financial know-how: Budgeting and forecasting • General management knowledge • Governance, policies, by-laws, public administration, laws and regulations • Dealing with contaminants like oils, grease and fats • Treatment – how to improve the quality of their end product, most efficient plant configurations etc.
Uthungulu	• *An appropriate technology matrix based on current data. For example, we have ponds that are not optimised. Will they be able to meet standards when optimised or should we start planning for alternative technology?* • *PCs (process controllers) have no knowledge and discipline of documentation. For example, their incident registers are empty*.

2.2.5 Implications for the WRC and its sector partners

1. It would be important for the WRC to take note of the knowledge needs and gaps listed above and communicate them to the relevant water sector partners to address.
2. The WRC could include those knowledge needs and gaps that fall within its own mandate in its list of solicited research proposals.
3. In particular, there is an important need for knowledge sharing between municipal officials across municipalities in the form of a technology database and technical discussion forums. The regional offices of DWS or the newly established CMAs (Catchment Management Agencies) could lead this knowledge sharing. The WRC could support such an initiative with an interactive website tool, which links to the its planned Application.
4. The need for knowledge sharing across municipalities confirmed the value of the WIN-SA best practice Lesson Series. The study found that municipal officials would welcome decentralised opportunities to share and discuss best practice. The WRC should explore this need with its sector partners, DWS and SALGA (South African Local Government Association).

2.3 KNOWLEDGE SOURCES

The study found that officials consult a wide range of knowledge sources, which could be classified as

a. Personal (colleagues, consultants, we work out our own solutions) or
b. Impersonal (internet, other guidelines and documents, WISA documents or events, WRC research reports).

2.3.1 Knowledge sources according to performance

The chart below shows the interaction between performance and knowledge sources for the visited municipalities.[3]

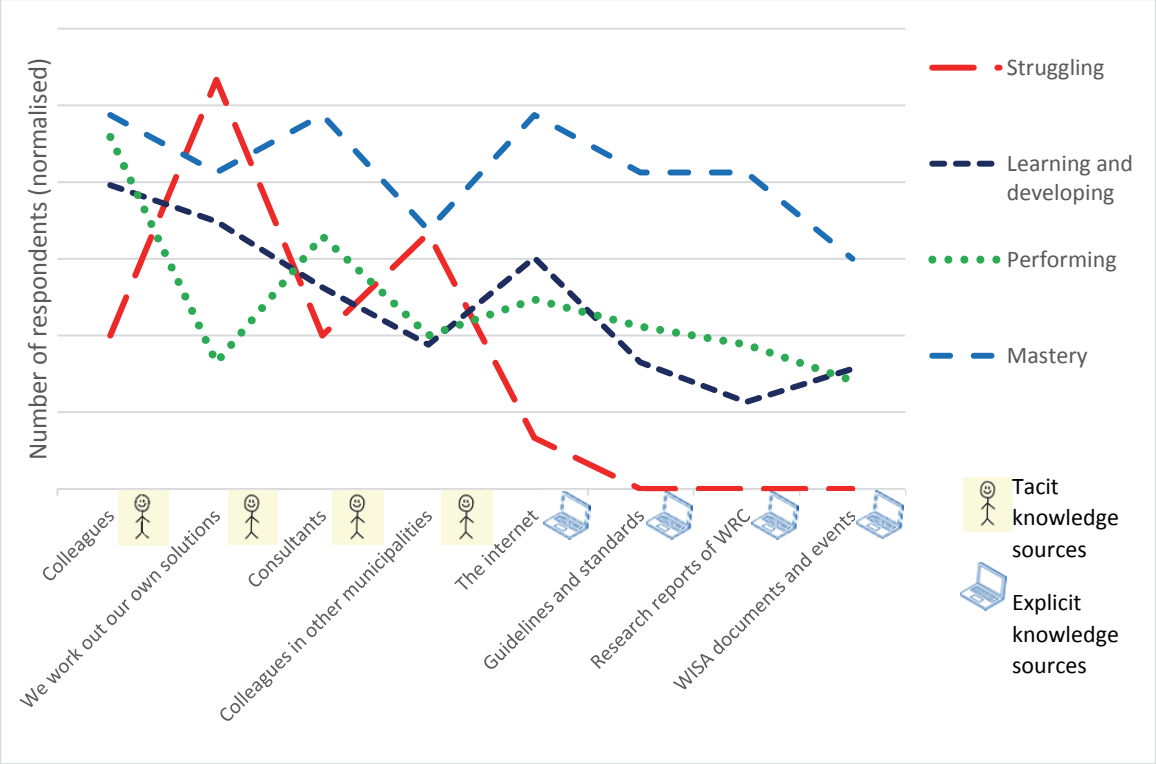

Figure 5: The interaction between municipal performance and the sources of knowledge that officials in wastewater and sanitation use

(Please note that the respondents were not prompted for these sources; they mentioned them spontaneously.)

The chart shows that wastewater and sanitation officials from municipalities in Performing and Mastery categories consult a wide range of knowledge sources, representing both tacit and explicit knowledge.

Colleagues are the main source of knowledge for officials in three of the four performance categories. Officials in struggling municipalities are more likely to consult with colleagues in other municipalities than with colleagues in their own municipality, indicating a lack of confidence in their own colleagues.

[3]The data was normalised because the sample for learning and struggling municipalities was smaller than for developing and performing municipalities.

When financial resources and management support are lacking, officials in these municipalities have to work out their own solutions. For the better performing municipalities, the pattern is reversed.

The better performing municipalities are more likely to use consultants as a source of knowledge, and less likely to rely on their own ability to come up with solutions. All the municipalities that we visited outsource some of their functions to consultants. Consultants are regarded as an essential source of knowledge that might be lacking within the municipality.

The use of explicit knowledge sources such as the internet, guidelines and research reports, is the highest in learning municipalities where officials are trying to broaden their knowledge. In struggling municipalities, the use of these knowledge sources is particularly low, which could signify a lack of a learning culture or limited access to resources, or both.

Implications for the WRC

1. The WRC features relatively low on the list of knowledge sources that municipal officials directly consult, but research-based knowledge is probably also taken up through intermediaries, such as training institutions, consultants and knowledgeable colleagues, and internet searches.
2. The internet is an important source of knowledge for municipal officials. Most officials use Google to search for knowledge; few go directly into a known and trusted website. It is therefore very important that the WRC's website is optimised for Google and that its internal search engine is linked to Google.
3. The high use of DIY solutions in wastewater raises the question: Are these makeshift solutions or do they include useful solutions that could be replicated in other wastewater plants? This could be further explored by the WRC.

2.3.2 Knowledge sources according to position

The study found that knowledge sources differed according to post levels and responsibilities as illustrated by the chart below.

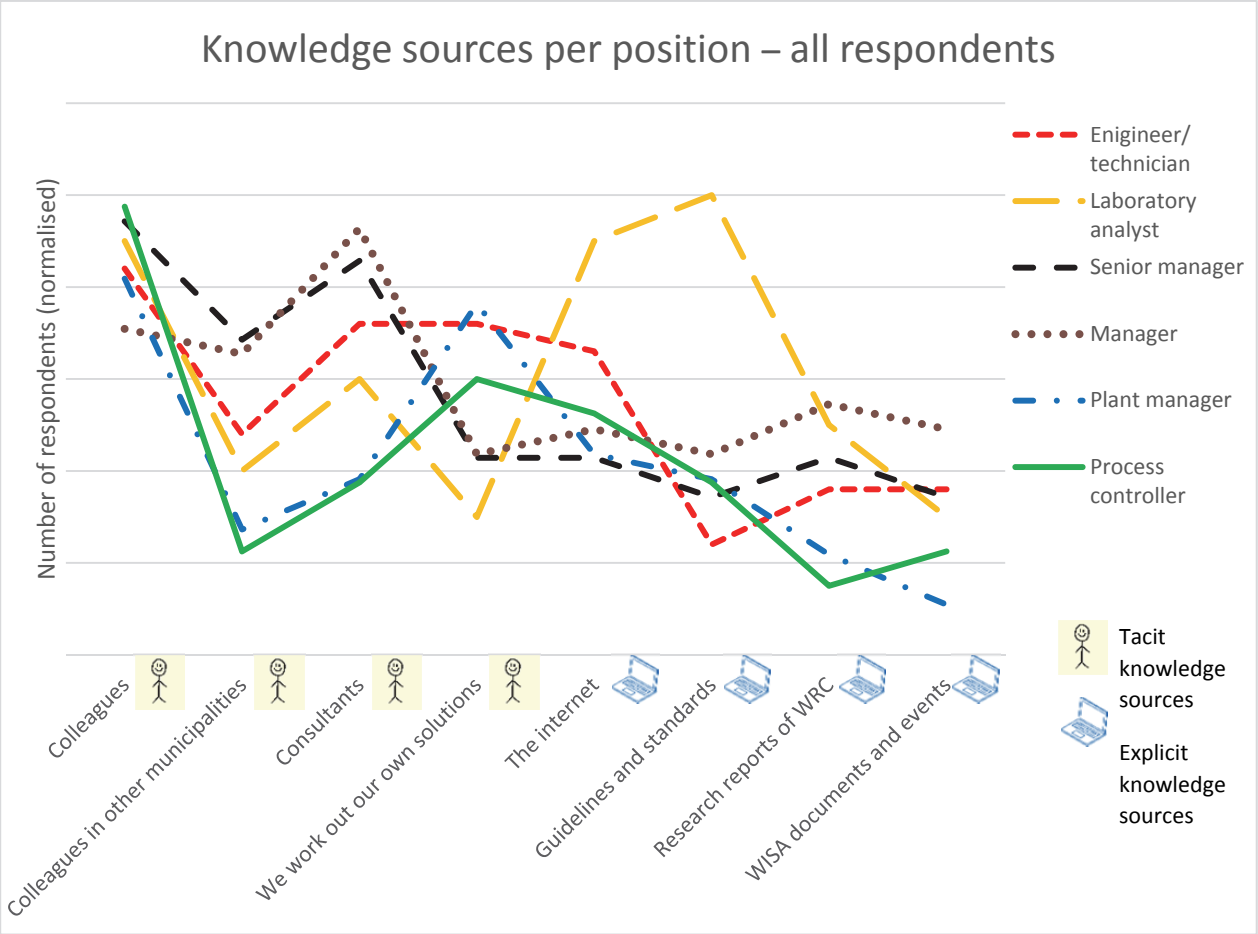

Figure 6: The eight most widely used sources of knowledge per position – all respondents

(Note: respondents could mention more than one source of knowledge.)

Tacit or experiential knowledge is highly valued and respected in the wastewater and sanitation environment. It is therefore not surprising that colleagues are the most widely used source of knowledge.

> *(I ask) everyone that could give me a solution, from process controller to senior management or higher*. (Technician, Uthungulu)
>
> A plant manager from the City of Umhlatuze had this to say about his colleagues: *I find my PCs are the most valuable knowledge source. You should not isolate yourself from the people under you.*

Officials operate on a knowledge trajectory that clusters around knowledgeable and experienced individuals. Personal networks are very important:

You basically work with someone you know, someone that works in the same field as you.

You also meet and network with people at the presentations and courses we go to. You then take telephone numbers of the people in your line of work. When you have a question, you phone them. (Project engineer, Sembcorp/Mbombela)

These knowledgeable individuals could be a colleague (often a former colleague) with many years of experience, a manager, a consultant or even a study leader from university. They often act as mentors to other officials and participate in informal and formal knowledge sharing.

In a knowledge field where tacit knowledge is highly valued, mentorship could be expected to be common. Yet, only two of the municipalities that were visited have structured mentorship programmes.

Most of these knowledgeable individuals are familiar with the WRC and its products. They are often true ambassadors or champions of the WRC. When they retire they leave a major knowledge gap.

Consultants are mostly dealt with at manager level; it could therefore be expected that **managers**, more so than other positions, would regard them as an important source of knowledge.

Relative to the other positions in wastewater and sanitation services, **laboratory analysts** rely the most on impersonal sources, such the internet, DWS guidelines and documents, and the laboratory information management software system (LIMS), for the knowledge that they need. The solutions they need are mostly scientific; hence probably the preference for impersonal knowledge sources.

Plant managers, engineers/technicians and process controllers in especially the LMs and DMs rely strongly on their own knowledge to work out solutions. This also ties in with the high value that

Implications for the WRC

To channel uptake of its products through knowledgeable individuals, the WRC could:

1. Identify these individuals and influence the establishment of a knowledge culture in municipalities through personal contact with them. Use them as a knowledge conduit and make sure they are kept up to date of new research and research opportunities.
2. Involve them in research projects to grow their knowledge and to add value to the municipality's service.
3. Cultivate a new generation of knowledgeable ambassadors/champions through the structures and opportunities of the Young Water Professionals.
4. Establish libraries on wastewater treatment plants through them. Brand these libraries as WRC products. This action will increase awareness of the WRC at plant level.

The WRC could also investigate innovative ways to capture and share the tacit knowledge of these knowledgeable individuals.

experiential knowledge has in wastewater treatment.

2.3.3 Examples

The websites of the World Health Organisation, and the US Environmental Protection Agency were mentioned when the interviewers probed internet use. Respondents also mentioned Canada and

Australia as being on the forefront of wastewater and sanitation management. Websites and documents from these two countries are often used.

Other sources of knowledge that were mentioned were:

- In-house and on-site training
- Suppliers and contractors
- Mentorship and coaching
- Conferences and workshops (WISA, Young Water Professionals (YWP))
- LinkedIn professional water groups
- SABS guidelines
- The City Managers Forum
- MISA reports and
- The Dutch ''Centre of Expertise''.

Below are two individual examples. The research scientist of the microbiology laboratory of ERWAT listed the following knowledge sources:

- Internet – uses Google, not Google Scholar
- Scientific journals (*we use those that are available free of charge*)
- Specific websites: Water Environment Research Foundation (WERF), World Health Organisation (WHO), the US Environmental Protection Agency (EPA), research institutes, universities
- Knowledgeable people (e.g. Fanus Venter, University of Pretoria on E. coli). He is also the respondent's mentor. He was his supervisor for his MSc.)
- Cholera: Martella du Preez of the CSIR (Council for Scientific and Industrial Research)
- Neil Read, Rand Water, on technical aspects of the Polymerase Chain Reaction (PCR).

The research scientist also gave a fascinating overview of how and where the ERWAT laboratory sources information for their research projects.

> *We consult the WRC website and reports, but not for all research projects. For the PCR work, we mainly use scientific journals.*
>
> *European countries, USA and Australia are strong in the water sector and the PCR.*
>
> *I do not know if the WRC has done any work on the PCR. For the EDC (Endocrine Disrupting Chemical) project, we did an intensive literature review, which included the WRC's work on the topic. For the E. coli work – I am sure TG Barnard would have looked at WRC reports. The Vibrio work was a WRC project.*
>
> *There was very little literature available for the tapeworm study. As a result, we were forced to get into contact with local and international experts on the topic. We looked for articles in scientific journals and email the author. For example, there was a woman from Mexico who responded. We also contacted Colleen Archer from the University of Natal.*

A plant manager from the City of Cape Town use these knowledge sources:

- Colleagues: project managers (chemical and civil engineers) provide info on new products
- Colleagues: the plant managers share information and assist each other to solve problems
- Consultants

- Specialists – since he has been in the industry for many years, he has a personal relationship with many specialists, he can simply phone them and ask for advice
- Private companies – arrange exhibitions/launches, info on new products available; also, they send reps to do presentations (but these are referred to the project managers to evaluate new products)
- Internet – he reads extensively on the internet, also going onto WRC website. He has been a member of the Bellville library's reference section for many years; on a Saturday morning he would visit the library to read and download what he needs (municipality does not allow them to download too much.)
- Google – he types in a question, and gets astonishing answers from all over the world; however, you have an obligation to respond and tell people whether the proposed solution worked or not
- Own documents: they create their own set of documents (which incorporates their experiences)
- Own training: they have developed a training program that incorporates theory (amongst other sources, WRC reports are used) and also their own experience.

The interviews confirmed that, for managers, writing specifications for tenders is a research task for which they consult various knowledge sources, including WRC reports. A senior manager from //Khara Hais explains their process:

> *My managers and I would write our specifications. We would communicate with other municipalities and consultants with whom we have good relationships to find best practice in terms of specs. We would also do research on the internet. We also use our own previous tender documents and our experience.*

> ***Implications for the WRC***
> Some of the mechanisms suggested in Chapter 4: Recommendations for the WRC's marketing and research strategies could also be used to link municipal officials for this purpose.

2.3.4 Guidelines and manuals

Guidelines and manuals for standard operating procedures, compliance, risk management, incidence management protocol, operation & maintenance, sludge treatment, asset register, laboratory processes and quality control are important knowledge sources in the day-to-day activities of wastewater plants.

The municipalities use guidelines and manuals from the Department (DWS), the WRC, SABS, consultants, and templates that they get from the internet. **Licensing requirements and the Green Drop criteria are widely mentioned used as guidelines that set a goal and structure activities.** Some officials are worried about the future of the Green Drop because of the delays to release the 2013 report.

Supplier's manuals and guidelines are used for equipment:

> *We use operation and maintenance guidelines as provided by OEM's (Original Equipment Manufacturers). Each contractor is responsible to compile an operation and maintenance manual for the equipment provided. These are then used to operate and maintain the equipment/infrastructure. We request the above info for all new projects so items can be*

maintained, operated effectively and replaced if needed. This includes drawing etc.… and is as per their Guideline book, which was drawn up with the assistance of Tshwane Municipality and various consulting engineers. (Maintenance foreman, Mbombela)

Some operating guidelines hey develop themselves. See the quote below from the summary of the interview with a plant manager from Johannesburg Water.

> *The processes are split into two, one for liquids and the other for sludge.*
>
> *For the handling of liquids, we use "The Joburg Process", a guideline that was developed and written over a period of 30 years by all the officials in the Johannesburg Water and Sanitation Department. For sludge treatment, we use the guidelines that are set by the WRC and the Department of Water and Sanitation (Volumes 1-5).*

In the weaker performing municipalities, guidelines and manuals are typically absent or not properly used.

Implications for the WRC

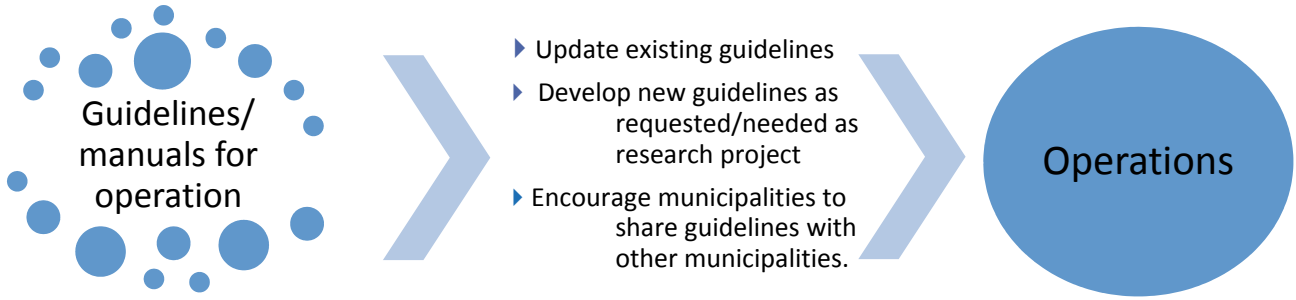

Figure 7: Guidelines and manuals

2.3.5 Consultants

All the municipalities that we visited outsource some of their functions to consultants. Consultants are regarded as an essential source of knowledge that might be lacking within the municipality.

> *Very important; municipalities are no longer the custodians of knowledge, private enterprise is, and consultants also know how to convey the information to municipalities.* (Senior manager, City of Cape Town)

Consultants are the top users of WRC research reports. One could therefore safely say that a significant portion of WRC research-based knowledge is applied in municipalities via consultants.

The perspective of a senior manager in Mogalakwena LM illustrates how he regards the role of consultants:

> *It is an essential service. Engineers with experience can give you options, that you might never have thought of. They also cost options for you – we don't have time for that.*
>
> *They have the system of CPD points, which means they are up to date with new knowledge.*
>
> *Consultants are particularly good for planning and construction.*

The interviews with a senior manager from Tlokwe LM echoed this attitude:

> *Consultants are a very important source of information. I have built up good relationships with a number of consultants.*
>
> *Consultants are appointed up to a 3-year period; 20 consultants are currently appointed.*

When asked how does one ensure knowledge transfer, officials gave different answers:

> *Consultants are not always willing to share their knowledge with other consultants. We had a good knowledge transfer experience with Bigen Africa. They did our GIS system. They trained the officials on the system.* (It was a DBSA initiative, co-funded by the municipality). *We take the reports and Bigen submitted the as-builts electronically as part of the GIS.* (Manager, Mogalakwena)
>
> *Many municipal officials are in a comfort zone in terms of consultants. They pick up a phone and request the consultant to take care of the issue.*
>
> *For me, it is important to have knowledge transfer. To ensure this, I would:*
>
> - *Be involved in the design phase. The consultant must explain to us what they want to do. We will give input from an operational point of view. For example, we do not want our sewer manholes to be further apart than 80 metre, because we experience operational problems if they are further apart.*
> - *Attend site meetings. Many officials would leave the consultant and the contractor to handle the site meetings. I would not insist to attend technical meetings.*
> - *Visit the project sites, preferable combined with the site meeting.*
> - *Ensure that we get the as-built-drawings, the final hand over report and the operational manual.* (Senior manager, //Khara Hais)

An engineer from the City of Cape Town follows this strategy to ensure knowledge transfer:

> *Where we don't have necessary skills, we outsource the job to get the specialised skills. The engineer pulls his team as well as the outsourced skills and they handle it as a project. There is a project manager (internal) and the vendors then work with the team and the team adds their skills to the project.*

Consultants are also used to give advice on new products, as the example from Tlokwe illustrates. The flow of information is typically as follows:

- A rep from a company introduces a new product/material/process, etc.
- The municipal official contacts a consultant to obtain an opinion.
- If he and the consultant think it might be worthwhile to explore, he gives the supplier the opportunity to pilot the product for 12 months.

It was interesting to see from the data that consulting companies that have given training to municipalities, for example Aurecon, are specifically mentioned as sources of knowledge.

Not all municipalities regard consultants as a positive knowledge source. The weaker municipalities tend to feel that consultants bypass them, or that senior management appoints consultants because they have no confidence in their own employees:

> *Yes, we rely on consultants a lot. Mostly they do things that I feel should be done by us to grow and work without consultants. I feel we are pushed to rely on consultants. We are not involved in a number of things. You go to a plant and find a consultant, changing things in your plant and you were not spoken to about it. I feel that management believes in consultants more than their staff.* (Process technician, Uthungulu)

Implications for the WRC

1. Regard consultants as a partner in improving research uptake in the municipal space.
2. Develop a database of consultants who are active in municipal wastewater and sanitation, and engage them to confirm what the research needs in municipalities are and how existing research could be packaged to enhance use.

2.3.6 Suppliers

A substantial number of respondents said that the sales representatives of suppliers give them information on new trends in technology and new products. The post-sales support that suppliers offer represents another knowledge flow into the municipality.

The laboratory analyst of Tlokwe said that they download brochures and other useful information from the laboratory companies' websites.

2.3.7 International sources

It is mainly the Metros that have exposure to international institutions as knowledge sources. The interaction with international institutions provides a valuable knowledge flow for these municipalities, which enhances personal knowledge and, ultimately, wastewater and sanitation services.

Below are a few examples:

Through the stature and leadership of Neil Macleod, eThekwini got representation in many international committees and other structures of the World Bank, the World Health Organisation, the GWOPA, etc. Through these organisations and with their funding, the municipality became involved in development projects in countries such as Malawi, Zimbabwe, Brazil and Korea.

eThekwini sends their young engineers overseas to get exposure to new technologies and ideas. Cape Town sent employees to Germany to study membrane technology; they are expected to come back and transfer knowledge to the rest of the team.

Implications for the WRC

The WRC already has relationships and agreements with international water and donor organisations. Projects that involve small, well-performing municipalities could go a long way to increase awareness of the WRC and demonstrate the value of research-based knowledge in the participating municipalities.

2.4 KNOWLEDGE SHARING

This section discusses knowledge sharing at an individual level. However, it also touches on knowledge sharing between municipalities.

2.4.1 Within teams

Knowledge sharing presupposes that the individual must think that there is valuable knowledge to be shared and that sharing knowledge will improve processes and outputs. Knowledge sharing is therefore indicative of a knowledge culture and the way that a municipality engages with knowledge. It is also a function of leadership.

Structured knowledge sharing programmes were only found in the better performing municipalities. Below is the example from Johannesburg Water:

> Johannesburg Water has a ''Best Practice Manager''. She is responsible for compliance and also meets with all manufacturers or suppliers who want to promote new products or technology. She sends the staff regular updates on their performance, as well as any relevant information that might assist them to improve performance; if she finds out about equipment that might be relevant, she refers it to them.
>
> Once a month, the Best Practice Manager meet with the plant managers and maintenance teams; once every three months they meet with the full teams. In these meetings, knowledge is shared. She takes them through the statistics of the results, trends and implications for operations. The plant managers would take the information from these meetings and then put up the results for their staff and discuss it with them as a training session.
>
> The plant managers meet with their Process Managers at least once a month and will often arrange specific meetings for specific reasons. They have monthly performance plans for effluent management as well as for drying and composting of sludge and feedback is given to the operators on a monthly and six-monthly basis. Here the Best Practice Manager plays an important role. (interview summary, Johannesburg Water)

The three examples below illustrate how knowledge sharing can differ, even between Metros.

The first example is from Nelson Mandela Bay. The laboratory manager's response to a question about knowledge sharing in her team was as follows:

> *Analysts are very protective of their equipment. They are not good with sharing.*

The response from the eThekwini laboratory manager was completely different:

> *We encourage monthly toolbox talks, if you have a new method, share it with everyone. We also insist on record keeping i.e. attendance register. Topics discussed are safety and method based. Also MSDS (materials data safety sheet – based on health and safety methods especially for dangerous goods) enforces ongoing training. It also breaks complacency. We rotate them around on different methods.*
>
> *We have different qualifications as microbiologist and chemists. We share knowledge and advise each other on the different disciplines.*

In the Cape Town laboratory, the staff have weekly science meetings where they discuss not only water, but any findings that are interesting from a scientific perspective.

2.4.2 Between departments

Several officials referred to a lack of knowledge sharing between departments in their municipality as disempowering. For example, a sanitation operations manager from eThekwini mentioned a lack of coordination with other departments such as housing and roads, and water and sanitation. And a manager from the City of Umhlatuze called departments working in silos their biggest challenge: *"There's hardly any knowledge sharing".*

2.4.3 Between municipalities

The study found knowledge sharing between municipalities to be ad hoc and mostly on an individual level.

> *We have no idea what other municipalities are doing.* (Engineer, City of Cape Town)

> *We do not really know what is happening outside the province, except if you should attend WISA or IMESA conferences.* (Senior manager, //Khara Hais)

A manager from Uthungulu DM speculated that there is a reluctance to share knowledge with other municipalities.

> *People do not want to speak about their failures. You never know when you end up on Carte Blanche.*

There are exceptions, both on an individual level and between municipalities:

Knowledge about the Terms of Reference for tenders are often exchanged between municipalities. So is information on new legislation and regulations.

Thaba Chweu has been on a learning journey to Steve Tshwete, which included learning about their Blue and Green Drop programme, maintenance and process controller training.

In the Southern Cape, municipal officials would contact knowledgeable individuals in the area, such as Neels Windt, Geoffrey Bredenkamp and Chris Swartz, for assistance.

Sol Plaatje visited Drakenstein and Malmesbury.

> *We realised their productivity is four times higher; also their attitude is pro-active.*

The respondents regard contact with other municipalities, sharing knowledge, but also challenges and experiences with equipment, materials and processes as a major knowledge need. This need is also captured in the recommendations that respondents have made.

eThekwini's MILE (Municipal Institute of Learning) project is a very successful response to this need.

2.4.4 Mentorship

In a knowledge field where tacit knowledge is highly valued, mentorship at an individual level is common.

A few of the municipalities that were visited have structured mentorship programmes.

The mentorship programme of Johannesburg Water was discussed previously. Also in Johannesburg Water, a plant manager would put apprentices with artisans in a team:

> *The best opportunity for knowledge transfer is to place a new person (apprentice) with an artisan for a couple of months, where they learn the practical aspects hands-on.*

Cape Town does not have an institutional mentorship programme, but individual managers have developed their own mentorship programmes.

> No formal mentorship programme – so he has drafted his own mentorship programme for three years to ensure the internal transfer of skills. He has also devised his own formalised training program. (Interview summary, engineer, City of Cape Town)

> She is busy designing a mentorship programme for level 5s. She herself was mentored years ago – had a formalised programme through Peter Flower. Currently they don't have anything like that, that's why she is trying to re-initiate it. According to her, *"if there is no mentorship, people don't understand the vision, or how things are done. Building trust is easier through mentorship programs."* (Interview summary, Cape Town laboratory manager)

2.4.5 Students

Many municipalities, especially those close to tertiary institutions, have student programmes and internships. In these programmes, knowledge sharing is reciprocal. The students bring research-based knowledge into the municipality, whereas they are given the opportunity to absorb tacit knowledge.

To give an example:

> *The Cape Town laboratory has 21 students in the graduate programme. They are all doing a Masters or a PhD. There is a mentorship programme as well. Some students stay on the programme for 18 months to 3 years.*
>
> How are subject fields selected? *More than 125 topics have been researched. The municipality has established the MoUs (Memorandum of Understanding) through the University of Stellenbosch. Some topics focus on the improvement of technology; others focus on problem areas, for example too much algae in water or the influence of phosphorous in the water…* (Laboratory manager, City of Cape Town)

Implications for the WRC and its sector partners

The findings re-emphasised the need for mechanisms to share best practice in structured knowledge sharing**. On the other hand, it also emphasises the need of officials to share failures and operational problems in a safe and non-regulatory environment**. Possible mechanisms could include WhatsApp groups, email groups and best practice sharing workshops.

2.5 KNOWLEDGE USE

The literature review refers to the finding of Landry, Nabil and Moktar (2001)[4] that the use of research-based knowledge depends on the users' context and the effectiveness of the mechanisms that link the users to the research organisation, the researchers and the knowledge itself. These two conditions were explored in this study.

2.5.1 Context

The study found that the two main enabling factors for the way that the officials in a wastewater and sanitation department engage with knowledge are:

- A political structure that recognises the value of water, and creates an enabling environment for the water and sanitation department to deliver a high standard of service; and
- Competent and visionary leadership in the wastewater and sanitation department.

In municipalities with a supportive political structure, the wastewater and sanitation department gets sufficient budget and support from Council and top management. (The WIN-SA Green Drop and Blue Drop Lesson Series also found that performing municipalities, and even municipalities that are consistently improving, have support from Council and top management.)

The situation in the City of Umhlathuze LM, where there is lack of support from the LM to Mhlatuze Water, who is the WSP, illustrated again the importance of political support for long term planning and budgets. Municipalities that fail to get this support, struggle to comply and are falling further and further behind because they are unable to do preventative maintenance and proper asset management.

Wastewater and sanitation departments with competent and visionary leadership are characterized by:

- ✓ Good management practices.
- ✓ Long term plans for maintenance, the upgrading of infrastructure and skills development and training.
- ✓ Sufficient well-qualified employees. The number of well qualified employees in the wastewater and sanitation departments depends on the support from Council and the quality of management practices. In eThekwini, for example, there are sufficient resources to appoint brilliant young engineers who can spearhead innovation; in the City of Tshwane on the other hand, positions have been frozen because of insufficient resources and it is a struggle to have sufficient qualified technical people.
- ✓ Benchmarking standards: The municipality has developed its own internal standards (with or without the help of consultants) or it is using external standards such as Green Drop, ISO, SANS and DWS guidelines.

Where competent and visionary leadership is lacking, it leads to:

- × Poor management practices.
- × Lack of long term plans: reactive maintenance, old infrastructure.

[4] Landry, R., Nabil , A., & Moktar, L. (2001). Utilization of social science research knowledge in Canada. *Research Policy, 30*(2), 333-349. Retrieved July 15, 2015, from http://www.sciencedirect.com/science/article/pii/S0048733300000810

- Lack of qualified employees and unmotivated employees; no skills development plan.
- Inadequate development and implementation of benchmarking standards such as an Incident Management Protocol or a W_2RAP (Wastewater Risk Abatement Plan).

Visionary leadership and the impact that it has on the way that a municipality engages with knowledge was particularly evident in eThekwini and Ekurhuleni (ERWAT). These two organisations have a distinct knowledge culture and research and development have become institutionalised.

In the absence of a knowledge culture, the study encountered, even in performing municipalities, officials who do not recognise the value that research-based knowledge could have for them or how it could be practically applied in their day-to-day operations. Yet, these same officials might be well-qualified and working hard to keep their plants running and compliant.

2.5.2 Mechanisms linking the users to researchers and research-based knowledge

The effectiveness of the mechanisms that link municipal wastewater and sanitation officials directly to the WRC will be discussed in the next chapter. Officials are also linked to researchers and research-based knowledge through consultants and institutional structures and activities such as tertiary institutions, District Municipality forums, Departmental (DWS) activities, training organisations and WISA (and other) conferences and workshops.

2.5.2.1 Tertiary institutions

All the large Metros have some partnership relationship with one or more of the tertiary institutions in the province.

The relationship manifests in many forms:

- Student research projects have been discussed above. The close relationship that Metros have with the local universities allows postgraduate students access to plants and processes. In turn, the municipality gives input in the research methodology so that the results are also available and of benefit to them.
- eThekwini has an MoU with all the universities in the KwaZulu-Natal. This allows the municipality to have different sub-agreements. It does not tie them down to working with one university. It also helps the smaller universities to develop their research capacity. eThekwini also has an MoU with Unisa and the HSRC.

  Our principal scientists work with the University of KZN. Xolani is working with the university to do analysis for the university and this gives us the opportunity to work on their academic projects.
- ERWAT sponsors a chair at University of Stellenbosch and runs several research projects with universities in Gauteng.

Some smaller, well-performing municipalities also have partnership relationships with tertiary institutions:

Tlokwe, for example, has a close working relationship with the University of North West. Many Masters and PhD students (chemistry, engineering, biochemistry, etc.) do their research on the plant; "*there is a culture of knowledge sharing*".

Sembcorp/Silulumanzi collaborates on a river monitoring project with Rhodes University. *We would compare the manganese levels of the raw water that is drawn from the rivers with the manganese levels of our effluent.*

2.5.2.2 District municipalities (DM)

Only two examples were mentioned in the interviews of a knowledge relationship between LMs and their DM.

- Bela-Bela mentioned a district forum on which they are active and which they find useful; however, Mogalakwena LM never participates in the same forum and does not seem to find it useful.
- Thaba Chweu gets support from the DM – they have a team of engineers that has assisted the LM.

2.5.2.3 Regional office of the Department (DWS)

Examples of knowledge interactions with the Department's regional office were scarce:

> *Our District Forum fell flat and was replaced by the IGR Forum, which follows a more positive and supportive approach. The IGR is chaired by DWS. It is an informal discussion forum where people give constructive feedback. The forum is generally well attended.*
>
> *At these forums, municipal officials share report templates and presentations.*
>
> *The approach of the DWS officials sets the tone for the forum. We have a good relationship with the DWS people in the province and we find them supportive. (Senior manager, //Khara Hais)*

Officials from Sol Plaatje confirmed that they get good support from the DWS office in Kimberley.

The manager of water and sanitation of Mogalakwena said that he would contact the regional office for support, and that they are helpful, but *"they focus too much on their regulatory role and does not support enough"*.

A unique example comes from Uthungulu DM. The DM is under administration. As a result, they get more than the usual attention from DWS. The process manager has turned this attention into a knowledge source:

- He has regular consultations with DWS officials and see it as an opportunity to align yourself with stricter standards. They advise him, and give suggestions.
- He has invited them over to meet the supervisors.
- DWS requests weekly and monthly reports. For him, it is an opportunity to get the municipality's documentation in order.
- For his spreadsheets, the process manager uses examples from previous companies that he worked for. He runs them past the DWS official in Durban to check if they are comprehensive enough to meet even future DWS requests for information.
- *We don't have to wait for DWS to ask us for information. I tap into their information/knowledge regularly. I call them, I find out, I go there to talk to them. They use these big words that you don't understand.*
- DWS is willing to assist. *For example, we had to submit a corrective action plan and they came back and said our target dates are unrealistic.*
- *I use DWS requirements as a motivation for budget and equipment*.

2.5.2.4 WISA conference and activities

WISA conferences and activities are a vital mechanism linking municipal officials to researchers and the WRC's research products. Many officials said that they heard of the WRC or came into contact with a researcher and the WRC's research at a WISA conference. WRC-funded and -initiated research featured in a large percentage of presentations and other activities at the WISA Biennial conference in May 2016. However, the reference to the WRC was often low key, missing the opportunity to strengthen awareness of the organisation.

Unfortunately, many officials from LMs and DMs said that their municipalities can no longer afford

> ***Implications for the WRC and its sector partners***
> ***Although direct actions might fall outside its mandate, the WRC must have a strategy to create an enabling context for knowledge uptake. It could, for example:***
> 1. Influence the political space of municipalities by entering into a MoA with at least the Metros and B1 municipalities;
> 2. Leverage the WRC's partnership with SALGA to include water management as part of the Councillor Induction Training Programme;
> 3. Leverage the WRC's partnership with DWS to include knowledge culture into MuSSA assessments and to establish effective mechanisms that link officials to research-based knowledge;
> 4. Facilitate agreements between tertiary institutions and municipalities.
>
> Although the WRC is not a training organisation, it could strengthen its relevance and visibility in skills development by adapting relevant research reports as training material and making them available to training institutions.
>
> **These actions will increase awareness of the WRC in the municipal environment.**

to send them to the WISA conferences.

An alternative will have to be found if WISA conferences are no longer accessible for municipal officials of LMs and DMs. In the meantime:

Increase visibility of the WRC at WISA conferences

- The WRC could:
  - Explore co-branding;
  - Negotiate a much more prominent position at the entrance of the exhibition hall;
  - Make the relevant research reports and related material available at the venues where they are discussed. This was successfully done in some sessions.

Figure 7: Increase visibility

2.5.3 Success stories

One of the aims of the study was to find success stories; case studies where municipalities have used research-based knowledge, preferably knowledge that was developed and made available by the WRC.

Apart from the long-standing and successful relationship that eThekwini has had with the WRC, success stories in the other municipalities were not clear-cut or easy to find. For example, the successful use of research-based knowledge could not always be directly related to the WRC. Or, a long standing relationship with the WRC and its products did not always lead to a clear-cut case of successful application. Some ''success story'' projects are completed; some are in a planning stage and have not yet been successfully completed.

The table below captures some of these "success stories''.

Table 7: Success stories- Metros

Metros	**Success stories**
City of Cape Town	• The WRC sludge treatment reports have been used successfully – very useful according to the officials • The microbiology lab uses WRC reports extensively (water quality reports are very good)
Ekurhuleni (ERWAT)	• The PCR research work • A full time R&D manager to drive innovation in wastewater and sanitation • A culture of innovation and learning
eThekwini	• A culture of innovation and learning • A long standing agreement/relationship with the WRC • MoUs with tertiary institutions in the province • MILE • International agreements and sponsorships • Knowledge transfer to communities • Appointment of young engineers to spearhead innovation • Successful transfer of knowledge in a leadership hand over
Johannesburg Water	• The Shaun Deacon mentoring programme • Innovative transfer of knowledge
Nelson Mandela Bay	• Sewer maintenance (their master sewer plan) – innovative use of customer data to plan for sewer maintenance. • Wastewater and sanitation awareness campaign – knowledge transfer to the community
City of Tshwane	• A WRC-funded project on external nitrification in collaboration with UCT. The pilot project was such a success that the municipality adopted external nitrification and they are still using it.

Table 8: Success stories- LMs and DMs

LMs and DMs	Success stories
//Khara Hais	Involvement in a GIZ research project
Beaufort West	The WRC reports are used for the utilisation and disposal of wastewater sludge and to extend the laboratory.
George	George has used WRC information to improve their water treatment processes and to improve their Green Drop scores. They have also used the WRC reports to develop their W_2RAP.
Madibeng	The technologist: Water and Wastewater Treatment told the interviewer how a WRC document "*made me a star*". They had a problem where their reactor was 'confused', ammonia levels would not go down; he helped to solve this problem. *I still have the booklet, I take it everywhere, and it is my life. It is the one on nitrification in wastewater treatment, the complexity of the process, process combinations etc.*
Mbombela	They have many issues with stormwater ingress. As a result, they have pioneered the SWIM System – Stormwater Ingress Management. Their response was to install flow meters which measure the velocity and flow rate in the system as well as online rain meters. Peaks can double with stormwater ingress. It's essentially a data gathering system which sends data to a web server which translates data into usable info: graphs etc. Used to monitor, but also to design and optimize the system.
Mogalakwena	Exchange of resources: Lonmin Mine funded an upgrading of the Mokopane wastewater treatment plant. In exchange, effluent is pumped to the mine.
Mossel Bay	Neels Windt is a true champion for the WRC.
Rustenburg	The plant manager uses the NATSURV reports (that he got from the WRC in 1992) as a guideline to write reports on the industries' discharging industrial effluent into the municipal sewer system.
Tlokwe	*We do co-digestion. We take sludge from the plant and combine it with other waste, such as grass and pig slurry, and then we produce biogas from that. We have identified certain waste streams (e.g. greens on landfill site) in town that we can combine with sludge and we are experimenting with that.* They also plan to experiment with faecal sludge from rural areas to determine if it would be feasible for the municipality to empty pit latrines for biogas production. The Bill and Melinda Gates Foundation funds the study. SALGA investigated the feasibility for biogas production and identified Tlokwe as the most suitable candidate. There is a chance that SALGA would fund the production. At this stage, the research is at experimental stage. If the biogas starts running, waste from the biogas unit will be combined with dried sludge and sold as fertiliser.

2.6 MUNICIPALITIES AND THE WRC

In the last part of the interviews, respondents were asked about their awareness, perceptions and uptake of the WRC and its research products.

2.6.1 General perceptions

The WRC is well-respected among municipal officials who are familiar with the organisation.

> *Their reports are referenced properly. Well researched. Their water management reports have taught us a lot*. (Head: Operations, Cape Town)

The researchers were impressed by some young, energetic and knowledgeable managers who are keen to know more about the WRC and to participate in WRC projects.

Unfortunately, there are also a number of misconceptions about the WRC, and perceptions that the WRC has an academic role, which falls outside their day-to-day business:

> *They audit water, make regulations; it is an institute of scientists.* (Plant manager, Sol Plaatje)
>
> *I know they do research but as to what extent and to whom they give the information, I don't know. I thought they were just academics.* (Divisional Head: Water and Sanitation, Mogalakwena)
>
> *'I don't think I would want to use them, but they have their place in the academic world. We are caught up in day-to-day business; there is a need for an organisation that can stand back and look at the bigger picture.* (Acting Executive Manager, Tshwane)
>
> *The WRC does not feature in this municipality. We are worrying about basic needs. We see them as relevant for high level planning and not for operations.* (Scientific Services Manager, City of Umhlatuze*)*
>
> He regards the WRC to be too academic, providing information that is purely technical; at his level he requires information that he can use for strategic planning (interview summary): *There is a disconnect between academics and the operational guys.*
>
> *To do research about technology in isolation does not add value, you have to determine the impact of the technology on the process, including the social situation.* (Manager: Sanitation and reticulation, City of Cape Town)

2.6.2 Awareness of the WRC

Unfortunately, awareness of the WRC and its research products is particularly low in LMs and DMs. **53% of the respondents from the LMs and DMs were not familiar with the WRC or its research reports**. **Without awareness there can be no uptake.**

Respondents learnt of the WRC through their studies, a mentor, colleagues or a former manager, or a presentation at a WISA conference. Not one respondent said that they heard about the WRC through direct marketing from the organisation.

In most cases, awareness of the WRC, and even use, is championed by individuals. Only in eThekwini and in Ekurhuleni (ERWAT), the institution and its particular knowledge culture drive the awareness and use of WRC research-based knowledge.

These individuals regularly browse through the WRC's website or read the Water Wheel to keep abreast of new research:

> *I am actually one of those people with a Water Wheel magazine. I always look at what the WRC has done studies in. So if there is any pertinent stuff relevant to us, we look at actually obtaining the item.* (Manager: Wastewater conveyance, Nelson Mandela Bay}

> *I know about the reports. I sometimes download some of them. I have my user login, password, everything. If you are in the industry, people won't tell you to read this or this, but you have to keep abreast of it.* (Head of Operations, City of Cape Town)

2.6.3 Uptake of WRC research products

50% of the respondents said that they were familiar with the WRC and have used one or more reports in their work. The results are probably skewed towards awareness and use for three reasons:

1. The purpose of the research was explained in a formal letter to the participating municipalities. In some municipalities, this letter, which contained information on the WRC was circulated to participants; in other, the participants were simply summoned to come and talk to the interviewers.
2. It became evident in the course of the research that the municipalities arranged for their best employees to talk to the interviewers. Awareness and use among the respondents were therefore probably higher than for the average wastewater and sanitation official.
3. Many of the respondents who said they have used a WRC report could not give its name. It is likely that they over-reported use.

The chart below shows that officials' awareness and uptake of the WRC's research-based knowledge are related to the performance of the municipality as indicated on the performance journey map.

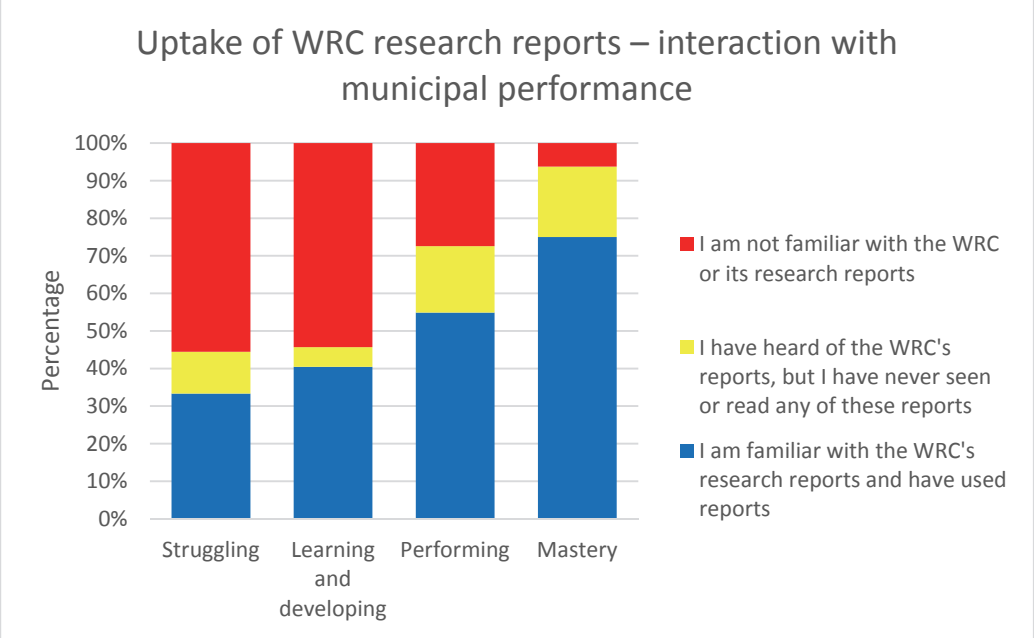

Figure 8: Interaction between municipal performance and awareness and uptake of WRC research-based knowledge

The relationship is not as simple as the chart suggests. However, one could say that, as wastewater and sanitation officials begin to better understand their own gaps and the knowledge that they need to improve, they access a wider range of knowledge sources. This takes them on an upward trajectory on the performance journey. **The WRC's knowledge products are integral to this upward trajectory.**

The research found that different levels of municipal officials differ in their self-reported use of WRC research. Laboratory analysts are the most likely to have used WRC reports; process controllers are the least likely to have used the reports.

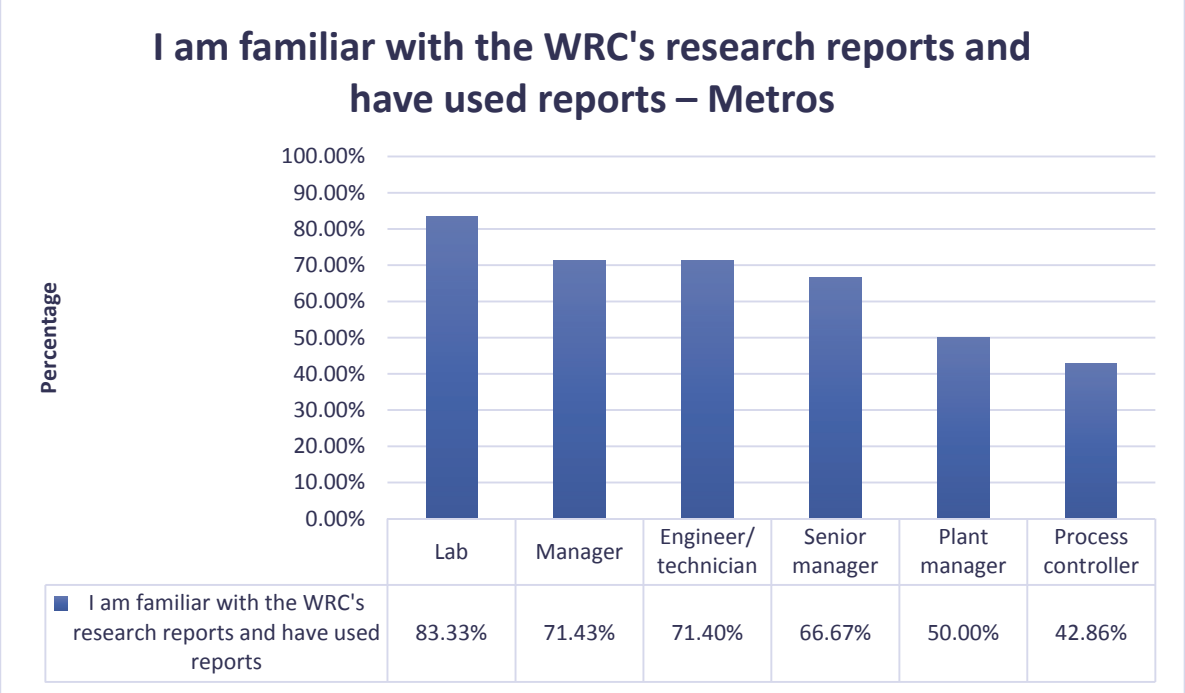

Figure 9: Use of WRC reports across different positions – Metros

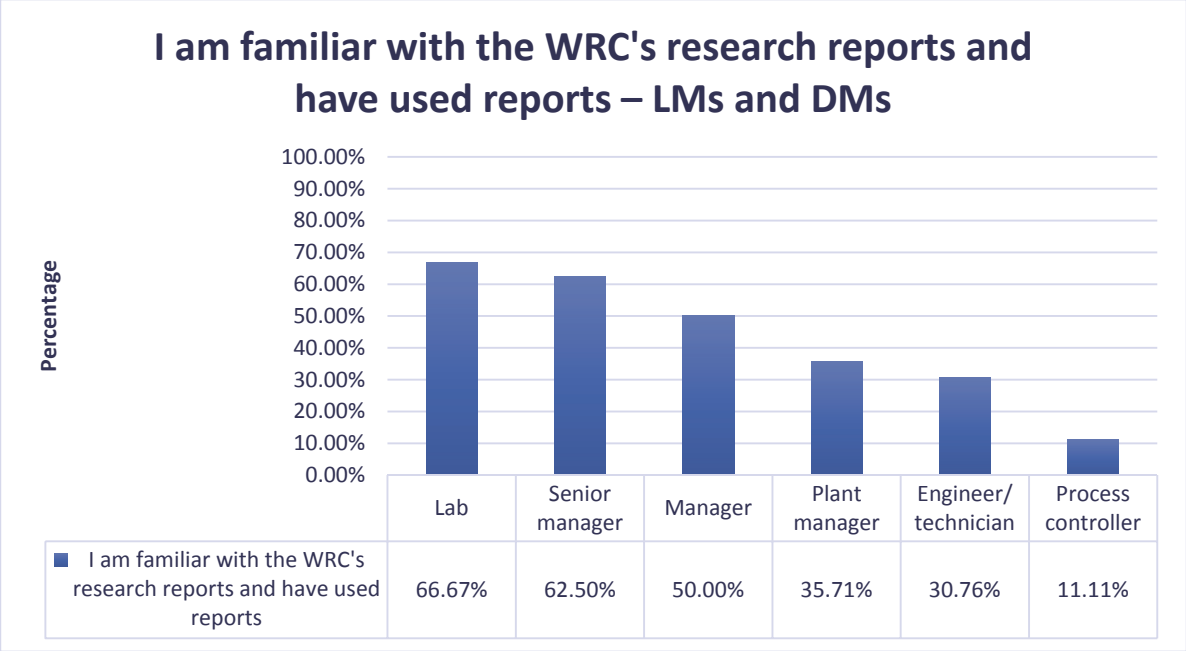

Figure 10: Use of WRC reports across different positions – LMs and DMs

Uptake in wastewater and sanitation is limited to a handful of research reports that are used over and over again. The sludge guidelines are the most widely used. Most of these reports offer operational guidelines; others offer practical support for regulated activities, for example how to develop a W_2RAP.

Research reports most commonly used are the following:

Table 9: Research reports most widely used by officials in wastewater and sanitation departments

Operation manual for biological nutrient removal at wastewater treatment works	Authors: Lilley ID; Pybus PJ; Power SPB; 1997/02/01; Research Report No.TT 83/97
Anaerobic digestion of wastewater sludge: Operating guide	Authors: Ross WR; Novella PH; Pitt AJ; 1992/08/01; Research Report No.TT 55/92
Evaluation and optimisation of dual digestion of sewage sludge (Executive summary)	Authors: de Villiers HA; Messenger JR; Kenmuir K; Laubscher SJA; Ekama GA; 1992/01/07; Research Report No.189/1/92
Evaluation and optimisation of dual digestion of sewage sludge Part 1: Overall system performance	Authors: de Villiers HA; Messenger JR; Kenmuir K; Laubscher SJA; Ekama GA; 1992/01/07; Research Report No.189/2/92
Evaluation and optimisation of dual digestion of sewage sludge Part 2: Aerobic reactor performance	Authors: de Villiers HA; Messenger JR; Kenmuir K; Laubscher SJA; Ekama GA; 1992/01/07; Research Report No.189/3/92
Evaluation and optimisation of dual digestion of sewage sludge Part 3: Evaluation of the technology for practical implementation	Authors: de Villiers HA; Messenger JR; Kenmuir K; Laubscher SJA; Ekama GA; 1992/01/07; Research Report No.189/4/92
Guidelines for the utilisation and disposal of wastewater sludge Volume 3 of 5: Requirements for the on-site and off-site disposal of sludge	Authors: Herselman JE; Snyman HG; 2009/06/01; Research Report No.TT 349/09
Guidelines for the utilisation and disposal of wastewater sludge Volume 4 of 5: Requirements for the beneficial use of sludge at high loading rates	Authors: Herselman JE; Moodley P; 2009/06/01; Research Report No.TT 350/09
Guidelines for the utilisation and disposal of wastewater sludge Volume 5 of 5: Requirements for thermal sludge management practices and for commercial products containing sludge	Authors: Herselman JE; Burger LW; Moodley P; 2009/06/01; Research Report No.TT 351/09
Guidelines for the utilisation and disposal of wastewater sludge Volumes 1-5: Impact assessment	2008/11/01; Research Report No.TT 370/08
Guidelines for the utilisation and disposal of wastewater sludge. Volume 1 of 5: Selection of management options	Authors: Snyman HG; Herselman JE; 2006/03/01; Research Report No.TT 261/06

Guidelines on using the web-enabled and supportive spreadsheet-based wastewater Risk Abatement Planning (W_2RAP) tools	Authors: De Souza P; Jack U; Van der Merwe M; 2015/01/01; Research Report No.TT 624/14
Wastewater Risk Abatement Plan (W_2RAP) template	Authors: De Souza P; Jack U; Van der Merwe M; 2015/01/01; Research Report No.TT 624/14
Wastewater risk abatement plan: A W_2RAP guideline	Authors: Van der Merwe-Botha M; Manus L; 2011/06/01; Research Report No.TT 489/11
The NATSURV reports	

In comparison with the above, the figure below shows the broad topic distribution of the 277 reports that are available on the WRC's website on aspects of wastewater and sanitation (up to 2015).

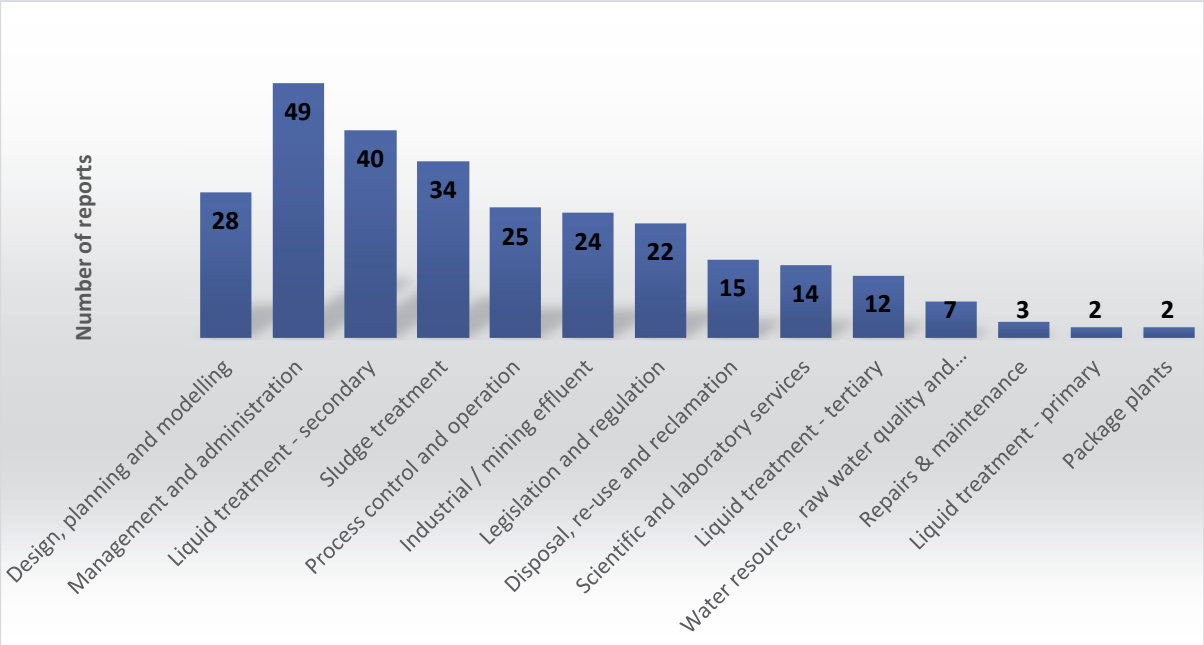

Figure 11: Distribution of WRC reports on topics in wastewater and sanitation

A list of recommendations for the WRC on how to increase uptake emerged from the conversations with the officials. These include recommendations on how to engage with municipalities, how to improve your service and suggestions for new research topics and products that would meet their specific needs. The recommendations that are relevant for the WRC's marketing and research strategies have been integrated into the last chapter. The full recommendations appear in Appendix A.

2.6.4 Understanding the value of research

There is a vast gap in understanding the value of research between Metros such as eThekwini and Ekurhuleni (ERWAT), where research and development have become institutionalised, and even well-performing municipalities.

Several officials, even in performing municipalities, do not recognise the value of research-based knowledge; they believe themselves to be ''too busy for research'' or that they have nothing to gain from the WRC products, that they are not of practical value to them.

The opportunities to become involved in research and in the creation of research-based knowledge are there, but officials in smaller municipalities tend to fail to recognise these opportunities and the additional spinoffs that it could have for them as the example below illustrates:

> *The German development organisation, GIZ, wanted to do a study on biomass to energy in municipalities. Initially, they contacted our electromechanical department without any success; the same happened with the solid waste department. Eventually, they got to us*. The senior manager identified the project as an opportunity and encouraged one of his technical managers to participate. The manager provided GIZ with the data they required. They sent the report, and invited the municipality to a presentation in Johannesburg. *We got an opportunity to interact with four other participating municipalities and we visited a successful plant in Johannesburg.* (Senior manager, //Khara Hais)

Without an individual driving the value of research-based knowledge, research reports might end up in a drawer:

> I asked the laboratory manager of Sol Plaatje about WRC reports; initially she said they do not use any. However, I then referred back to the reports that the lab lady from Tshwane used, and she then opened filing cabinets and pulled some of these out, amongst others "Guideline for utilisation and disposal for wastewater sludge TT 262/06" – therefore, they have reports in the lab, but she does not really use them or even realise that they are from the WRC. (Interview summary, Sol Plaatje)

Implications for the WRC

1. The research findings imply that municipal officials will use research-based knowledge if a) they are aware of it and b) if they find it practical and useful.
2. **The WRC is therefore faced with two challenges: a) to increase awareness in the municipal space and b) to bridge the gap between research and application**. These challenges have several implications for the marketing and research strategies of the WRC, the details of which are discussed in the final chapter of this report.
3. The findings of this report and recommendations from the municipalities indicate a range of opportunities for the WRC in terms of roles, levels of engagement, mechanisms, partnerships and issues and topics that could be further explored. These opportunities are listed and discussed in the final chapter of this report.

2.6.5 Questionnaire results

During the visits at the WSAs, hard copy questionnaires were distributed to officials not participating in the interviews. The questionnaire consisted of closed as well as open ended questions which determined the respondent's knowledge needs, knowledge sources and their awareness of the WRC and its products.

A total of 70 questionnaires were completed. The WSAs that submitted questionnaires were Nelson Mandela Bay, Tlokwe LM, eThekwini and municipal delegates from the Northern Cape at the WIN-SA/WRC workshop at //Khara Hais LM. The questionnaires were mainly completed by lower post levels, such as process controllers.

The distribution of the respondents is captured in the figure below:

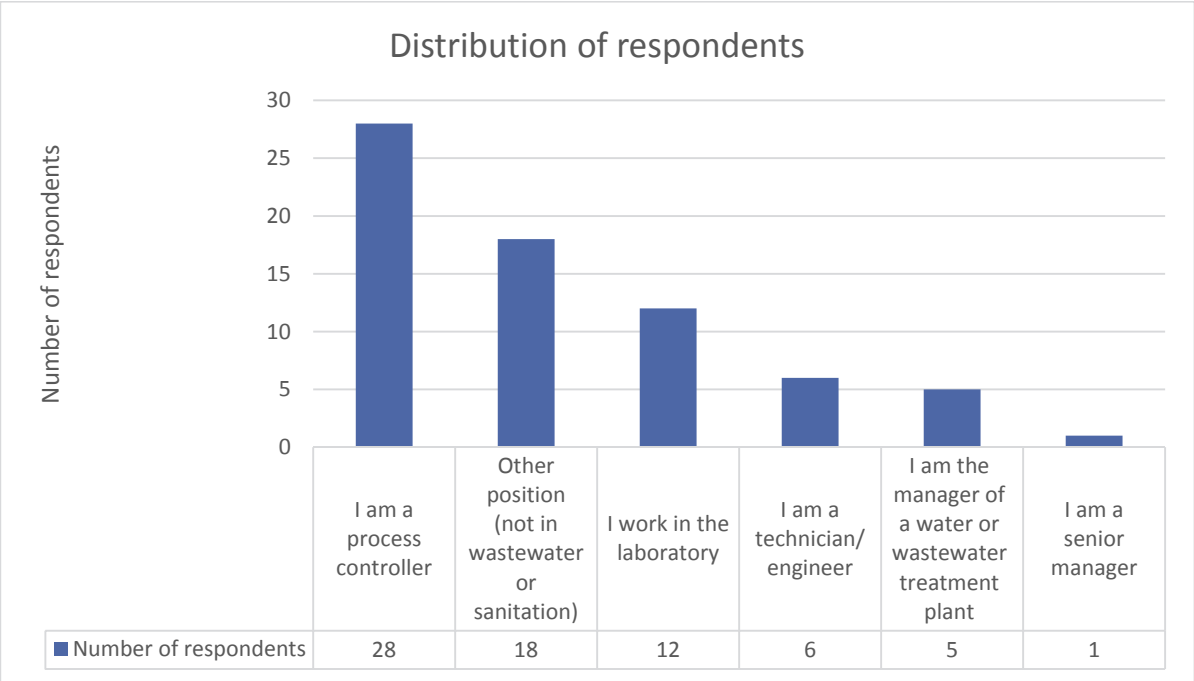

Figure 12: Distribution of respondents who filled in the questionnaires

The results from the questionnaires are very similar to those of the interviews:

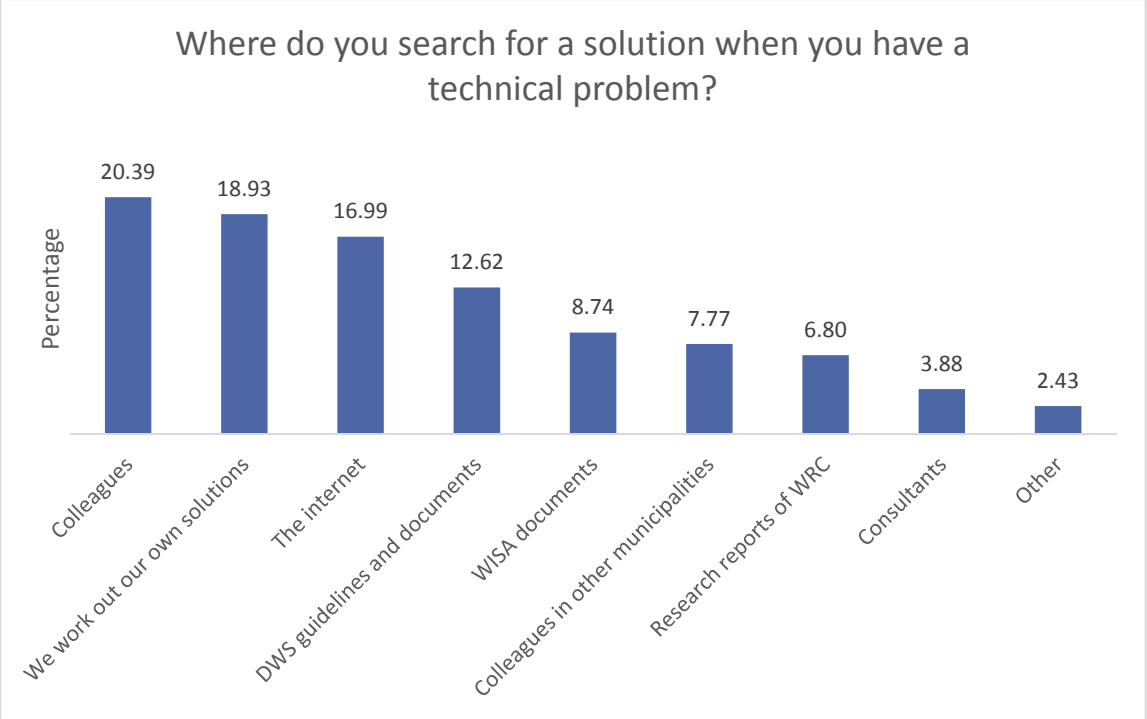

Figure 13: Knowledge sources

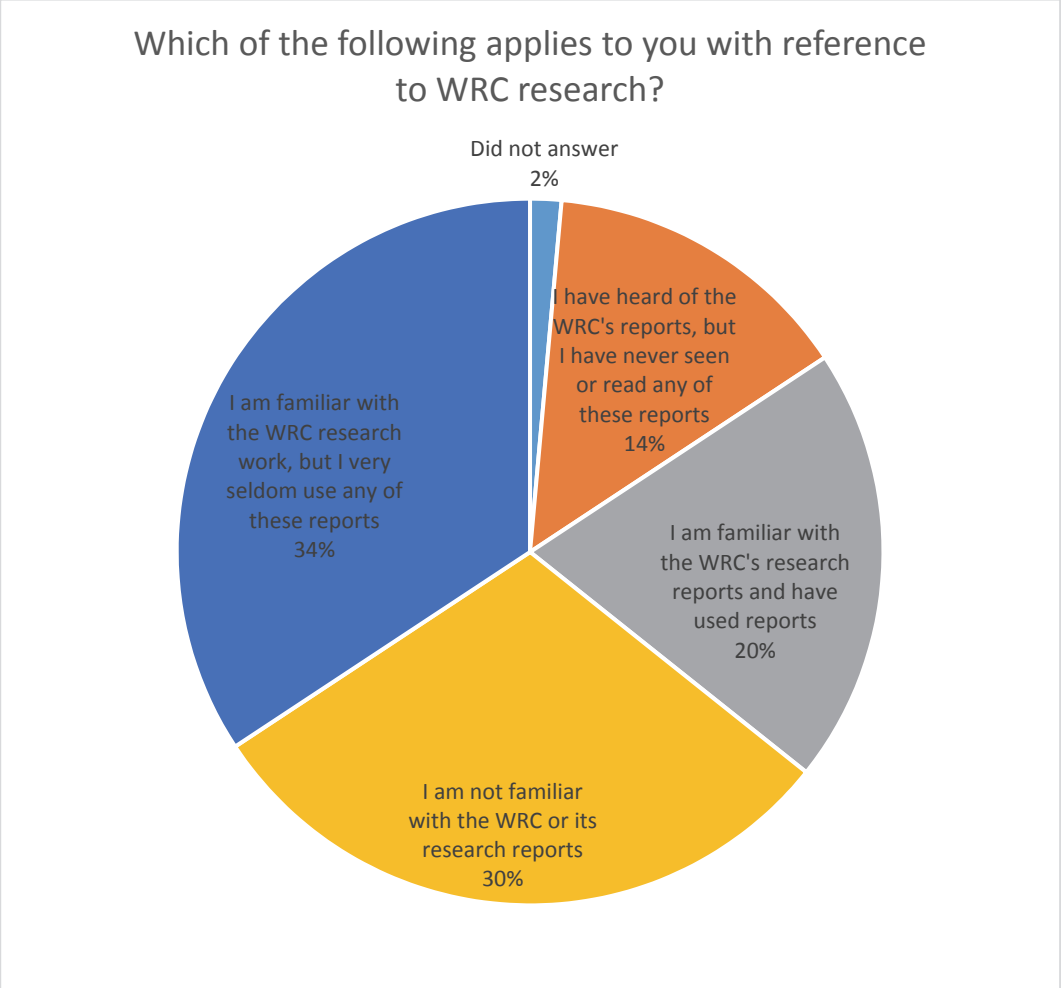

Figure 14: Awareness of the WRC and uptake of its knowledge products

In the open question, respondents quoted the following uses of WRC reports:

- *To investigate wastewater treatment chemicals and ultrafiltration plant chemicals to enhance the water qualities through membranes and to prevent membrane fouling*
- *In-service training*
- *Checking and applying process monitoring, controlling optimisation and troubleshooting*
- *To deal with activated sludge*
- *Sewer network maintenance*
- *To deal with industrial waste*
- *Research in somatic coliphages in water. Research in microbial loads in water during different seasons*
- *Report on package plant- I used this to provide guidance to stakeholders and developers as well as body corporates on how to run a package plant*
- *I use the Digester Report for the calculations on loading, etc. to troubleshoot digester problems.*

3 Conclusions based on the findings

The study confirmed a correlation between performance and engagement with knowledge as represented in the performance roadmap below.

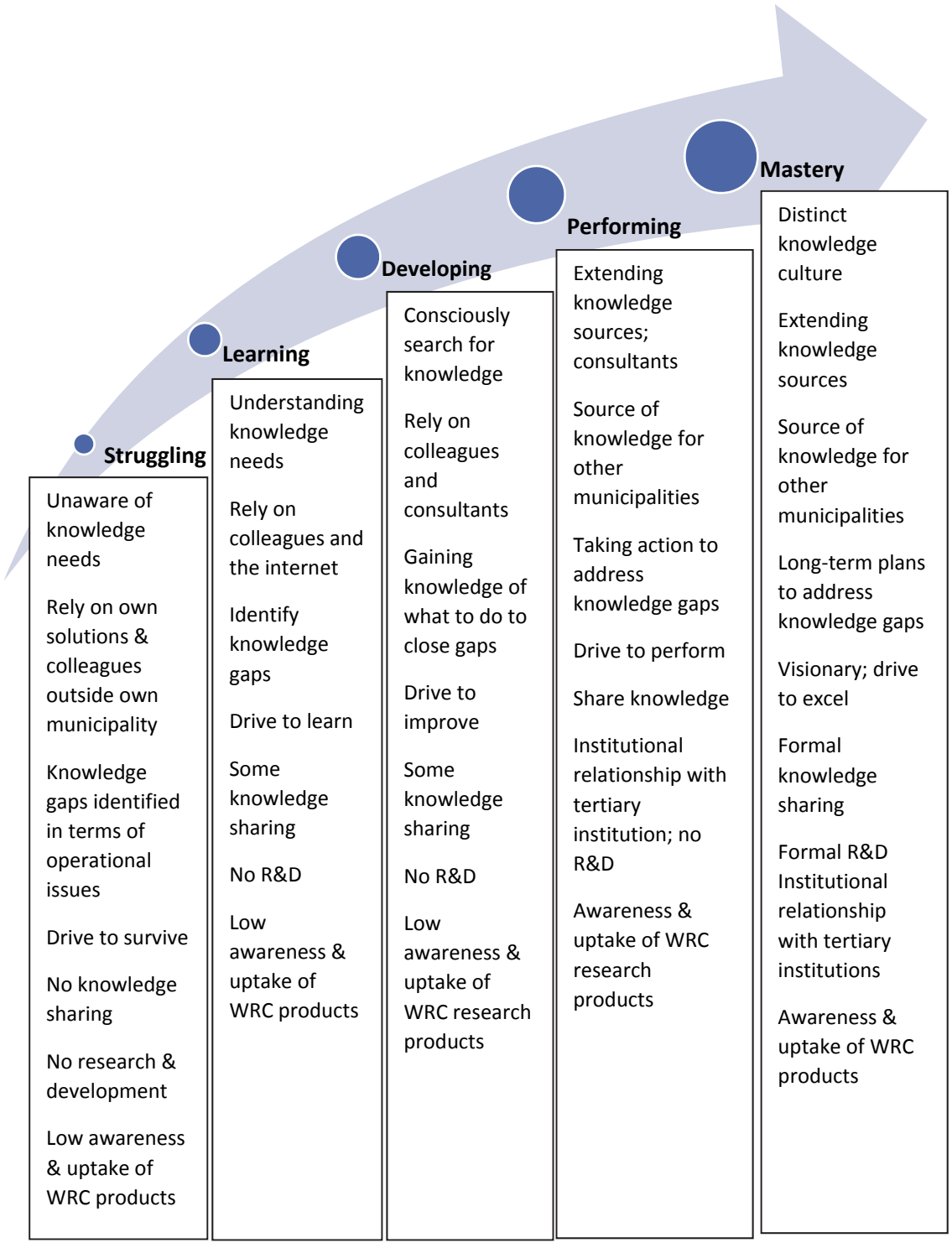

Figure 15: Engagement with knowledge

To summarize:

On the upper end of the performance journey, municipal officials in wastewater and sanitation departments of Metros and well-performing smaller municipalities (B1 and B2), tend to:

- Be aware of their own knowledge gaps and strategies to improve. These include agreements with tertiary institutions;
- Practise mentorship and knowledge sharing;
- Have a vision and the drive to improve (to be the best in the world [eThekwini]; be on the forefront; achieve a Green Drop; or to improve consistently);
- Be a source of knowledge for other municipalities;
- Be aware of the WRC and its knowledge products. Uptake is a function of context and the exposure that the individual has had to the researchers and research-based knowledge.

Institutionalised research and development were only found in Ekurhuleni (ERWAT) and eThekwini; in the small, performing municipalities it was common to hear that there is "no time for research".

On the low end of the performance journey, municipal officials in wastewater and sanitation departments tend to:

- Define their knowledge gaps in terms of operational or maintenance problems that they are unable to solve;
- Have limited knowledge sharing;
- Drive to survive and keep their plants more or less functional. This also becomes a mind set and a comfort zone: *We are doing well, but not really, because our focus is on short term solutions.*
- Focus their attention on innovative solutions to deal with operational challenges, for example to bypass broken infrastructure or to keep old equipment running. *I enjoy the challenge of dealing with challenges. I prefer keeping an old car on the road to a new car that keeps itself on the road*. (Process manager, City of Umhlatuze)
- Have a low awareness and use of the WRC and its research products.

The study furthermore found that that **engagement with knowledge in municipal wastewater and sanitation services is influenced by the interplay of a range of factors in both the institutional and the individual domains. The WRC will have to address both domains to achieve impact.**

4 Recommendations for the marketing and research strategies of the WRC

4.1 A BROAD RANGE OF OPPORTUNITIES

The findings of this study have highlighted a broad range of opportunities for the WRC in their engagement with municipalities. Opportunities include roles, levels of engagement, mechanisms, partnerships, and topics and issues.

4.1.1 Roles

The mandate which has been entrusted to the WRC includes:

- Promoting co-ordination, co-operation and communication in the area of water research and development
- Establishing water research needs and priorities
- Stimulating and funding water research according to priority
- Promoting effective transfer of information and technology
- Enhancing knowledge and capacity-building within the water sector.

Respondents from the municipalities indicated a number of roles for the WRC which fall within this mandate, namely to:

1. Capture and transfer tacit knowledge;
2. Assess knowledge needs in local government;
3. Facilitate knowledge transfer between a range of networks;
4. Act as intermediary between municipalities and DWS and other sector partners;
5. Give strategic direction to wastewater and sanitation management at local government level, for example to formulate a vision beyond Green Drop for well-performing municipalities, such as the following:

> *A wastewater treatment works that is not just some publically owned utility there to protect public health and water resources, but that is a self-sustaining revenue generating, sustainable utility that generates electricity, that produces methanol from gas and recovers phosphates and all of that. (*Senior manager, eThekwini)

6. Provide a service to municipalities: *There is no formal structure or process that communicates to municipalities: who is doing what research – institutions, other municipalities, who are the individuals involved, successes and failures, upscaling opportunities.*
7. Inform and enhance training interventions through:
    a. Adapting research reports for training purposes
    b. Identifying training needs
    c. Researching training methods
    d. Measuring effectiveness.

4.1.2 Levels

The study also identified opportunities for the WRC to establish relationships with municipalities at different levels. For example:

- An MoU with Council;
- Linking senior management to partners in tertiary institutions;
- Co-opting technicians/engineers onto research projects;
- Establishing a scientific forum for lab analysts;
- Exposing plant managers to new technology and treatment processes;
- Researching process controllers' training needs.

The WRC has already entered into some of these relationships.

4.1.3 Mechanisms

Respondents listed a wide spectrum of mechanisms to facilitate the uptake of research-based knowledge, including MoUs, reports, inventories; emails, email chat groups, Apps, newsletters, road shows, dialogues, decentralised workshops, the WRC website, news clips, search engine optimisation, social media, visits, technical forums and seminars.

Mechanisms to capture tacit knowledge for the next generation could include:

- Enlarging the audience (TED-type of talks and capturing demonstrations on video)
- Mentorship programmes
- Pairing
- A chat forum on the WRC website.

4.1.4 Partnerships

Apart from the municipalities themselves, tertiary institutions; private companies in PPPs (public private partnerships), DWS, CogTA (Cooperative Governance and Traditional Affairs), SALGA, WISA, SAICE, donor organisations, and international research organisations were named in examples as partners through which the WRC could work.

The findings of the study suggest the need for partners in the water sector to reflect on the knowledge needs and gaps in local government and their respective mandates in this regard to coordinate action. We would recommend a knowledge sharing event where the WRC could share and discuss the findings of this study with its partners in the water sector.

4.1.5 Issues and topics

Respondents suggested a wide range of issues and topics for research. See Appendix A. When discussing their knowledge needs, it became evident that there is also a need for research-based knowledge on aspects of municipal business administration that specifically speaks to officials in water and sanitation, for example conflict management, managing the financial aspects of wastewater and sanitation and supply chain management. Suggested topics that fall outside the mandate of the WRC could be communicated with tertiary institutions and other partners.

4.2 GENERAL RECOMMENDATIONS FOR A MARKETING AND RESEARCH STRATEGY

For a research organisation like the WRC, its marketing and research strategies are essentially integrated. The organisation's marketing champions are its researchers.

A marketing strategy is suggested that addresses both the institutional and the individual domains. In an institutional domain, the WRC could influence the context and the available mechanisms, directly in the form of a Memorandum of Agreement with a municipal Council, or indirectly by acting as a facilitator between municipalities and tertiary institutions, or through sector partners such as SALGA. Marketing in the individual domain should be driven by two key values: **decentralised marketing and personalised marketing** – "come to us" and "talk to me". All of these activities will increase awareness.

Market research should become a regular activity to stay in touch with the needs of municipalities and to assess awareness against a baseline.

It is recommended that the WRC expands its research strategy to specifically target municipalities by involving municipal officials in relevant research projects. The WRC needs to update reports that are widely used; identify the reports that meet officials' knowledge needs as expressed in this report, market them to municipalities and repackage or use different communication channels to improve accessibility if necessary. The WRC should furthermore leverage intermediaries and sector partners to improve the uptake of research-based knowledge in municipalities. All of these activities will increase awareness.

Both the marketing and research strategies should make sure that smaller municipalities are not excluded. **Weak performing B1 municipalities could be an important first target to encourage sustainable wastewater and sanitation services**.

4.3 MARKETING STRATEGY

> *The role of the WRC must be well marketed, must be known. The whole community must know about the WRC.* (Patrick Mbekwa, Plant manager, ERWAT- Ekurhuleni)

4.3.1 Issues

The research indicated that awareness of the WRC in municipalities can drastically improve, especially in LMs and DMs. There was furthermore no evidence that any marketing effort on the part of the WRC has been successful. Awareness of the WRC is random in most cases. WRC research-based knowledge arrives in the municipal sphere as a 'no name' brand via individuals – a colleague, a study leader, a consultant, a Green Drop auditor or a DWS official.

These realities raise several questions for the WRC's marketing strategy:

- How do we create brand awareness in municipalities?
- What do we brand?
- How do we brand ourselves?
- Where and how do we co-brand with WISA or DWS, for example?

- At what level do you focus when you market to a municipality?
- How do you deal with negative perceptions about the WRC when you market to municipalities?

4.3.2 Approach

The main message of the respondents to the WRC was: **Come to us; listen to us. T**he quotes below illustrate this:

- *The WRC should have annual contact with municipalities to get a feel of the needs in municipalities.*
- *Be more involved in smaller municipalities- know what are they struggling with and how the WRC can help them in this regard through their research.*
- *I would like them to take the research and operationalise it for daily activities. We lack the implementation of the research. We don't have time to read all their documents. We want something that is easy to integrate with our operations. They sit at a high level but have not got something we can integrate into our system.*
- *We don't always know our research needs. It would be good if the WRC could assess us, identify gaps and point out the areas where we need more research-based knowledge.*

Municipal officials represent only one customer segment of the WRC, but it is an important one. The research findings indicate that a marketing and communication strategy for this sector should include the following actions:

- The starting point would be to build and regularly update a database of all wastewater and sanitation officials, with their contact details, qualifications, interests, preferred communication medium, etc.
- A simple awareness baseline in the form of an SMS or telephone survey that can be repeated every two years to measure the effectiveness of marketing actions.
- Raise awareness through a branded email group or App that put officials in small groups (per province, per DM, per interest group; per position} in contact with each other to ask questions and get answers.

Set up decentralised technical workshops/forums through sector partners.

Figure 16: Set up decentralised technical workshops/forums with sector partners

- Update officials on the progress of relevant research projects: *I will be able to see what project the WRC is working on and when it will be out. This will help me to know when I might have some answer to my problem*. (Contracts Engineer, City of Johannesburg)
- Provide a database of new technology that is being piloted or used in municipalities.

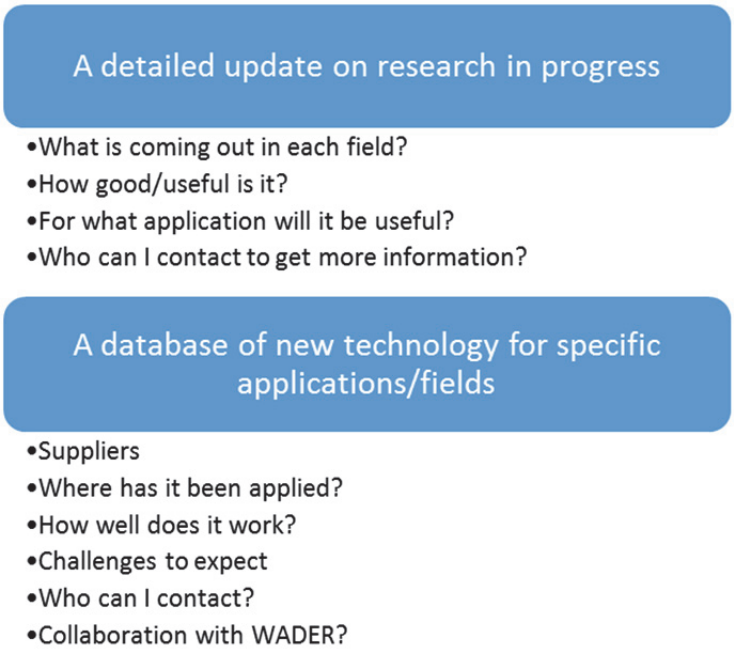

Figure 17: Detailed updates of research and a database of new technology

- Listen and learn about their achievements, difficulties, aspirations.
- Build a relationship with at least one individual in each municipality.
- Personalise communication as far as possible.
- Respond to questions.
- Communicate regularly.
- Check and assess the value and usefulness of the knowledge that the WRC provides to municipal officials.

4.4 RESEARCH STRATEGY

The WRC demonstrates its value in the research-based knowledge that it offers. For this reason, the guidelines for a WRC communication strategy (2011) recommended that, in line with international best practice, the WRC integrates its marketing strategy with its research strategy.

It is evident from the suggestions that respondents made that their research requirements are driven by their immediate needs.

These type of needs could be integrated into the WRC's research strategy through:

- Continuous dialogue;
- Involving municipal officials in research projects;
- A research grant to municipalities: *We get many forms of grants (INEP, MIG, etc.) If the WRC could put forward a type of grant that is specifically aimed at municipalities. All I have to do, is put forward a proposal. If it approved, you can do your project. We could get outside consultants or academics who will assist the municipalities with the proposal, but, still, a municipal official has to be a co-author and co-presenter at a conference.*
- An interface: *At management level, it is often more important to know WHAT is being researched by the WRC and to network with the experts involved in the project than to actually read the reports.*

In terms of current WRC products, the following interfaces could be explored:

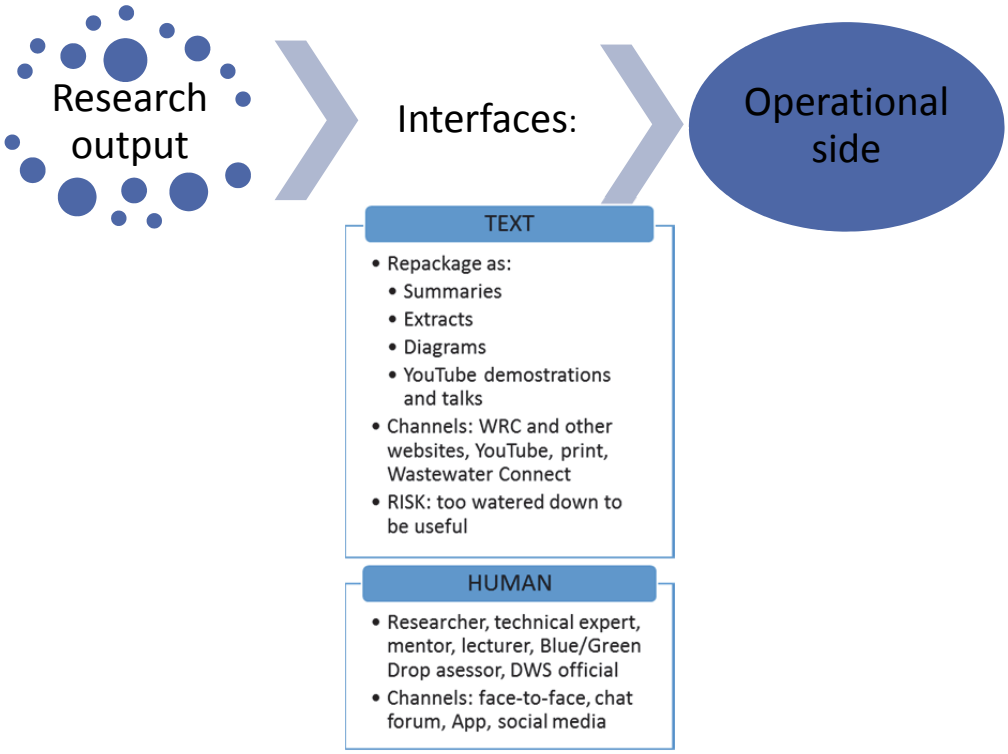

Figure 18: Research interfaces

The task is a major challenge. Municipal officials expect the WRC to meet knowledge needs as and when they arise; to create appropriate channels and mechanisms and most importantly, to demonstrate value.

4.5 PRIORITY ACTIONS

The following priority actions are recommended:

1. Establish a customer database of all municipal officials in wastewater and sanitation.[5] This database will have to be regularly updated.
2. Undertake a basic baseline assessment of these officials' awareness of the WRC.
3. Share the report of this study, or a summary, with these officials.
4. Develop and implement a municipal marketing and research strategy that caters for institutional relations, and individual relations with the database of officials. Assess and improve the strategy every year.
5. A knowledge sharing event where the WRC could share and discuss the findings of this study with its partners in the water sector with the aim of developing an action plan.
6. Update the reports that are widely used in the municipal wastewater and sanitation space and make sure that all relevant officials have the updates.

[5] This study focused on wastewater and sanitation; ideally the database should include all officials working in water (drinking water and wastewater) and sanitation.

5 List of references

Boyd, L., & Mbelu, A. (2009). *Guidelines for the inspection of wastewater treatment works.* Pretoria: Water Research Commission TT 375/08.

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Appendix A: List of recommendations from the officials interviewed

Appendices B-H are on the CD at the back of the report.

1 LIST OF RECOMMENDATIONS FOR THE WRC

This section lists the recommendations that respondents made when asked:

- What can the WRC do for you?
- How can the WRC improve its knowledge products and service for you?
- What would you research if you had the necessary funding?

The recommendations are grouped into three subsections: How to engage with municipalities; How to improve your service; Suggestions for new research topics and products.

The recommendations were kept very close to the respondents' actual words.

1.1 How to engage with municipalities

1.1.1 Visit municipalities and WWTWs

Although the research team explained the purpose of the visit and the interview, many respondents interpreted the interview as a visit from the WRC. They embraced the opportunity to talk about their knowledge needs and their work as some of the recommendations below illustrate.

- *This visit. Please revisit us in a year's time*. (Uthungulu, process manager)
- *By doing what they are doing, sending you here, they get the one-on-one knowledge of Uthungulu so that they do not generalise e.g. when they ask for a process manager at a plant, they will know that they don't exist. Some plants are purely run by superintendents*.
- *If they come and assist us on the plant and share their vast knowledge because what we know is only what we have.*
- The WRC should have annual contact with municipalities to get a feel of the needs in municipalities. *This would highlight critical aspects for research and the research findings would assist us*.
- They need to liaise with Dept. of Water and Sanitation and take the information to municipalities themselves.
- Take documents to municipalities, don`t have them available online only.
- Come on-site. Talk to us to see how they can help us. *Raise awareness about the WRC. People know more about WISA than about the WRC. They know about the PC workshops. They know about the WISA conferences.*
- He would like to learn more about the WRC. He suggests they hold briefings about their products at wastewater treatment plants. Different plants have different problems. Different municipalities have different problems. People do not know which products are available that will help them with the problems on the treatment plants. He would also like the WRC to show how their research (theory) links up with the practical work that is implemented on the plants

- If they can visit our plant from beginning to end, they would be able to advise us where to improve (Thaba Chweu)
- Put together a team of specialists to visit municipalities regularly. The Green Drop assessors have a specific role; officials are probably reluctant to admit failures and discuss challenges (Bela Bela).

1.1.2 Assist municipalities in their needs

- Could help in preparing things like Master plans, and The Water Service Development Plan.
- Be more involved in smaller municipalities- know what are they struggling with and how the WRC can help them in this regard through their research.
- We don't always know our research needs. It would be good if the WRC could assess us, identify gaps and point out the areas where we need more research-based knowledge.
- He suggests that wastewater treatment plants can be involved and assist in the WRC research when it makes sense. Plants often know what type of research is needed and where the knowledge gaps are. He maintains that the research that is already there; it is useful but often difficult to apply in small treatment plants. The information should also be made easier and accessible by municipalities and treatment plants as many are not aware that these studies exist.
- Umhlatuze plant manager's answer to the question "How can the WRC help you?" (he has never heard of the WRC): *"Replace the digester".*
- Create physical archives of information at plant offices for them to refer to.
- Make young black people aware of careers in water in wastewater.
- Respondent needs specialised advice on compliance without him having to study the whole Act. The WRC could summarise the relevant information for him as a Works Manager.

1.1.3 Create or expand services to involve municipalities

1.1.4 Forums

- Small technical forums that involves municipalities (ERWAT).
- Technical forum where info on tenders' specs could be exchanged (Jhb Water)
- An online forum that may be initiated and run by the WRC where he can post a question. He feels that retired people with a lot of expertise and knowledge can be used to answer these questions. He would like to be part of such a group to also share his experience. A lot of knowledge disappears when a manager retires or is transferred to another institution.
- There is a need to document the knowledge that people carry in their heads. Most of the supervisors are 55 plus and close to retirement.
- Find some way to document knowledge gained through a lifetime of experience.
- Have a forum for best practice, best research and let's get all the municipalities together to just talk about research or something like that. Pioneer ways for peer and review groups. Provide guidelines on what to discuss at the groups. Look at IWA local version but less commercialised. Tell us about more technology best practice for S.A.
- A forum where retired experts can give training to all municipalities in the province.
- A forum to discuss licence standards and the implications for municipalities. There seem to be common issues, e.g. over-chlorination and the impact that could have on river health.
- There is a need for a scientific forum where lab personnel can meet and discuss challenges specific to their work. And also share innovative and research work that they are doing. (ERWAT)
- There seems to be a need to revive the Water Scientist Group, perhaps in a different format.

1.1.5 Summits and seminars

- Call a provincial summit for all the municipalities to tackle problems municipalities have in common. Circulate information via emails, the Dept. of Water and Sanitation and Local Government.
- Include us in the seminars that they hold. Work with the Department to inform us about new developments.

1.1.6 Other services

- A service that will find out for them what has been done and who is doing what in a particular research field; *we do not always have the time or the resources*. For example, which plants in SA are using membranes?
- The WRC can be instrumental to convey information about the importance of wastewater management to Councillors via a presentation.
- Liaise with CoGTA at the top level to raise the awareness of political leadership on wastewater and sanitation. We would recommend a risk-based approach.
- Tap the Green Drop auditors for insight on the specific research needs of municipalities.
- Gas Chromatography Mass Spectrometry (GC-CMS): *We purchased this instrument about 4 years ago and we just did one test with it and it costed R2 mil. If they could help us to use this equipment, it would help.*

1.1.7 Integrate municipalities into research process

- Most people are hungry for education; it wouldn't hurt the WRC to take just one candidate from each municipality for training with researchers.
- Bring young and competent middle managers from municipalities onto the structures of the WRC, particularly as part of the project teams. Invite them to WRC workshops.
- *We get many forms of grants (INEP, MIG, etc.) If the WRC could put forward a type of grant that is specifically aimed at municipalities. All I have to do, is put forward a proposal. If it approved, you can do your project. We could get outside consultants or academics who will assist the municipalities with the proposal, but, still, a municipal official has to be a co-author and co-presenter at a conference.*
- Develop a partnership/relationship with us and assist us with some of the research that we require.
- They can attract people to become researchers, they can use their people to mentor researchers.
- She feels she could also teach the WRC things and vice versa. There is an opportunity to liaise with each other and share information. (Lab manager, Cape Town).
- Setting up formal agreements with municipalities. *If you sign agreements, you get buy in and commitment. Many municipalities might not know where to start (with research or a relationship with a tertiary institution).* This would set the scene for a relationship with the WRC.

1.2 How to improve your service

1.2.1 Increase your visibility

- There should be WRC attendance at DWS workshops for municipalities or the WRC should conduct their own workshops for municipalities.

- There is a need for one-day workshops during which the WRC can share the latest in water-related affairs. This way they may get other municipal officials/managers interested and involved in wastewater management.
- There is a lot that the WRC is getting right, like the plant optimizations, but it is not in the media.
- Respondent feels that the WRC should have a more "hands-on" approach. Currently they are too academic and only concentrate on research. The WRC should do more to market themselves and to share their skills and knowledge at ground level.
- The problem with WRC products is their `marketing', people do not know about the WRC`s existence. They need to know that this information is free, you pay nothing for it.
- Extend their offices to have satellites at tertiary institutions.
- The WRC's papers need to form part of the city's libraries.

1.2.2 Increase collaboration

- Work more closely with WISA.

1.2.3 Improve communication channels

- There is opportunity for the WRC to become active on new technology – Facebook, Twitter, YouTube.
- Respondent found the website of the WRC a bit difficult to access and suggest that they use a better search engine. Respondent would like to know what research is currently being done and who the researchers are.
- Make it easier to get information from the website. If you don't know that TT number, you struggle. Make website more user friendly.
- Respondent would like to get regular updates on what the WRC is working on. Who is doing the research, where are they from, contact details, when will the research be completed and a synopsis.
- A list of publications by the WRC – the titles must accurately reflect the content of the report. This could be made available in a once-off email every 6 months.
- Respondent would like to get an overview of what they are currently busy with.
- Optimise your search engine.
- Website maintenance and improvement is needed (Rustenburg)
- The WRC should have a good index and glossary of all reports with synopses.
- Follow up downloads with an email. Did you find what you needed in this report? Yes/No
- Don't have time to check if something has been done. They should push more from their side. More pro-active about the projects they are working on and the research they are doing.

1.2.4 Personalised marketing

- Respondent recommended personalised marketing, (for example an email to notify you of a new product in your field of interest.
- Have a mailing list for information relevant to us on wastewater treatment.
- *I think the best way would be to send us a weekly or monthly news clip, or email or magazines. I think they must make it approachable for us to learn from them.*

1.2.5 Make products/service more relevant to municipalities

- *I would like them to take the research and operationalise it for daily activities. We lack the implementation of the research. We don't have time to read all their documents. We want*

something that is easy to integrate with our operations. They sit at a high level but have not got something we can integrate into our system. They must do, for example research on how the W_2RAP filters down to municipalities to improve local government unless it's happening and we're not seeing it. That is how the CSIR has repositioned themselves at local government.

- Respondent questions the process to decide on projects and believes the WRC should carefully select topics that would be of use to their stakeholders. Respondent questioned the value of unsolicited proposals.
- The WRC tends to overproduce research on fashionable topics: biomass to energy, climate change, etc.
- The WRC is doing a lot but most times it just becomes reports and they are not influencing guidelines and laws.
- Their research has changed. There's a deliberate bias towards community-based projects. That has compromised the production of academic research such as the UCT example on nutrient removal*. I understand what they are doing but we need to strike a balance. We cannot compromise on the technical knowledge.*

1.3 Suggestions for new research topics and products

The long wish list has been compiled from direct quotes from respondents. The WRC might already have done research on some of these topics.

In general, respondents would like to have practical and usable information – *things they can apply directly into their day-to-day operations.*

Many of their suggestions are directly linked to the official's immediate knowledge needs.

1.3.1 Research topics

- Tell us more about technology best practice for South Africa.
- For struggling municipalities: very basic process management guidelines and checklists. Detailed case studies of successful plants.
- A South African process-specific benchmarking exercise. Looking at a specific piece of equipment, e.g. dewatering equipment, are we in the right ball park in terms of what everybody else is doing? What is the expectation in South Africa from this type of equipment? What are the preferences? What are the typical output that you can expect from a particular piece of equipment? (eThekwini) [6]
- How do you make old technology work?
- A national spreadsheet of typologies with all details – to allow municipalities to make appropriate decisions (and not be conned by clever sales people) and track their progress
- National baseline of service levels (NOT the census, though it could be a starting point): what typologies are where, what is the cost, what infrastructure is required to support these.
- How to reuse the by-products of wastewater treatment and not dump it.
- The WRC can research and differentiate the different types of processes and inform people about it, especially students.

- [6][What about JASWIC (Joint Acceptance Scheme for Water Services Installation Components? No awareness? Inappropriate? – See interview with Frans Mouton, Tshwane.

- Anaerobic digestions. Some of that research has already started, if you're looking at co-digesting, industrial waste with domestic and that's already started.
- Different kinds of pump stations, maintenance that they need, capital outlay, comparison of performance
- High aluminium in water: *I suspect it might be from the treatment chemicals, but we don't test those whereas we should. We have the knowledge, but we do not get the samples. We would need specialised equipment for this*.
- As a result of the heat in Beaufort West, they struggle with seasonal foam at the plant. A lot knowledge is needed to solve this problem.
- New guidelines for biogas to methanol and hydrogen.
- Stormwater ingress: formal mechanisms to investigate; what has worked in other municipalities
- Better valves and network systems/ sewer network and pipe technology (Mossel Bay)
- Hormones and wastewater treatment plants. How do you remove hormones from wastewater?
- A basic guide on hydraulics (pump?) (Tshwane engineer)
- Modelling for plant optimization under conditions where parts of a plant is dysfunctional (i.e. mapping the experiments of the plant operators; intuitive modelling) might yield interesting results
- Research the impact of a marine outfall with high industrial content on coastal water in the Richard's Bay area
- If we can take our effluent to a certain level, can we blend it with groundwater or bulk water that we buy from the Metro and treat to drinking water quality? Will the WRC be able to do a feasibility study for them? (senior manager, Kouga LM)
- WRC could help as they have the ability and scope to research more innovative (treatment/plant) processes. The team does not have the time to research these issues. WRC can conduct investigations which will have significant impact – assessment of newer type developments – more innovative solutions are needed. (Cape Town
- *I've indicated that we want to move to research on gas, bio gas to energy projects, especially bio gas to methanol and bio gas to hydrogen. I haven't seen anyone doing that in this country. A lot of bio gas to electricity, but there are other ways that we could get bio gas converted to a revenue generating stream*
- Best practice in training: workplace skills plan. *We purchased DVDs and books from American Waterworks Association and IWA and all of those places and we show them to the staff and we explain, but there's a lot more we can be doing. I'm trying to get an exchange program with our overseas partners, so we're upskilling our staff to become trainers, developing our own material with help from our partners and all of that will be invested into our staff to get them up to speed.*
- A Green Drop for school sanitation? (eThekwini) They want to rate their schools in terms of sanitation. Develop criteria and colour code them and give rewards for Green Drop schools.
- Guidelines for water quality of different coastal waters (Durban and Cape Town are different)
- No two municipalities seem to have the same management structure. Koos Wilken of ERWAT said that the WRC could do research to optimise municipal management structures for water and sanitation.
- The optimal use of electricity vs the rebate received, therefore determining the cost over a longer period in capital outlay and maintenance costs. (Johannesburg Water, Maintenance Manager.

- Section 78 studies – to build case studies for privatization of municipalities. (Semcorb Silulumanzi)
- Opportunities to invest in PPP arrangements
- The state of the Vaal River (Sol Plaatje)
- More research-based knowledge on rivers and the environment (George)
- A national strategic plan for risk management in the event of a natural disaster or sabotage.
- Guidelines on effective community engagement
- Laws on land use – encroachment of wetlands. Alternative land use processes, how to formalise informal settlement where possible (to enable the installation of infrastructures required).
- The WRC must write a technical audit – how to rectify various problems at various stages of the process.
- The WRC can also help to develop a national strategic plan for risk management in the event of a natural disaster or sabotage.

1.3.2 Products

- An App for process controllers. Provides possible solutions to operational problems, e.g. you are getting spikes in turbidity, what must you do? How do you balance chlorine retention time, type of chlorine (gas or HTH solution), dosing and effectiveness?
- A database of technologies and companies on the forefront of research
- From a modelling perspective, wastewater characterisation, you have the old book from Prof Ekama, that has changed quite a bit in the last few years and it needs to be expanded and updated. There is a little table, which I have probably used the most, but if you had a range of values to look at, it would be much more useful.
- Update reports that are used the most.
- Produce journal/publication/communication about aspects specifically relevant to local government = repackage existing info in this way.
- WRC needs to provide a template to provide a standard to follow for putting operation and maintenance manuals together
- The WRC should be able to assist and suggest a job classification system for Engineering. Will assist in career development and aspiration of advancement – A ***road map of excellence*** should be designed by the WRC. (Head: Operations, Cape Town)

APPENDICES B-H APPEAR ON THE ENCLOSED CD