PROJECT NO: 7023

Guidelines on using the Wastewater Treatment Technology Selection Decision Support Tool (W_2DST)

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EXECUTIVE SUMMARY

The most commonly used wastewater treatment technologies in South Africa include activated sludge, bio/trickling filters, rotating biological reactors, wastewater ponds, membrane bio-reactors, wetlands and aerobic granular activated sludge (e.g. Nereda, an emerging technology). There are various aspects to consider in selecting the appropriate wastewater treatment technology.

Selection of wastewater treatment technology is in many instances influenced by effluent quality standards; however amongst other things; operations, maintenance, sludge management, financial issues and day to day running of the institution also need to be considered. There is, therefore, a need for guidance in selecting an appropriate wastewater treatment technology. The process of selection of a preferred technology should be guided by the particular circumstances, including design, operations, maintenance and institutional resources. By way of example, in many instances, wastewater pond systems are being either upgraded to conventional systems and/or in some cases being de-commissioned due to the fact that they do not meet effluent standards. This failure to meet effluent standards may be due to poor management of these systems, as reported (de Souza and Jack, 2010), and not because of inappropriateness of the technology. This indicates the need to come up with guiding criteria incorporating all relevant variables influencing selection of appropriate wastewater treatment technologies.

The purpose of this study is to provide guidance to decision makers on selecting the most appropriate wastewater treatment technology for their particular circumstance. In this regard, the guide provides, *inter alia*, a summary of wastewater treatment works status in South Africa, highlights key aspects to be considered when choosing an appropriate wastewater treatment technology, and provides step-by-step guidance on how to use the decision support tool for wastewater treatment technology selection which is hosted on RiskQ (www.riskq.co.za).

This guide is intended for use by the following people or groups:

- Managers of wastewater services within a WSI
- Water quality managers
- Councillors
- Wastewater treatment works designers, e.g. consultants
- Project Management Unit managers
- Department of Water and Sanitation officials
- Other water sector stakeholders including South African Local Government Association (SALGA) and Department of Cooperative Governance and Traditional Affairs (CoGTA)
- Water resources managers
- Any person responsible for wastewater services status

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Reference Group

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- Tlokwe Municipality (North West)
- Drakenstein Municipality (Western Cape)
- Breede Valley Municipality (Western Cape)
- Nedbank - Olwazini (Gauteng)

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ACRONYMS AND ABBREVIATIONS

AGAS	Aerobic Granular Activated Sludge
BDC	Blue Drop Certification
COD	Chemical Oxygen Demand
CoGTA	Department of Cooperative Governance and Traditional Affairs
CSIR	Council for Scientific and Industrial Research
DWS	Department of Water and Sanitation
GDC	Green Drop Certification
RiskQ	Web-based Risk Management System
SALGA	South African Local Government Association
UNEP	United Nations Environment Programme
WHO	World Health Organisation
WRC	Water Research Commission
WSAs	Water Service Authorities
WSI	Water Service Institution
WSP	Water Safety Planning
WWTW	Wastewater Treatment Works

GLOSSARY OF TERMS/DEFINITIONS

Determinand/Parameter	: micro-organism, physical property, aesthetic property or chemical substance.
Discharge	: the release of wastewater to the environment.
Domestic wastewater	**:** human generated sewage that flows from homes and businesses
Effluent	: treated wastewater flowing out of a wastewater treatment facility
Ponds	**:** described as relatively shallow bodies of wastewater contained in an earthen basin
Raw sewage:	: untreated wastewater
Sanitation	**:** measures necessary for improving and protecting health and well-being of the people. Sanitation is any system that promotes proper disposal of human and animal wastes, proper use of toilet and avoiding open space defaecation.
Sewer system	**:** collectively, all of the property involved in the operation of a sewer utility. It includes land, wastewater pipes, pumping stations, treatment plants and general property
Sludge	:semisolid material deposited during the treatment of wastewater
Wastewater	**:**is water containing wastes from residential, commercial, and industrial processes
Wastewater Treatment Plant	: process or combination of processes undertaken to render wastewater/sewage acceptable for discharge to the environment or reuse.
Water Services Authority	**:** any municipality that has executive authority to provide water services within its area of jurisdiction in terms of the relevant national legislation or the ministerial authorizations made in terms of the relevant national legislation
Water Services Institution	**:** WSA or WSP or both

1. A BRIEF INTRODUCTION TO WASTEWATER TREATMENT WORKS STATUS IN SOUTH AFRICA

The most commonly used wastewater treatment technologies in South Africa activated sludge, bio/trickling filters, rotating biological reactors, wastewater ponds, membrane bio-reactors, wetlands and aerobic granular activated sludge (e.g. Nereda, an emerging technology). Figure 1 below shows the range of wastewater treatment technologies that are mostly used in South Africa according to the Green Drop progress assessment of 2012 (DWA, 2012).

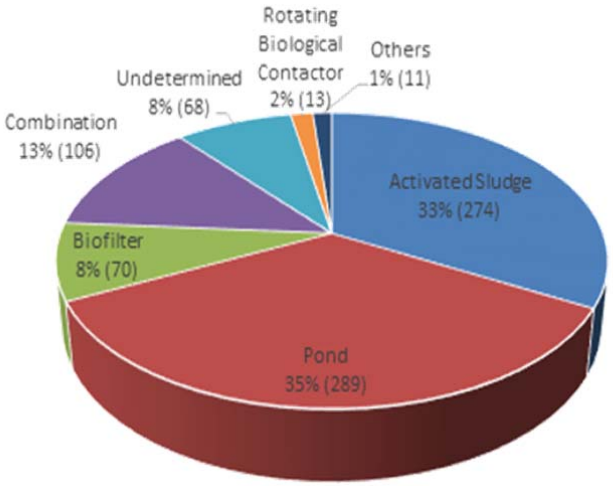


Figure 1: Distribution of wastewater treatment technologies in South Africa

In addition to categorization of wastewater treatment plants by the technology, they are also categorised by size as indicated in table 1 below *(Golder and Zitholele, 2006)*.

Table 1: Size categorisation of wastewater treatment plants

Wastewater Treatment Plant Categories	Flow rate	Population Equivalent
Micro size plant	< 0.5 Ml/day	5 000
Small size plant	0.5 – 2 Ml/day	5 000 – 20 000
Medium size plant	2 – 10 Ml/day	20 000 – 100 000
Large size plant	10 – 25 Ml/day	100 000 – 250 000
Macro size plant	>25 Ml/day	>250 000

Population equivalent is based on 100liters sewage per capita per day (Golder and Zitholele, 2006)

In 2012, 831 plants were assessed for the Green Drop progress and the size ranges of the assessed plants are indicated in table 2 (DWA, 2012).

Table 2: Size Range of wastewater treatment plants assessed through Green Drop Certification in 2012

	Micro size <0.5 Ml/d	Small size 0.5 -2 Ml/d	Medium size 2 - 10 Ml/d	Large size 10 - 25 Ml/d	Macro size >25 Ml/d	Undetermined
No of plants	138	243	236	66	63	85
Total design capacity	28.07	227.62	1012.39	964.8	4357.7	85

In a recently conducted study by the WRC, it is projected that the future distribution of wastewater treatment technologies in South Africa is likely to change as indicated in Figure 2 (Bhagwan, 2012):

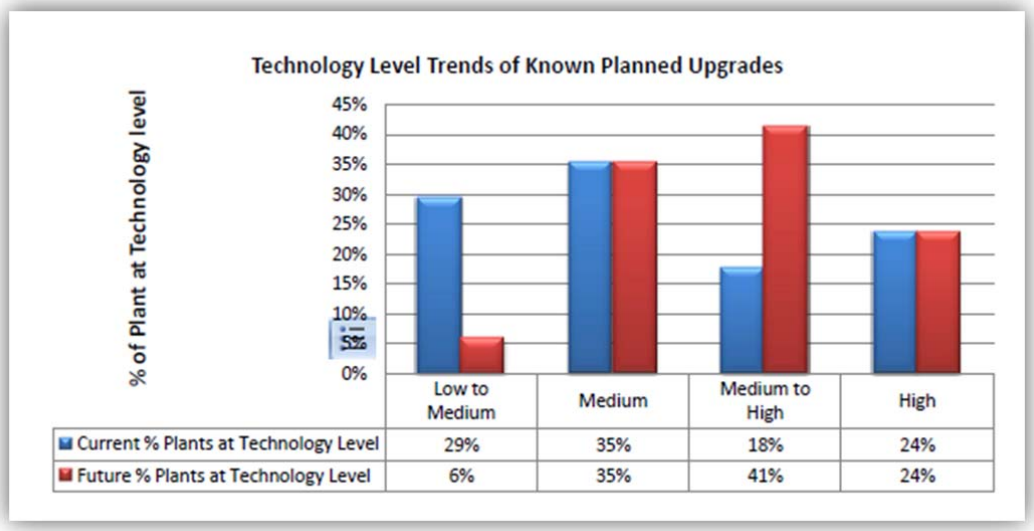


Figure 2: Projections of future distribution of wastewater treatment technologies in South Africa

According to Bhagwan (2012), the future projections indicate that more complex, and potentially more costly levels of technology, will enjoy a higher preference to the low/medium levels of technology. In this regard the most suitable technologies are not always considered and decided upon, and the necessary drivers are not employed to arrive at sustainable technology choices. However, this aspect has not been documented and remains purely anecdotal and speculative.

This project therefore provides guidance to decision makers on selecting the appropriate wastewater treatment technology using a tool that takes into account the most critical factors that should be considered when selecting a wastewater treatment technology.

2. ASPECTS TO CONSIDER IN SELECTING A WASTEWATER TREATMENT TECHNOLOGY

2.1 Introduction

World Health Organisation (WHO)/United Nations Environment Programme (UNEP) (1997) has confirmed that technology selection eventually depends upon wastewater characteristics and on the treatment objectives as translated into desired effluent quality. The latter depends on the expected use of the receiving waters.

In China it has been identified that the main challenges faced in wastewater treatment systems are high development costs, poor quality discharge, imperfect sludge disposal, a lack of long-term, clear development planning and a focus on short term profits (Water 21, August 2014). This has been confirmed to be the case in South Africa as indicated by Gaydon (Water & Sanitation 2014). Gaydon pointed out that the appointments of wastewater plants designers, in many instances, are based on lowest tender bid and not necessarily on experience and competency. This may be what China refers to as 'lack of long-term, clear development planning and short term profits'. There is, however, no sector guide that addresses appointment requirements.

2.2 South African approach

It has been reported that in South Africa, insufficient attention to long term cost and the ability to operate and maintain high level technologies (lack of skills, cost of expansion, repairs vs capital cost of new systems) is a key challenge (Bhagwan, 2012; Gaydon, 2014; vd Merwe and Quilling, 2012).

Best practice requires that various factors influence technology selection decisions, including:

- Sensitivity of receiving water body / land water use license requirements
- Capacity and local skills base to O&M systems
- Funding to construct the facility
- Running costs and consumer ability to pay
- Availability and price of land
- Projected population growth
- Re-use opportunities (energy, nutrients)

Though wastewater discharge standards are provided by the Regulator according to the sensitivity of the receiving water body, a survey by the Council for Scientific and Industrial Research (CSIR) of a substantial number of the wastewater treatment plants run by municipalities showed that many of these are producing effluent that is not meeting Department of Water and Sanitation (DWS) requirements (CSIR, 2007). Some of the plants are producing effluent that is not distinguishable from the raw sewage that flows into the works. The reasons for this include one or more of the following:

- Gross under-budgeting by the municipality for wastewater system maintenance,
- Managers who have insufficient understanding of the technology or requirements for effective management of wastewater treatment, and

- Officials who do not seem to be motivated to carry out their duties with the necessary care and energy.

The following summarised aspects have been highlighted in most of South African wastewater treatment and management literature to be key upon selection of the most appropriate wastewater treatment technology *(*Ekama, 2015; van der Merwe-Botha and Quilling, 2012; Nozaic and Freese, 2009; Golder and Zitholele, 2006, Water Institute of Southern Africa et. al, 2002*).*

- plant size
- flow rate
- land availability
- type of influent
- size of contributing community
- treated wastewater quality
- receiving environment
- sludge management
- costs
- operation and maintenance

Table 3 further elaborates on the above aspects.

Table 3: Aspects to consider in selecting an appropriate wastewater treatment technology

Aspect / Criterion	Pond system	Wetlands	Trickling filters/ Biological filters system	Rotational Biological Contactors	Activated sludge system	AGAS system	Membrane bio-reactors
Plant size	Typically applicable in micro to small plant size	Typically applicable in micro to small plant size	Small and medium size plant	Small and medium size plant	Focused on a medium sized plant	Focused on a medium sized plant	Suitable for where plant capacity is needed
Flow rate	Suitable in small/low flow volumes (0.5 – 2 Ml/day)	Suitable in small/low flow volumes (0.5 – 5 Ml/day)	0.5 – 10Ml/day	0.5 – 10Ml/day	Suitable for large volumes of wastewater (>2 Ml/day)	Suitable for large volumes of wastewater (10Ml/day)	Suitable for large volumes of wastewater
Land availability	Requires adequate land Requires a buffer strip between human settlement and residential areas	Requires adequate land	Requires minimal land area	Requires minimal land area	Requires little land area	Requires little land area especially where there are land restrictions	Requires little land area
Type of influent	Domestic, industrial, agricultural	Treated	Domestic	Domestic	Domestic, industrial	Domestic, industrial	Domestic, industrial
Size of contributing community	<5000 persons	<5000 persons	5000 – 50 000 persons	5000 – 50 000 persons	Ranges from 20 000 to 100 000 persons	Ranges from 20 000 to 100 000 persons	Ranges from 20 000 to 100 000 persons

Aspect / Criterion	Pond system	Wetlands	Trickling filters/ Biological filters system	Rotational Biological Contactors	Activated sludge system	AGAS system	Membrane bio-reactors
Treated wastewater quality	Removal of pathogens is high Removes high concentrations of COD	Removal of Phosphates and Nitrates is high	No strict Nitrogen and Phosphorus standards	No strict Nitrogen and Phosphorus standards	Highly efficient treatment method where discharge standards are strict with respect to phosphate	Highly efficient treatment method where strict Nitrogen and Phosphorus discharge standards are required	Highly efficient treatment method where high quality treated wastewater is required, especially for reclamation and reuse
Receiving environment	Evaporation, Specified irrigation	Local stream or river, specified irrigation	Local stream or river, specified irrigation	Local stream or river, specified irrigation	Local stream or river, specified re-use according to the authorisation	Local stream or river, specified re-use according to the authorisation	Local stream or river, specified re-use according to the authorisation
Sludge treatment/handling	Sludge drying beds, sludge lagoons	No sludge expected	Sludge drying beds	Sludge drying beds	Anaerobic digestion, sludge lagoons, drying beds or mechanical de-watering	Sludge lagoons, drying beds or belt presses for de-watering	Sludge lagoons, drying beds or belt presses for de-watering
Costs (in terms of municipal affordability) Based on the current (2015/2016 industry norms)	Low capital cost (Approximately R2-4 Million/Ml)	Low capital cost (Approximately R2-4 Million/Ml)	Medium cost (Approximately R7-9Million/Ml)	Medium cost (Approximately R7-9Million/Ml)	High cost (Approximately R13 – 15 Million/Ml)	High cost (Approximately R13 – 15 Million/Ml)	High cost (Approximately R13 – 15 Million/Ml)

Aspect / Criterion	Pond system	Wetlands	Trickling filters/ Biological filters system	Rotational Biological Contactors	Activated sludge system	AGAS system	Membrane bio-reactors
Operation Number of skilled operating staff	Requires low skilled operating staff	Requires low skilled operating staff	Requires moderately skilled operating staff	Requires moderately skilled operating staff	Operational requirements are demanding Competent and highly skilled staff is required	Competent and highly skilled staff is required	Competent and highly skilled staff is required
Reliable and available electrical power	Suitable in areas where there is minimal electricity supply	Suitable in areas where there is minimal electricity supply	Requires electrical power supply though the trickling filter unit does not necessarily require electricity.	Requires reliable electrical power	Requires reliable electrical power	Requires reliable electrical power	Requires reliable electrical power
Maintenance	No mechanical/electrical equipment and instrumentation to maintain	No mechanical/electrical equipment and instrumentation to maintain	Low maintenance	Low maintenance	Requires high level of reliability with respect to mechanical equipment. Requires a formal planned and preventative maintenance programme	Low maintenance due to removal of mixers, recirculation pumps and settling tanks	Incorporate more instrumentation and automated process control Requires high level of reliability with respect to mechanical equipment

The other aspects that should be considered, though there are no clear guidelines on how to make a decision on them, are:

- Equipment and chemical suppliers - that is, proximity of the system to the supplier which may also be affected by road conditions and the availability of backup.
- Upgrading options – that is, if there is a need to upgrade the existing plants, what are the available options for upgrade or will the plant have to be reconstructed?
- Wastewater re-use – that is, are there options for re-use of effluent produced at the wastewater treatment works?
- Availability of water as a resource – that is, if water is scarce and/or may be insufficient in future, should dry sanitation methods be considered rather than water borne sanitation methods?
- Implementation of by-laws – that is, if there are industries/abattoirs, are the decision makers prepared to enforce by-laws over other issues (e.g. job creation)?
- Waste minimisation/re-use – that is, are there any measures considered to minimise or re-use waste?

2.3 Other countries perspective

UNEP (2004) suggested that a holistic approach to water supply and sanitation be adopted. This incorporates not only the provision of household services, but various other components of water resource management, including protection of the resource that provides the water, wastewater collection, treatment, reuse and reallocation to the natural environment.

Addressing the environmental dimensions, mitigates direct and indirect impacts on human and ecosystem health. The following aspects are therefore suggested:

Multi-criteria analysis for technological selection

A technology should be:

- Environmentally sound
- Appropriate to local conditions
- Applicable and efficient in the context of the entire river basin
- Affordable to those who must pay for the services

Other aspects to consider during the technology selection process are:

- Awareness and the need for changes in behaviour
- Workable policies and regulations
- Possibilities for enforcement
- Technical performance and reliability (under variable wastewater flows, compositions and operational problems)
- Institutional manageability (planning, design, construction, operation and maintenance capacity including local availability of skilled human resources)
- Investment, operation, and maintenance costs

Selection criteria

Many factors influence the final selection of a system:

- Population density (number of people per hectare)
- Produced wastewater volume (in cubic meters per hectare per day)
- The presence of shallow water wells susceptible to wastewater pollution
- Soil permeability
- Unit cost of wastewater collection
- Socio-economic and cultural considerations.

Adapted from UNEP (2004)

Singhirunnusorn (2009) has highlighted seven attributes which determine the success of the treatment systems, and therefore must be taken into consideration during the evaluation and selection process of wastewater treatment technologies. The seven characteristics include:

1. System reliability
2. Simplicity
3. Land requirement
4. Affordability
5. Efficiency
6. Social acceptability and
7. Sustainability.

Singhirunnusorn (2009) also pointed out that local conditions and resource availability are important factors affecting the suitability of the wastewater treatment system in a particular situation. These include socioeconomic, physical, institutional and political conditions, and the extent of water pollution. The relationship between these factors is presented in figure 3 below (Singhirunnusorn, 2009).

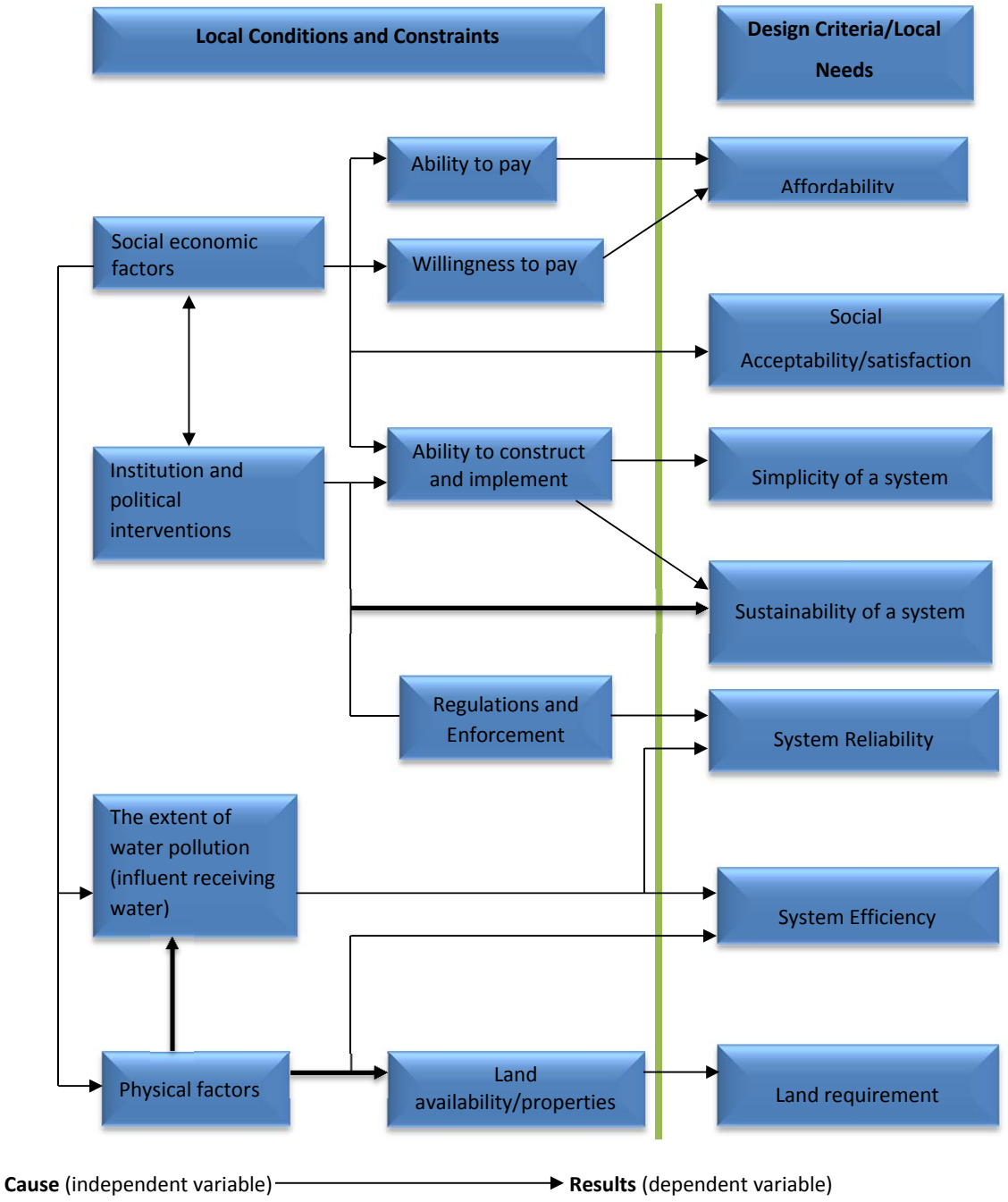


Figure 3: Framework of the relevant parameters and their interrelationship

The above has been further confirmed by Flores et al., (2008) as he also emphasized that selected technologies should be environmentally sustainable, appropriate to the local conditions, acceptable to the users, and affordable to those who have to pay for them. Simple solutions that are easily replicable, that allow further upgrading with subsequent development, and that can be operated and maintained by the local community, are often considered the most appropriate and cost-effective. Flores et al. also indicated that operational features of wastewater systems and their potential contribution to environmental sustainability include those presented in the table below.

Table 4: Operational features of wastewater and their contribution to the environment

Operational Feature	Potential Contribution to Environmental Sustainability
Decentralisation	Facilitates resource recovery at local level, facilitates source stream separation and thus separate treatment and reuse of the waste streams, minimize material and energy requirements through reduced wastewater infrastructure and transport distances, and allows adaptability to local conditions, including management at the household or community level.
Use of locally available and affordable resources (land, energy, materials, and labour)	In developing countries conventional wastewater treatment plants have often failed due to lack of local capacity to meet the required stable energy supply, materials, and human skills. Land availability may also be an issue as wastewater system components that are less technologically and mechanically complex may require more land area.
Waste flow stream separation	Contributes to sustainability by preventing cross-contamination and allowing for treatment appropriate to the wastewater quality, which can lead to reduced chemical and energy consumption and improved treatment. Facilitates recovery on nutrients and organic matter. Separation and upper disposal of urine can reduce groundwater pollution.
Water Conservation	If water supply is limited, water conservation (e.g., use of dry toilets) is a critical feature of a sustainable system. Because water extraction, treatment, and delivery consume materials and energy, minimizing water consumption is nevertheless a sensible step towards sustainability regardless of water availability. Low water use also makes pollution less mobile and, if necessary, manual emptying of toilet contents easier.
Nutrient and Organic Matter Recovery	Recovery of nutrients and organic matter from wastewater not only provide a renewable source of these valuable resources, but also reduces their potential negative environmental impacts, such as eutrophication. Use of wastewater derived nutrients and organic matter can be especially beneficial in developing countries where land has been severely degraded by erosion and over- farming, and where artificial fertilisers may be unaffordable.
Water Recovery	Wastewater is a renewable water source that can ease the demand on limited fresh water supplies. Depending on local regulations, highly treated wastewater can be used directly or indirectly to augment drinking water supplies. More widely accepted are its uses for mitigation of salinity intrusion, irrigation. At the household or community levels, grey water may be reused with or without treatment.
Energy Recovery	Organic matter in wastewater can be used as a renewable short term cycle carbon energy source, often done through anaerobic digestion of sludge to produce biogas for use as fuel: direct incineration of sludge can also be used.
Minimisation of Waste Sludge	Sludge from wastewater treatment is often viewed as a waste, even though it can actually be a valuable source of nutrients, organic matter, and energy. Treating sludge as a resource rather that waste can reduce its environmental impacts and the demand on other non-renewable sources of nutrients, organic matter, and energy.

WHO/UNEP, (1997) suggested that the suitability of various sanitation technologies must be appropriate to the type of community, i.e. rural, small town or urban. Typically, in low-income rural and peri-urban areas, on-site sanitation systems are most appropriate because:

• They are low-cost (due to the absence of sewerage requirements).

• They allow construction, repair and operation by the local community.

• They effectively reduce the most pressing public health problems.

The figure below indicates considerations in deciding on the appropriate wastewater treatment technology as suggested by WHO/UNEP (1997).

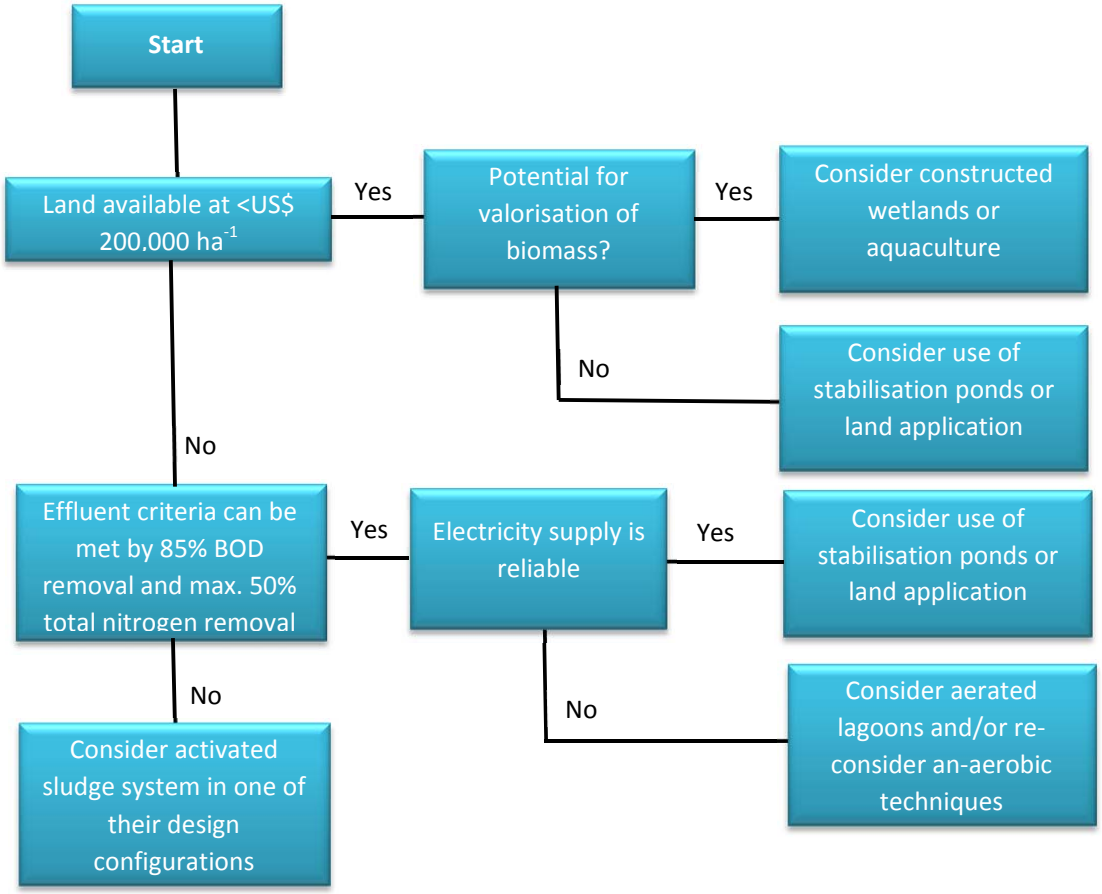


Figure 4: Classification of basic wastewater treatment technologies

UNEP (2004) emphasised the importance of public involvement and communication in planning and management of wastewater treatment systems. The involvement and communication with the public should address, *inter alia*, understanding potential obstacles to change, presenting relevant and practical options, and informing people about the impacts of choices they make. People must be informed and convinced, or else they do not feel part of a process and may not be motivated to change their behaviour.

Enforcement and evaluation of existing rules and regulations was identified by UNEP (2004) as one of the most difficult aspects of governance. The goal should be to have rules that are generally accepted by society and that can be easily enforced. Strong and objective

enforcement is required when certain parties clearly benefit economically from breaking the rules. Enforcing wastewater policy also entails:

- Monitoring water quality, comparing actual values with agreed effluent and receiving water quality standards
- Issuing discharge licenses
- Collecting discharge fees or penalties

Institutional arrangements and social participation in wastewater management should result in commitment to a clean environment and "catchment solidarity". This requires:

- A long-term strategy for institutional reform
- Capacity building to strengthen weak or inadequate structures, legal and regulatory instruments, and organizations, both inside and outside government
- Involvement of and real willingness to cooperate and contribute by all relevant actors
- Creation of continued awareness among citizens regarding their dual role as polluters and beneficiaries of wastewater management

Challenges, experiences and key aspects considered in selecting an appropriate wastewater treatment technology seem to be similar in South Africa and other countries. The aspects that were noted not to have set standards in South Africa are also mentioned as important in other countries; however, these other countries also do not provide details on any standards being used.

3. USING THE WRC WASTEWATER TREATMENT TECHNOLOGY SELECTION DECISION SUPPORT TOOL (W_2DST)

3.1 Introduction

Both web and spreadsheet-based versions of the decision support tool for wastewater treatment technology selection are available via RiskQ (www.riskq.co.za). The key advantages of using the web-based tools (in favour of the spreadsheet-based tools) include:

- Enhanced sharing (parties can access/edit a database at the same time)
- Enhanced security (sensitive information can be easily protected and users can be protected from making mistakes – e.g. deleting information, loading incorrect information)
- Efficiency and cost effectiveness (minimize duplication, economies of scale – enhancements rapidly available to all)
- Enhanced reporting (format the same data many ways in various reports create more interactive features/outputs)
- Ease of maintenance and lowered downtime (less likely to be corrupted than spreadsheet)
- Repository of information (hold greater numbers of records than spreadsheets)
- Less duplication (duplication of existing information in a new spreadsheet or creation of copies of existing spreadsheets lead to not knowing what the latest/correct version is.)

Despite the above advantages of the web-based tool, the choice of tool used is dependent on user preference and circumstance.

The following tool versions will be described:

1. Web-based wastewater treatment technology selection decision support tool (W_2DST)
2. Spreadsheet-based wastewater treatment technology selection decision support tool (W_2DST)

Both versions of the tool can be accessed directly via RiskQ. The sections that follow, provide a guide to the features of the decision support tool and how to successfully use them.

If you do not yet have access to RiskQ, you are welcome to test the tool versions using the following login details:

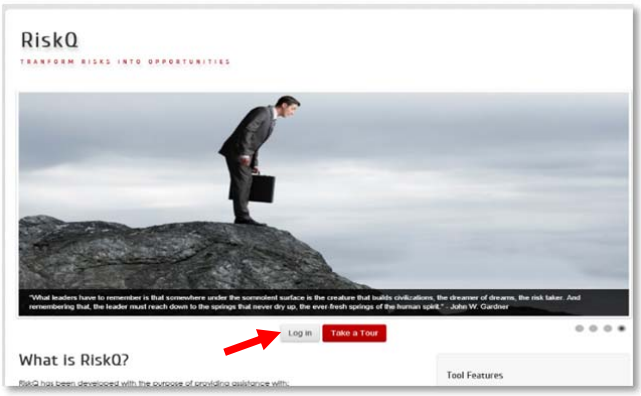
- *www.riskq.co.za*
- *Username: test1*
- *Password: 123*

If you would like your own personal access details, please contact RiskQ website administrators at Tel: 021 880 2932 or e-mail: info@riskq.co.za.

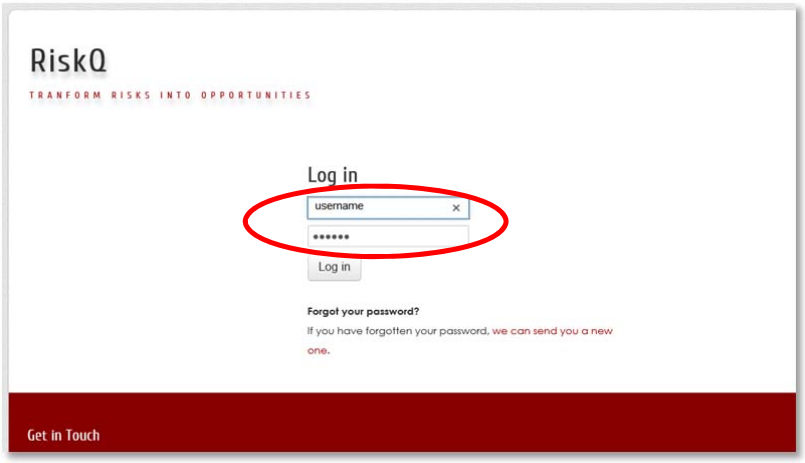
NOTE: *The W_2DST may in future be reviewed and updated to ensure that it is aligned to sector needs and requirements. The user should therefore make sure that the most recent version of the tool is used.*

3.2 Accessing the web-based tool

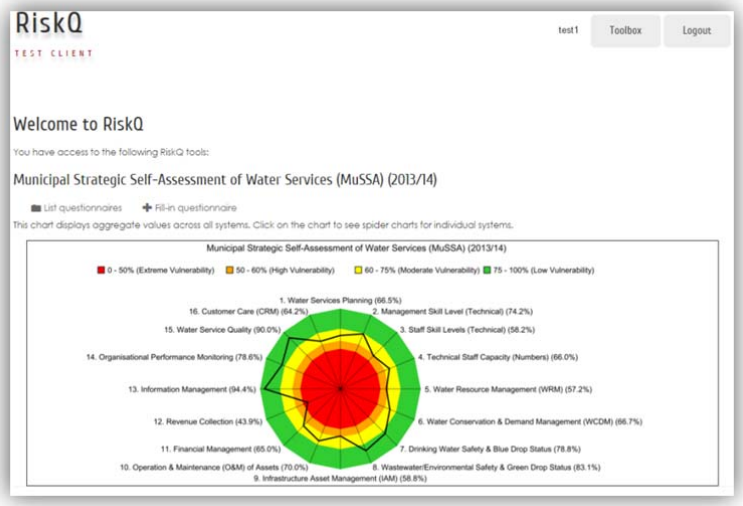
- Open your browser to www.riskq.co.za



- Click "Login". Complete your username and password. If you do not have personal access details to RiskQ, please contact the RiskQ webmaster at Tel: 021 880 2932 or E-mail: info@riskq.co.za.



- Once you are logged in, the Dashboard will open.

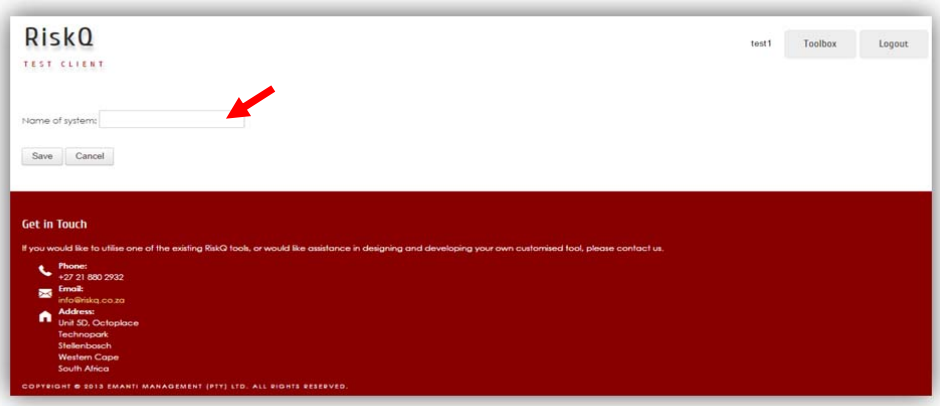


At this level, the user will see all the tools they are currently registered for and the current displayed performance.

- Using the tabs at the top of the Dashboard, go to "Toolbox" and select WRC Wastewater Treatment Technology Decision Support Tool.

- Select one of the options, that is, W_2DST – Initial assessment/screening or W_2DST – Detailed analysis
- Click on "fill in questionnaire" to complete a new assessment

- The following screen will be the start of the questionnaire (i.e. complete a new assessment)



The following important points are noted:

- The tool will sequentially take you through all steps required to be able to support a decision about the appropriate wastewater treatment technology for your conditions
- Answer all questions presented in the tool by clicking on the appropriate answer/making an appropriate selection or completing the required information
- Remember to click on "Next" or "Save and continue later" before you close the browser or your information will be lost (both of these buttons act as a "save" button and store your information). It is advised that the user frequently saves their work
- If required, outputs from the completed decision support tool can be copied and pasted to a document to be part of a report

Use of the web-based decision support tool consists of the following components and steps:

Step	Component
1	Initial assessment/screening
2	Detailed analysis

Each step is described in more detail in the sections that follow.

3.3 Using the web-based W_2DST – initial assessment/screening

It is recommended that you do the initial assessment/screening before you do the detailed

Step 1: Login to RiskQ and select the WRC – Initial assessment/screening tool

- Access the WRC W_2DST using the procedure explained in section 3.2
- Select the W_2DST – Initial assessment/screening option

Step 2: Fill in the system name

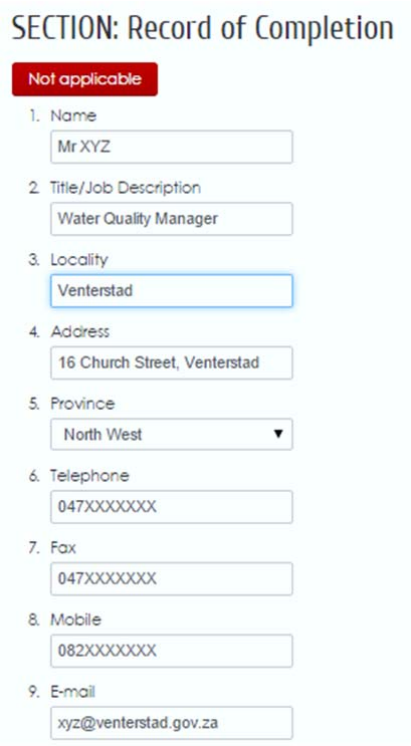
- Click on "fill in questionnaire" to complete a new assessment
- Complete the name of the wastewater treatment system to be assessed. If the

system does not exist yet, a suggested name could be used

- Click on the “save” button

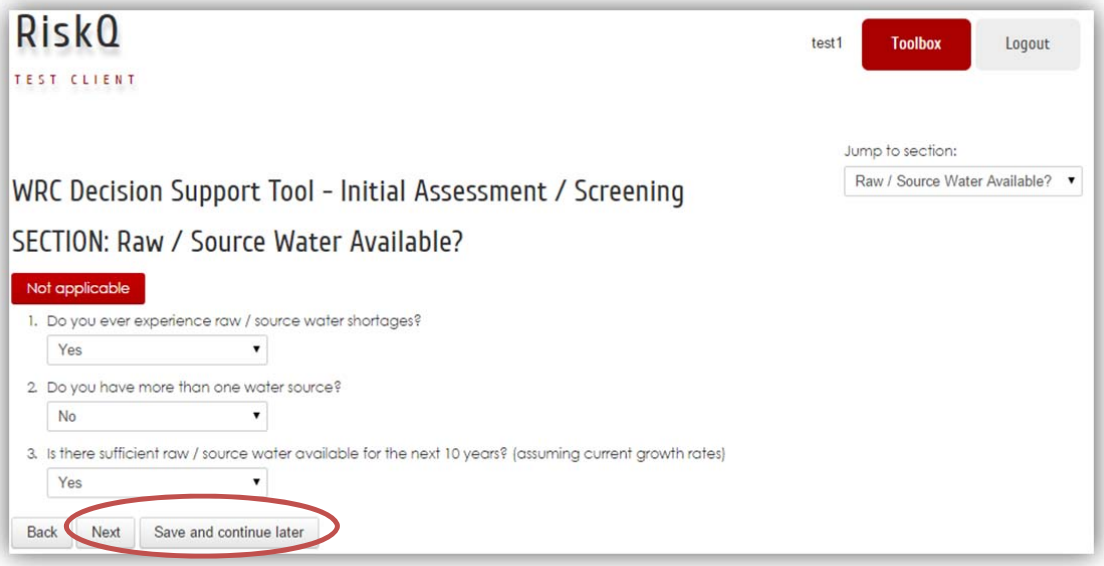
Step 3: Fill in record of completion

- The user will need to complete some general information before completing the assessment. This includes the contact details of the person providing the information and date of the assessment



Step 4: Initial assessment/screening

- Complete the “initial assessment/screening” component by clicking on the appropriate answer/making an appropriate selection or completing the required information. This will help the user to obtain an idea of the typical primary aspects to consider when choosing a wastewater treatment technology
- Remember to click on “Next” or “Save and continue later” before you close the browser or your information will be lost

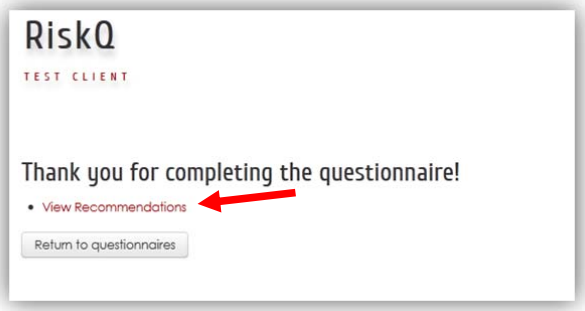


> ***NOTE:*** *With regards to the land availability question (section 2), the N/A option can be used. This takes into consideration systems that are being upgraded, therefore do not require large areas of land as they would when constructing a new system.*

At the end of all sections (i.e. section 5), click on "view recommendations" to view the output/recommendations.

Step 5: View Recommendations

- The table with a list of common wastewater treatment technologies in their order of preference will be presented
- The user should focus more on the preferred technology/ies. If there are none under preferred, the next level is "proceed with caution"
- It is advisable not to consider the treatment technologies under "Do not



Name	Test WR1
Submitted By	Test User
Date	20 April 2016

Recommendations

Preferred Technologies (75 - 100%)

Technology	Score	Total	%
Waste Stabilisation Ponds	9	11	82%

Proceed with caution (review inputs) (50 - 75%)

Technology	Score	Total	%
Rotating Biological Contactor	8	11	73%
Trickling / Biological Filters	8	11	73%

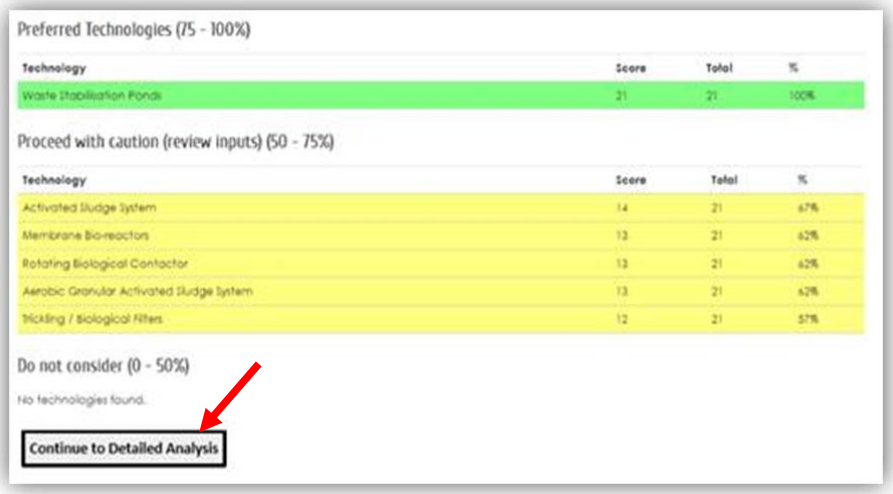
Do not consider (0 - 50%)

Technology	Score	Total	%
Aerobic Granular Activated Sludge System	5	11	45%
Membrane Bio-reactors	5	11	45%
Activated Sludge System	5	11	45%

> ***NOTE:*** *These are recommendations for initial assessment/screening which is only a preliminary part of the assessment.*
> *The initial assessment/screening assessment, assesses the user's preparedness in constructing a wastewater system or upgrading the existing using basic*

Consider the results of the initial assessment whilst proceeding to the detailed analysis.

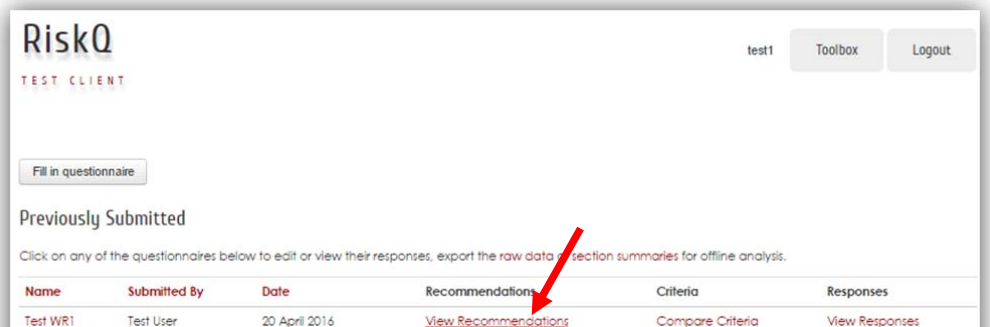
- Once you have completed the initial assessment, click on “continue to detailed analysis” at the bottom of the page.



3.4 Using the web-based W_2DST - detailed analysis

Step 1: Login to RiskQ and select the WRC – Detailed analysis

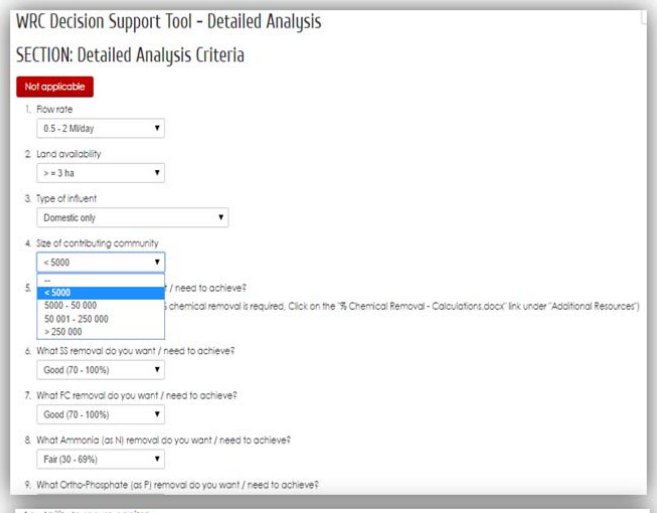
- If you have just completed the initial assessment, continue to detailed analysis.
- If you completed the initial assessment on a different day, you have to first login as described in section 3.2
- Select the W_2DST – Initial assessment/ screening option
- The list of completed assessment will be presented
- Click on “view recommendations” of the system you want complete the detailed analysis for. For an example, if you want to continue with the analysis of Test WR 1 system.

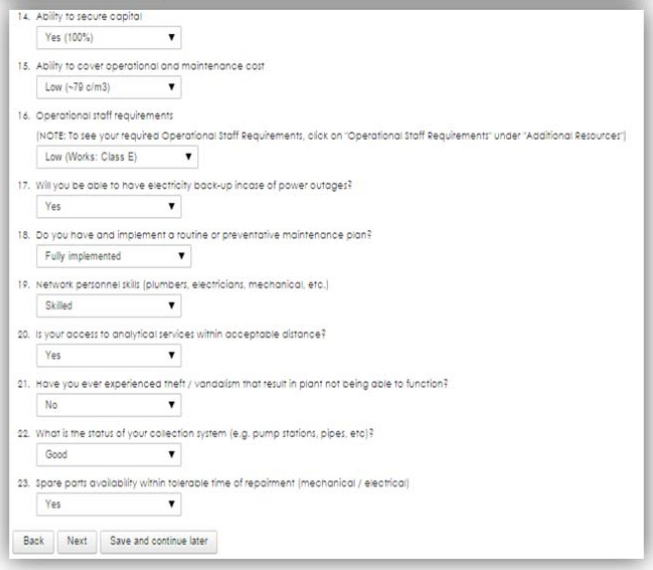


- At the end of the view recommendations page, click “continue to detailed analysis”.
- The list of completed assessment will be presented.

Step 4: Complete detailed analysis

- Complete the “detailed analysis” component by clicking on the appropriate answer/making an appropriate selection or completing the required information. This will help the user to obtain an idea of the typical overall aspects to consider when choosing a wastewater treatment technology
- Remember to click on “Next” or “Save and continue later” before you close the browser or your information will be lost



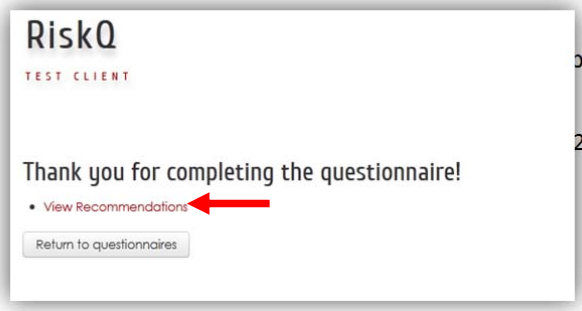


> ***NOTE:*** *answers to some of the questions are guided by the information found under “additional Resources”.*

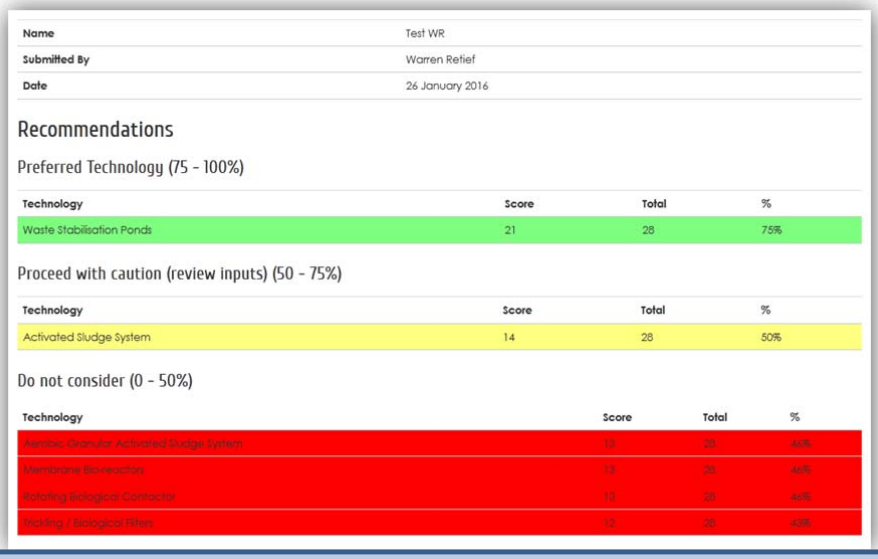
- At the end of all questions, click “next” or “save and continue later”
- The next page will indicate that you have completed the questionnaire
- At the end of all questions, click on “view recommendations” to view the output

Step 5: View Recommendations

- The table with a list of common wastewater treatment technologies in



- The user should focus more on the preferred technology/ies. If there are none under preferred, the next level is "proceed with caution"



Name	Test WR
Submitted By	Warren Retief
Date	26 January 2016

Recommendations

Preferred Technology (75 - 100%)

Technology	Score	Total	%
Waste Stabilisation Ponds	21	28	75%

Proceed with caution (review inputs) (50 - 75%)

Technology	Score	Total	%
Activated Sludge System	14	28	50%

Do not consider (0 - 50%)

Technology	Score	Total	%
Aerobic Granular Activated Sludge System	13	28	46%
Membrane Bioreactor	13	28	46%
Rotating Biological Contactor	13	28	46%
Trickling / Biological Filters	13	28	46%

At this point the user should take the time to consider the results of the initial assessment and that of the detailed analysis. This should assist the user in identifying the technology that best

Step 6: Combined Scores

- Click "combined scores" at the bottom of view recommendations table
- A table with a combination of initial assessment and detailed analysis results will be presented
- The table is automatically in the order or preference of the detailed analysis results

Preferred Technologies (75 - 100%)

Technology	W2DST Initial Assessment Score	Total	%	W2DST Detailed Analysis Score	Total	%
Waste Stabilisation Ponds	9	11	82%	21	21	100%

Proceed with caution (review inputs) (50 - 75%)

Technology	Score	Total	%	Score	Total	%
Rotating Biological Contactor	8	11	73%	14	21	67%
Trickling / Biological Filters	8	11	73%	13	21	62%

Do not consider (0 - 50%)

Technology	Score	Total	%	Score	Total	%
[illegible]	[illegible]	[illegible]	[illegible]	13	21	62%
[illegible]	[illegible]	[illegible]	[illegible]	13	21	62%
[illegible]	[illegible]	[illegible]	[illegible]	12	21	57%

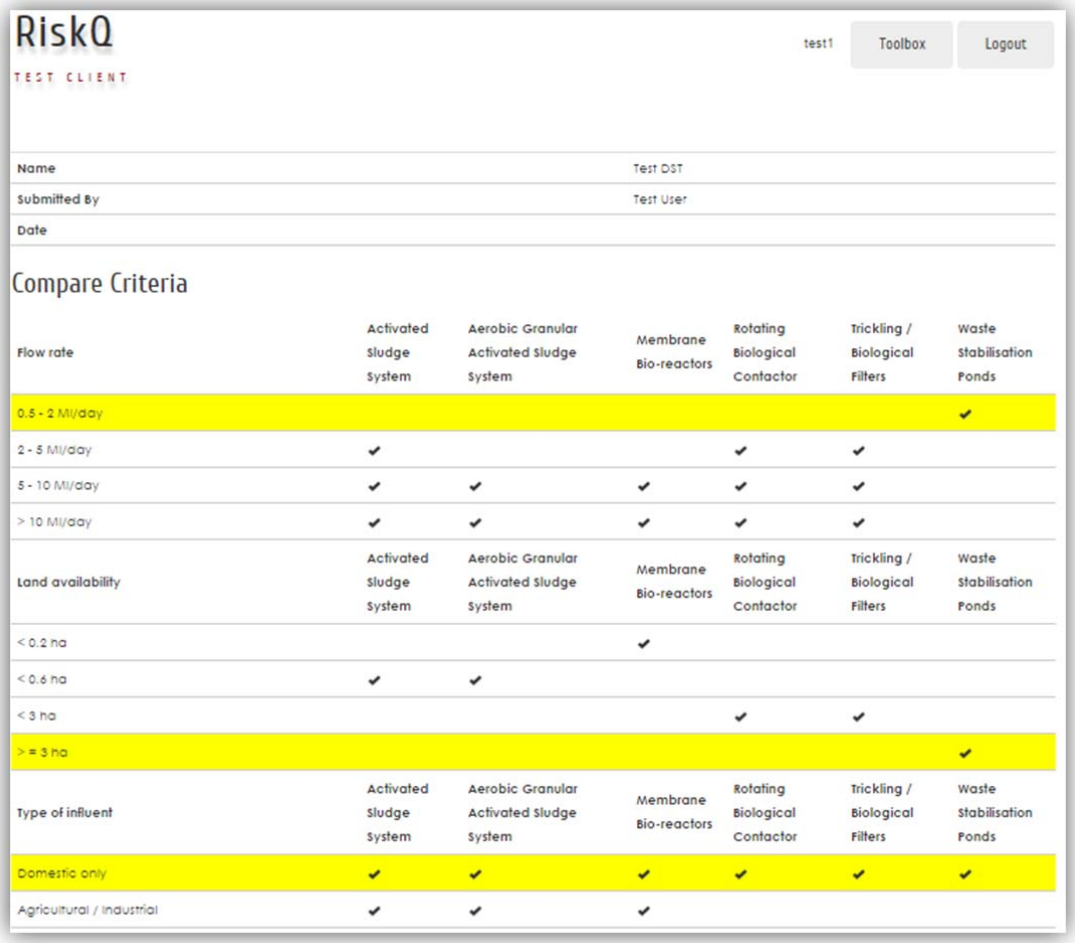
- Consider the most preferred technologies listed under the detailed analysis
- However, take note of the initial assessment/screening aspects
- Identify the most suitable technology for your conditions

You might want to understand what your output would have been should you have made a different choice?

Step 7: Compare wastewater treatment technologies

- Click on "compare technologies" at the bottom of the combined scores table

- A table listing the different wastewater treatment technologies will be shown, as well as an indication of suitable criteria conditions (tick)
- The rows that have the answer you selected for each criteria under the detailed assessment, will be highlighted
- This comparison will assist you to identify where you would fall if conditions might change



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TEST CLIENT

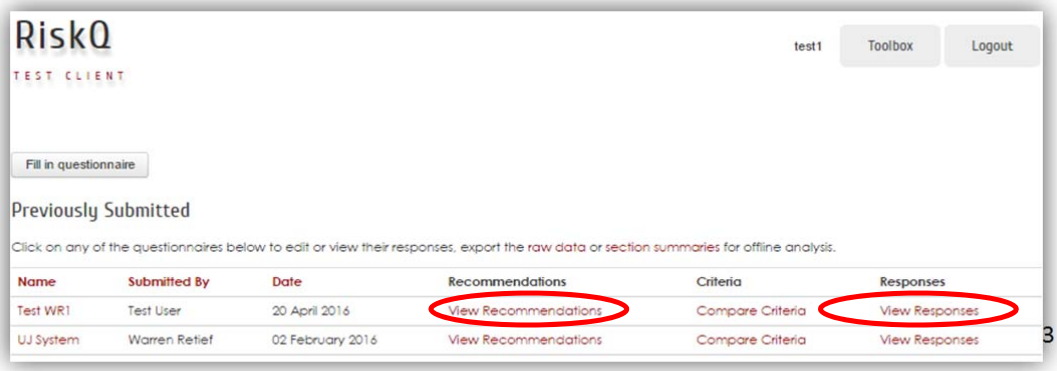
test1 Toolbox Logout

Name	Test DST
Submitted By	Test User
Date	

Compare Criteria

Flow rate	Activated Sludge System	Aerobic Granular Activated Sludge System	Membrane Bio-reactors	Rotating Biological Contactor	Trickling / Biological Filters	Waste Stabilisation Ponds
0.5 - 2 Ml/day						✔
2 - 5 Ml/day	✔			✔	✔	
5 - 10 Ml/day	✔	✔	✔	✔	✔	
> 10 Ml/day	✔	✔	✔	✔	✔	
Land availability	**Activated Sludge System**	**Aerobic Granular Activated Sludge System**	**Membrane Bio-reactors**	**Rotating Biological Contactor**	**Trickling / Biological Filters**	**Waste Stabilisation Ponds**
< 0.2 ha			✔			
< 0.6 ha	✔	✔				
< 3 ha				✔	✔	
> = 3 ha						✔
Type of influent	**Activated Sludge System**	**Aerobic Granular Activated Sludge System**	**Membrane Bio-reactors**	**Rotating Biological Contactor**	**Trickling / Biological Filters**	**Waste Stabilisation Ponds**
Domestic only	✔	✔	✔	✔	✔	✔
Agricultural / Industrial	✔	✔	✔			

You can view recommendations and responses of the completed assessments by clicking the respective buttons.



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TEST CLIENT

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Fill in questionnaire

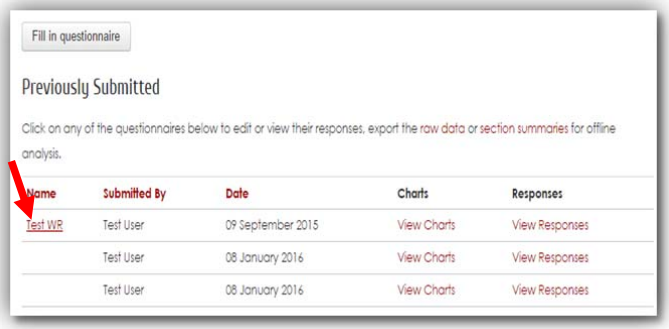
Previously Submitted

Click on any of the questionnaires below to edit or view their responses, export the raw data or section summaries for offline analysis.

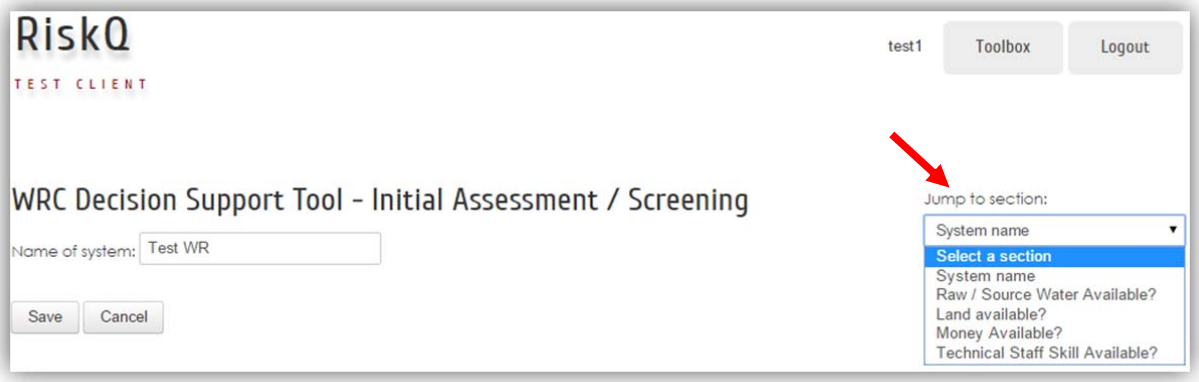
Name	Submitted By	Date	Recommendations	Criteria	Responses
Test WR1	Test User	20 April 2016	View Recommendations	Compare Criteria	View Responses
UJ System	Warren Retief	02 February 2016	View Recommendations	Compare Criteria	View Responses

3.5 Amending existing assessments

- Access the WRC W_2DST using the procedure explained in section 3.2
- Select the tool you want to amend (whether the initial or detailed analysis)
- To amend existing assessments that have previously been submitted/completed, click on the name of the assessment

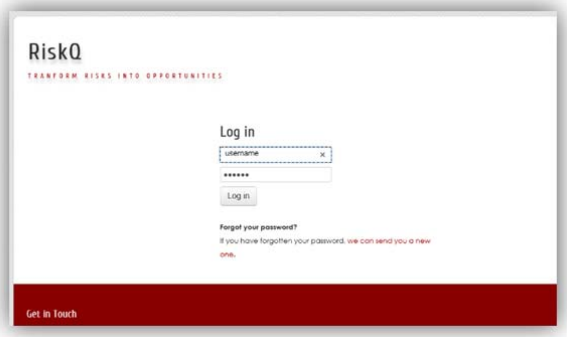


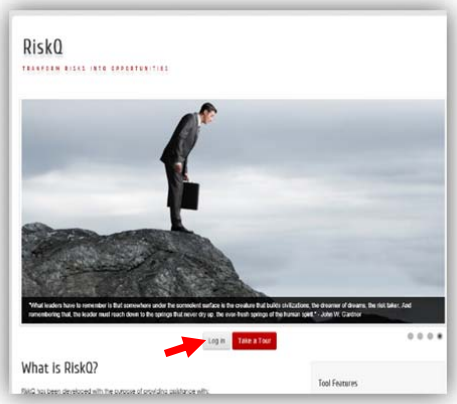
- Once you select the name of the assessment you want to amend, a screen with the name of the system will open allowing you to amend the questionnaire
- You can choose the section you want to amend by clicking on "jump to section" on the right of the screen
- Amend the assessment and save



3.6 Accessing the spreadsheet-based tool and other supportive information

- Go to www.riskq.co.za
- Complete your username and password. Click "Login"

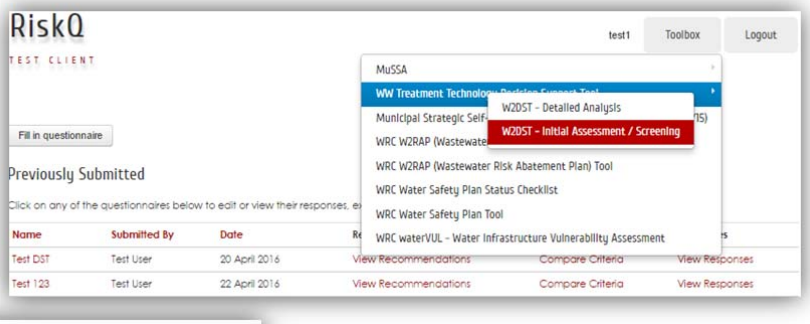


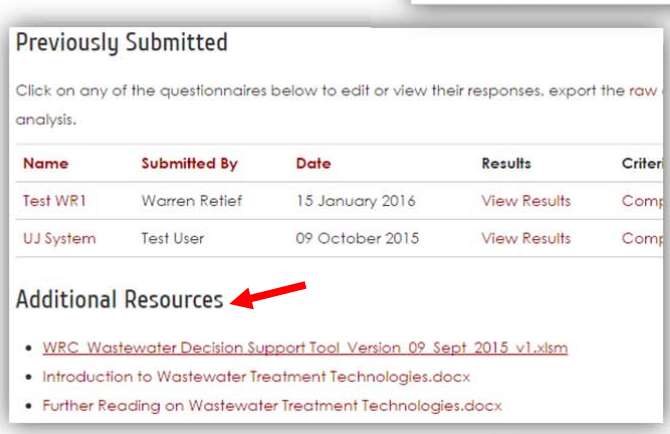


- Once logged in, the Dashboard will open

3.6.1 Selecting additional resources for the Initial Assessment/Screening

- Using the tabs at the top of the Dashboard, go to "Toolbox". Select the WW Treatment Technology Decision Support Tool: W_2DST - Initial assessment/Screening

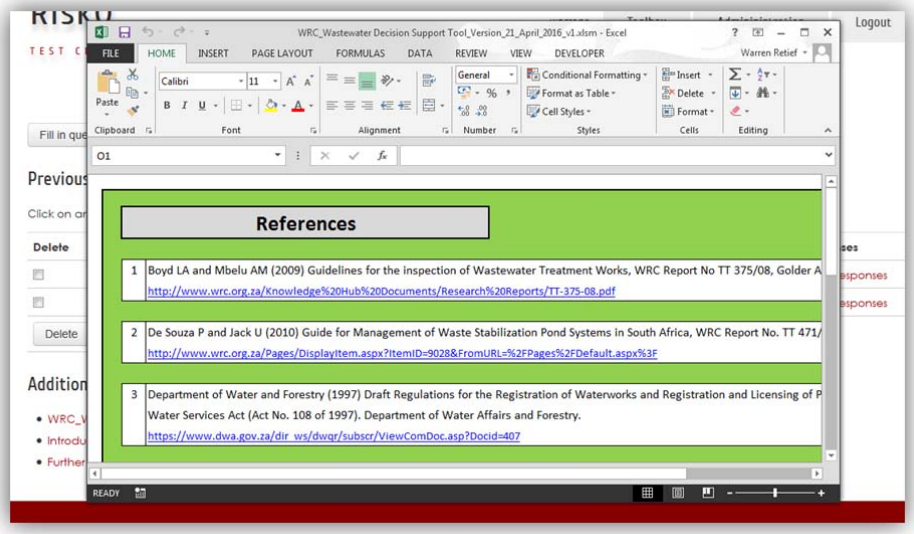




- At the bottom left corner of the newly loaded page, click on the link of the information you want under "Additional Resources"

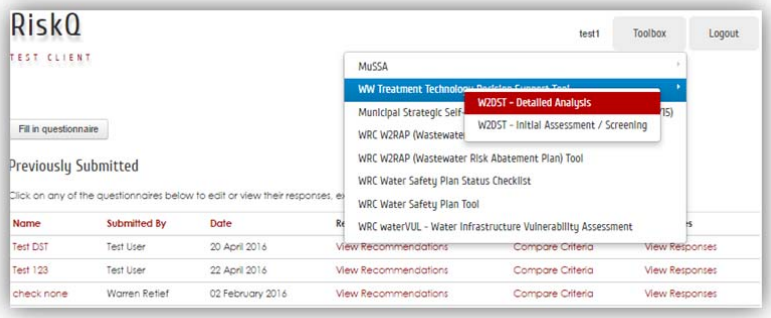
- For an example, if you click on "WRC Wastewater Decision Support Tool", a message box will ask if you want the spreadsheet file to be opened/saved
- The spreadsheet can be saved to a suitable location and opened from there, as shown alongside

- Other decision support related items that may be of use and which are also contained under "Additional Resources", include:
    - Introduction to wastewater treatment technologies – this provides a summarised introduction on the wastewater treatment technologies included in the tool
    - Further reading on wastewater treatment technologies – this provides a list of references related to wastewater treatment technologies and sludge management

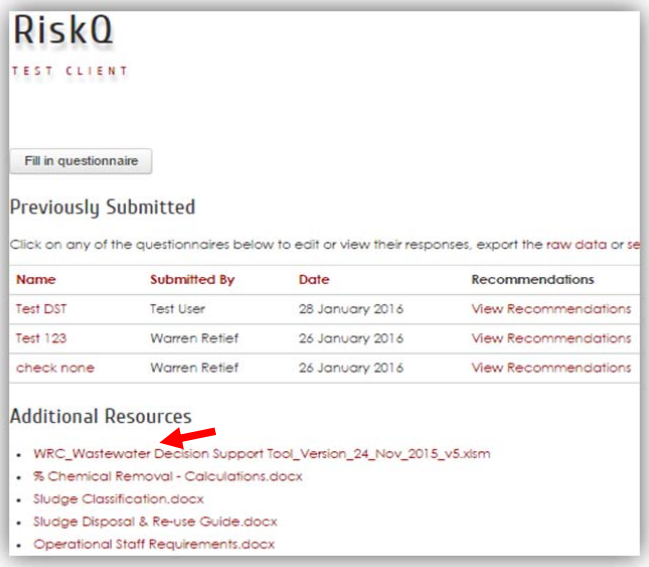


3.6.2 Selecting additional resources for the Detailed Analysis

- To access the detailed analysis tool additional resources, use the tabs at the top of the

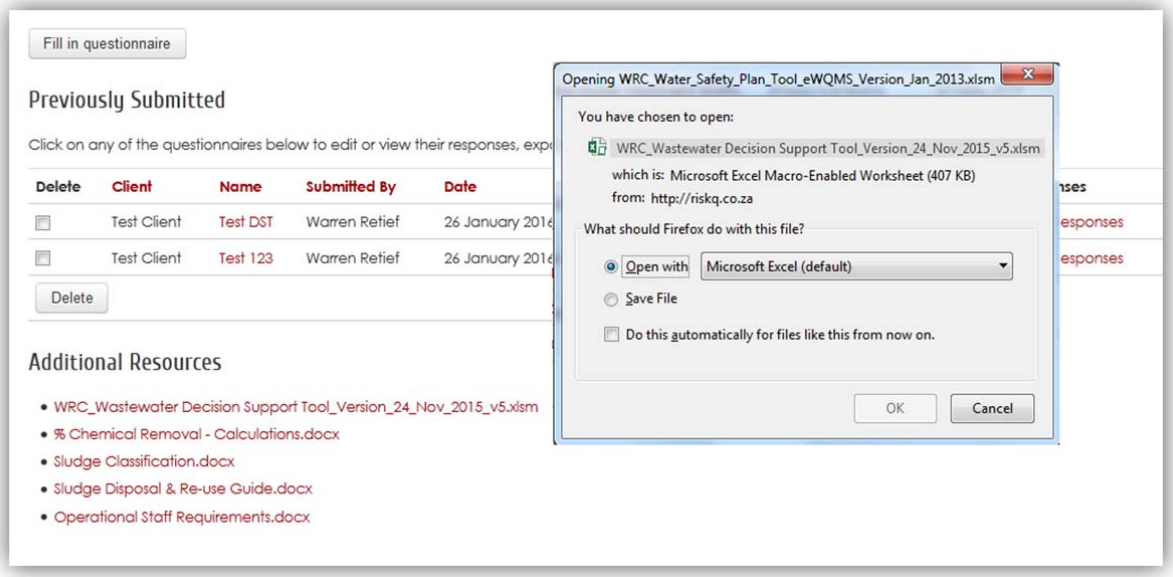


Dashboard, and go to “Toolbox”. Select the WW Treatment Technology Decision Support Tool: W_2DST - detailed analysis

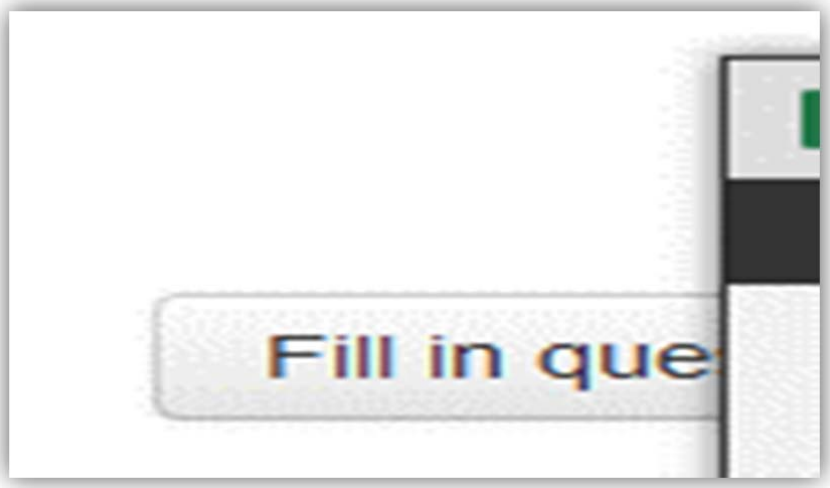


- At the bottom left corner of the newly loaded page, click on the document you want under “Additional Resources”

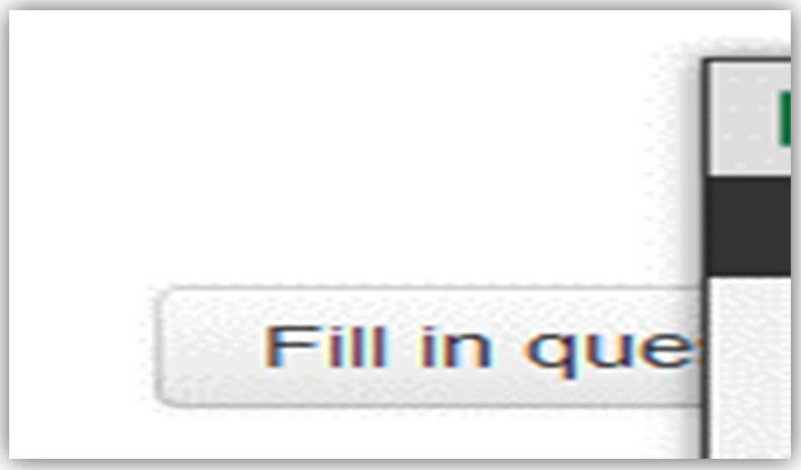
- To download the spreadsheet based tool, click on “WRC Wastewater Decision Support Tool”. A message box will ask if you want the spreadsheet file to be opened/saved
- The spreadsheet can be saved to a suitable location and opened from there, as shown below



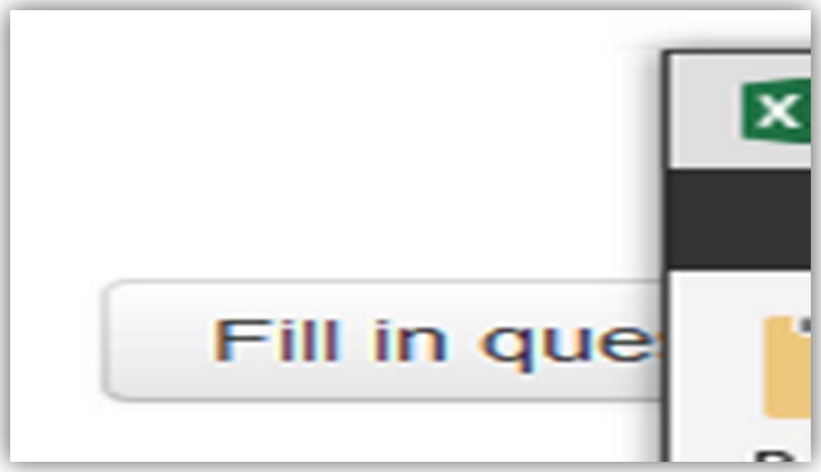
- Other decision support related items that may be of use and which are also contained under “Additional Resources”, include:
    - % Chemical Removal – Calculations - this provides guidance on the efficiency of the technologies to remove the specified parameters



- Sludge classification – this provides guidance on how sludge is classified

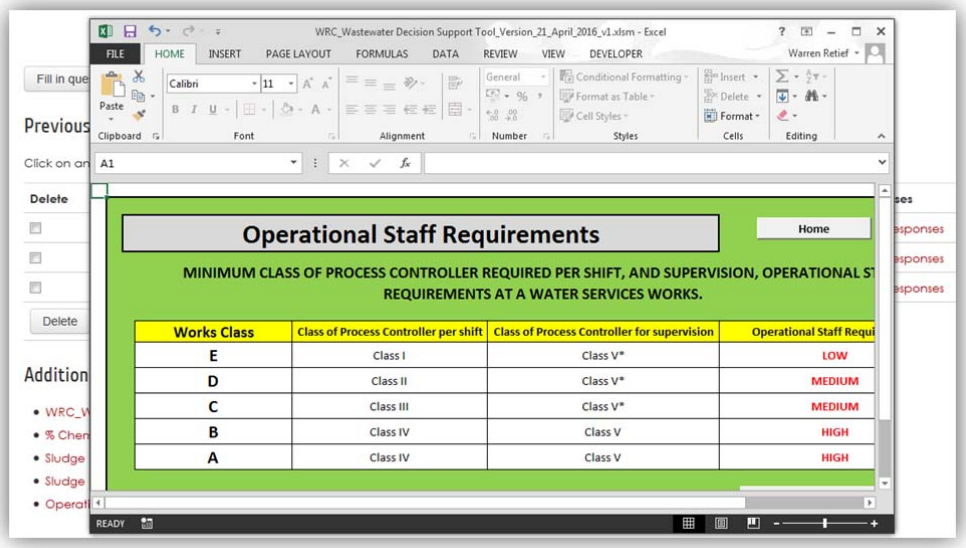


- Sludge Disposal and Reuse Guide – this provides guidance on the sludge disposal and re-use options, relative to the sludge class



- Operational Staff

Requirements - this provides guidance on the operational staff skills requirements, relative to the class of works



3.7 Completing the spreadsheet-based tool

The following important points are noted:

- The tool will sequentially take you through all steps required to be able to support a decision about the appropriate wastewater treatment technology for your conditions
- Answer all questions presented in the tool by clicking on the appropriate answer/making an appropriate selection or completing the required information
- It is advised that the user frequently saves their work
- Tabular reports will be generated in the Summary sheets
- If required, outputs from the completed decision support tool can be copied and pasted to a document

Use of the spreadsheet-based decision support tool consists of the following components and steps:

Step	Component
1	Initial assessment/screening
2	Detailed analysis

Each step is described in more detail below.

Step 1: Login to RiskQ and download the wastewater treatment decision support tool

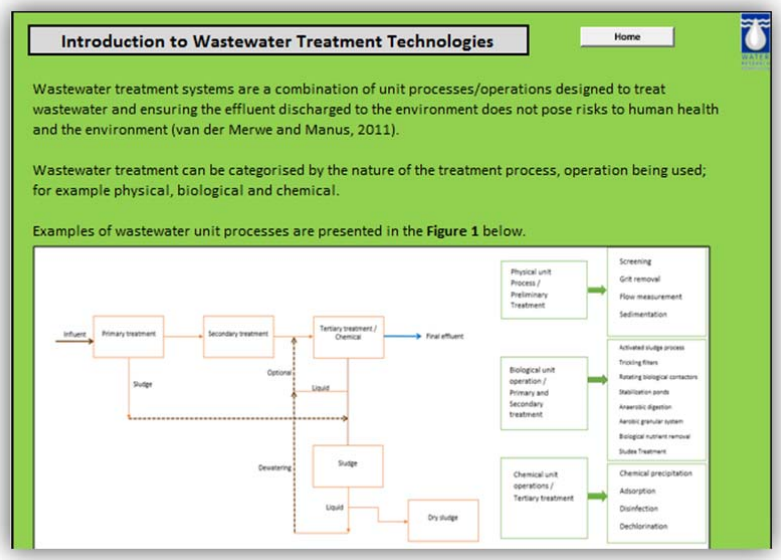
- Go to www.riskq.co.za
- Complete your username and password. Click “Login”
- Download the wastewater treatment decision support tool (as described in Section 3.6)

- The wastewater treatment technology decision support tool is a macro-enabled spreadsheet (*.xlsm). **In order to use the W_2DST, macros need to be enabled**
- The tool menu assists with navigating through the tool
- To read about commonly used wastewater treatment technologies, click on the "wastewater treatment technologies" button
- To complete the initial assessment/screening, click on the "initial assessment/screening" button. This will take you through the 5 sections of this section
- To complete the detailed analysis, click on the "detailed analysis" button. This will take you through all sections of this analysis
- To compare criteria for different wastewater treatment technologies, click on the "compare technologies" button

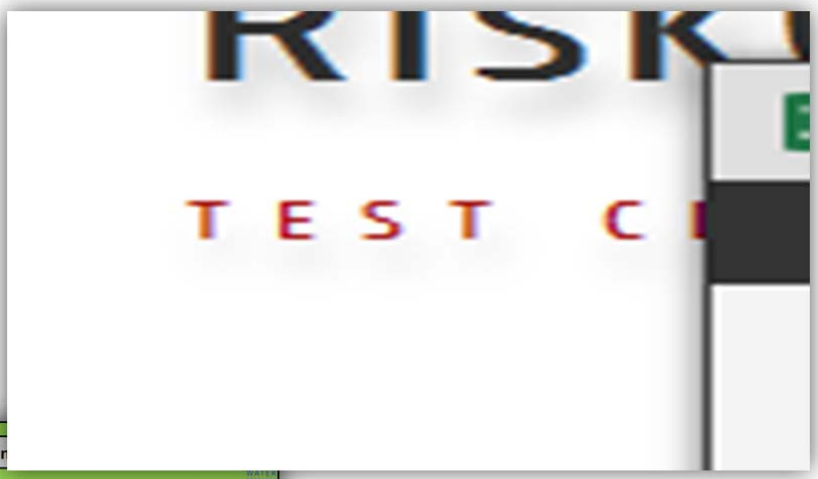
- You can click on any of the menu options in the blocks shown in the home page, as illustrated below.

Step 2: Introduction to Wastewater Treatment Technologies

- Click on the "wastewater treatment technologies" button on the Menu. A brief summary about commonly used wastewater treatment technologies will open.



- At this point, you can either go back to the top of the page or continue further reading about wastewater treatment technologies
- To go back on top of the page, click on the "Back to Top" button at the end of the page
- To view a page that will provide you with references that contain more relevant information, click on the "Read more" button at the bottom of the page and the following page will appear
- Click on "home" at the top of the page to go back the home page

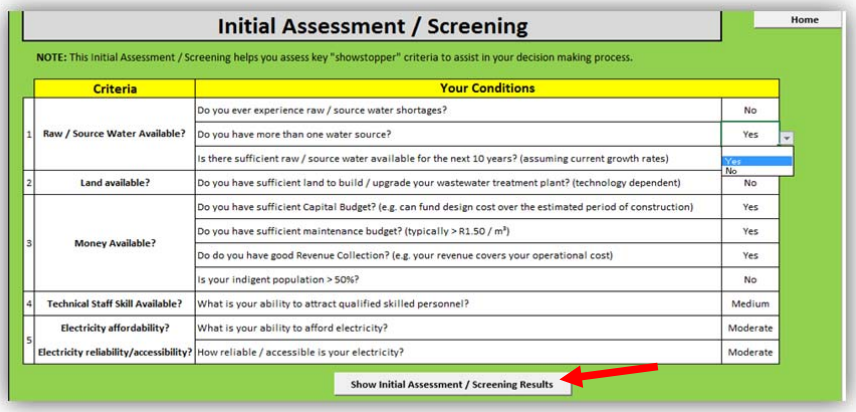


- It is recommended that you start with the initial assessment/screening whether you have an existing wastewater treatment system or whether you want to build a new wastewater treatment system

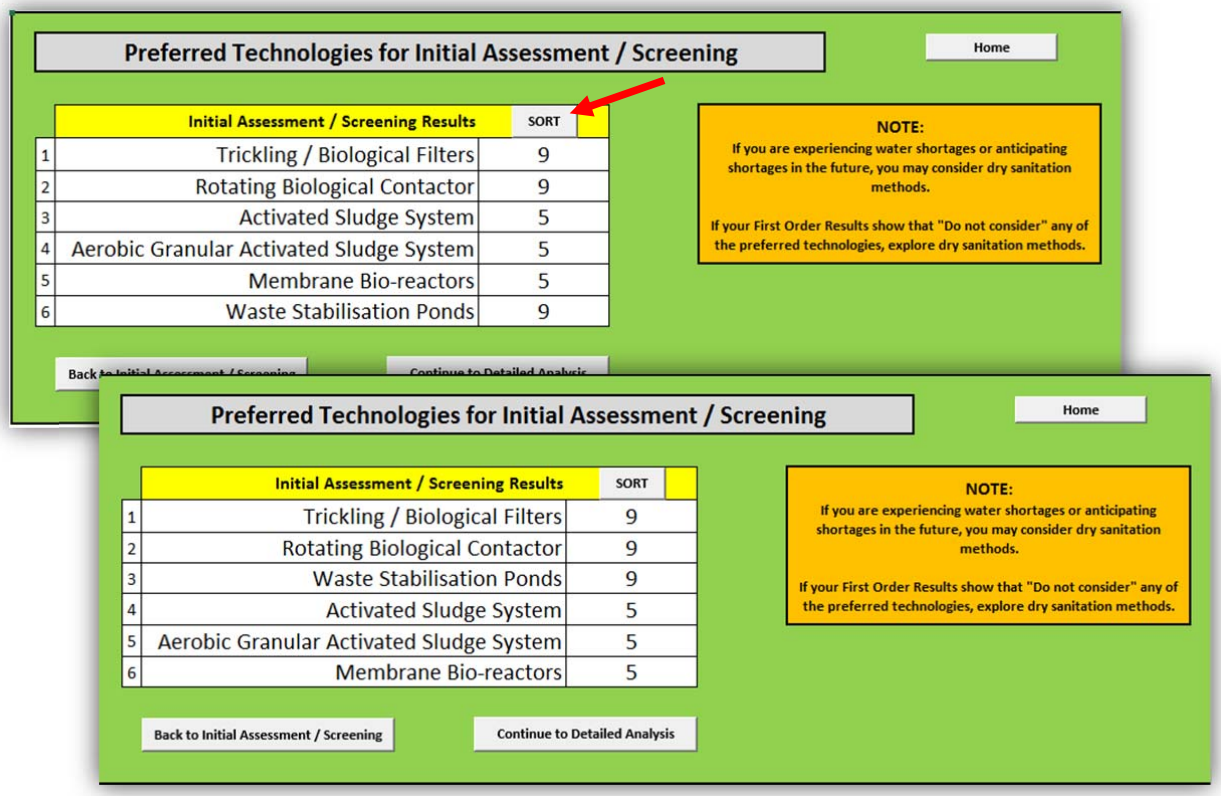
- Click on initial assessment/screening to complete your initial assessment/screening

Step 3: Initial assessment/screening

- Complete the "initial assessment/screening" by clicking on the appropriate answer/making an appropriate selection from the drop down menu or completing the required information
- Remember to regularly save your work or your information will be lost
- Once you have answered all the questions, click on the "show initial assessment/screening results" at the bottom of the page

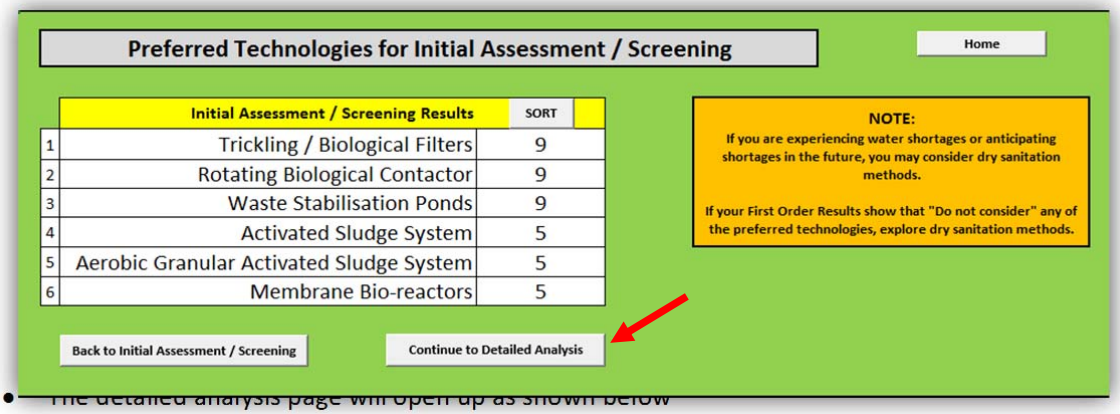


- The table with the initial assessment/screening results will appear with scores indicating the order of preference
- The higher the score the more preferred the technology
- You can sort your list of results such that the most preferred wastewater treatment technologies are on top and the less preferred at the bottom
- Click "sort" to sort your list according to the order of preference as shown below

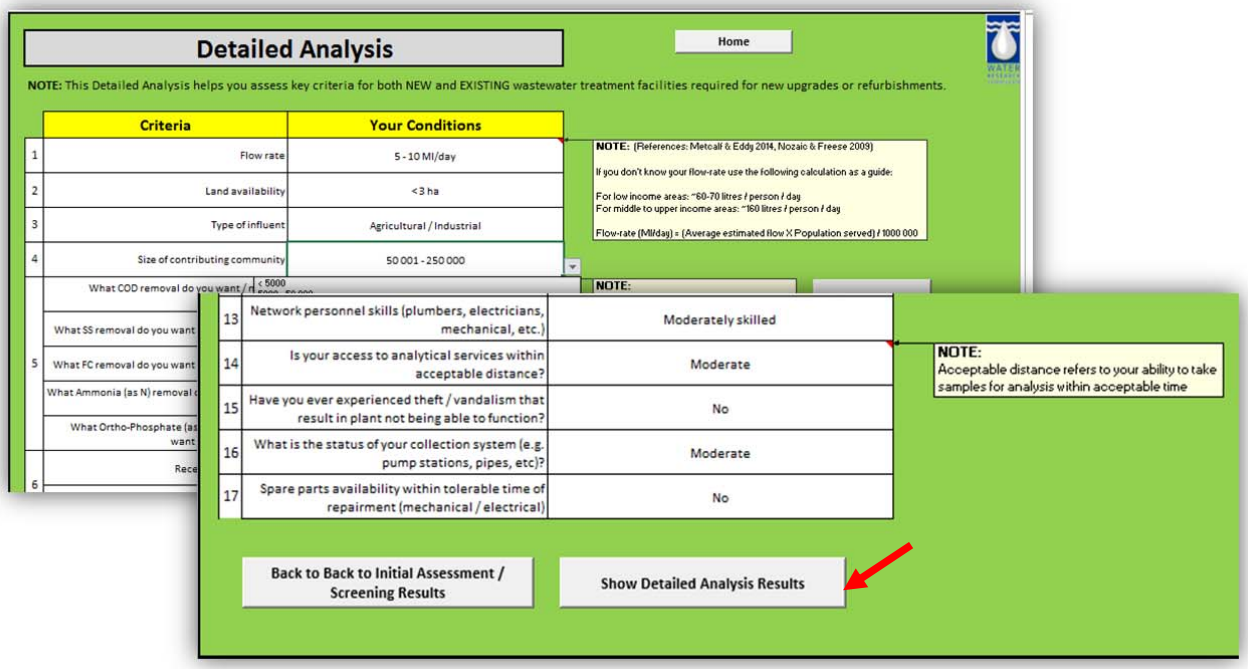


Step 4: Detailed analysis

- Click on “continue to detailed analysis” button at the bottom of the results page to complete the detailed analysis

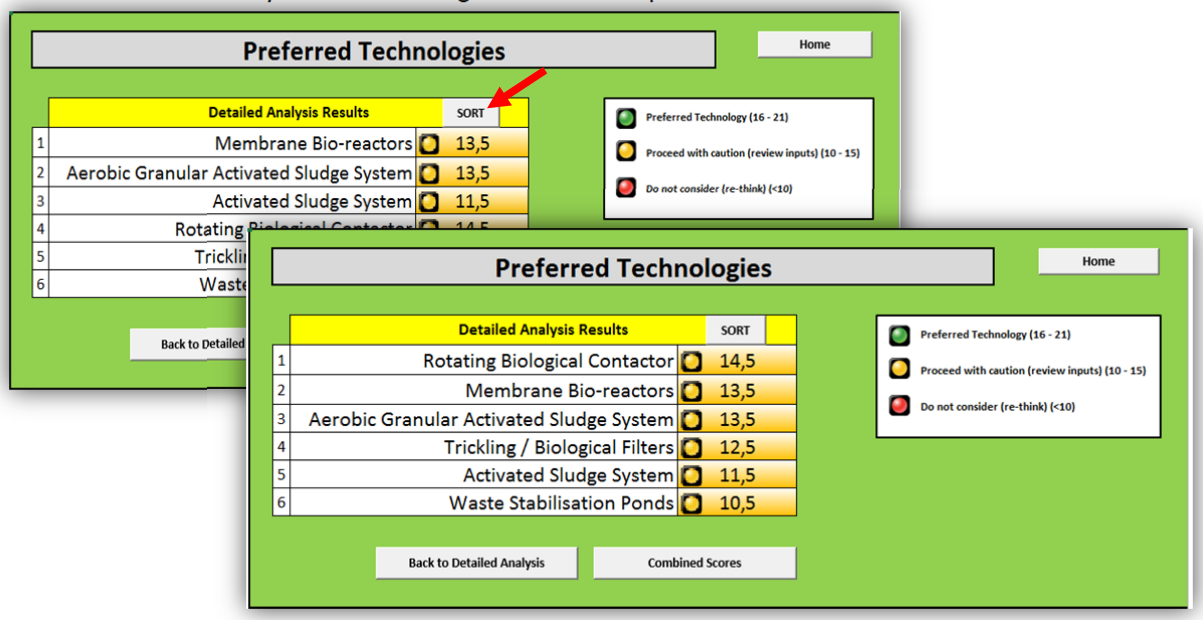


- The detailed analysis page will open up as shown below
- Select appropriate answers for all the criteria conditions from the drop down menu
- When you have answered all the questions, click “show detailed analysis results” at the bottom of the page



- The table with the detailed analysis results will appear with scores indicating the order of preference
- The higher the score the more preferred is the technology
- Use the legend with the green, yellow and red colours on the right of the table as a guide to the preference of technologies
- You can sort your list of results such that the most preferred wastewater treatment technologies are on top and the less preferred at the bottom

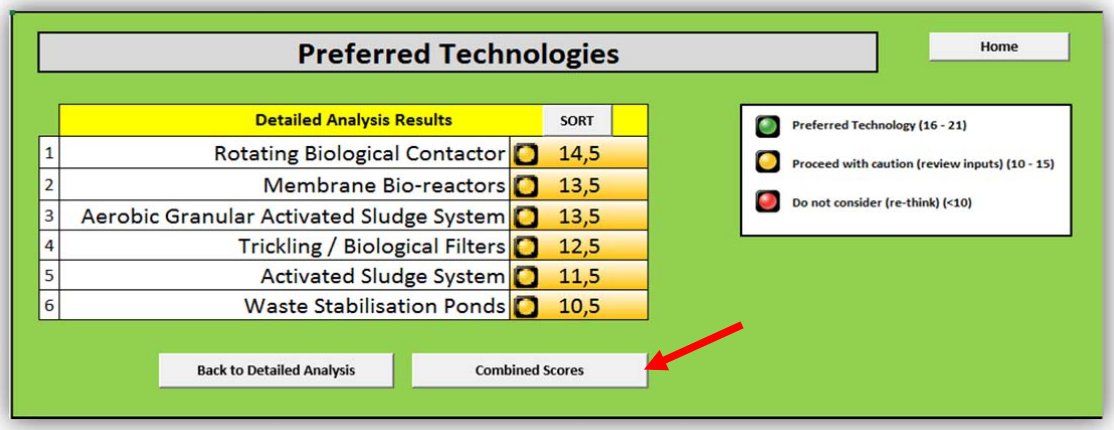
- Click “sort” to sort your list according to the order of preference as follows

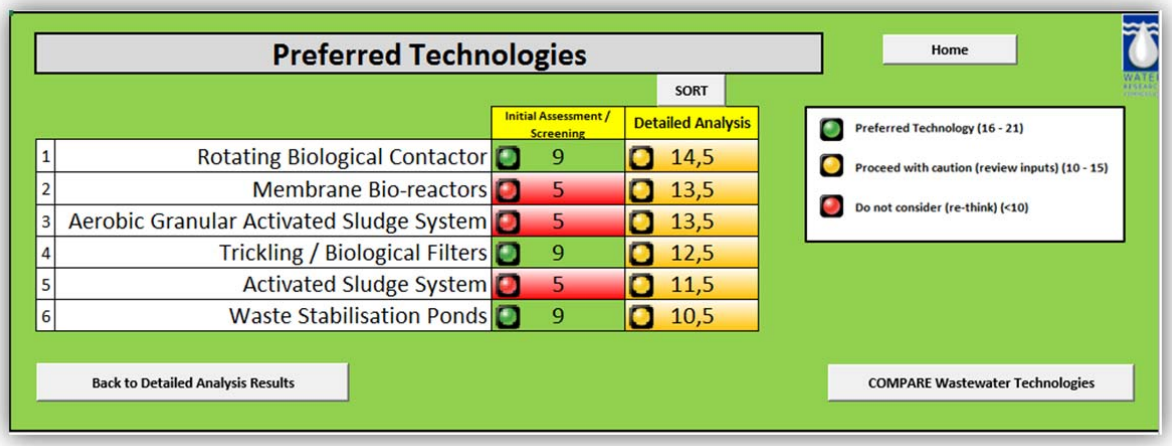


Now you have an idea of the preferred technologies according to the detailed analysis conditions. You need to align the first order analysis results with the detailed analysis results. This will ensure that the conditions of the first order analysis are incorporated into the detailed analysis when making a decision.

Step 5: Compare results of initial and detailed assessments

- Click “combined scores” at the bottom of the results page as shown below





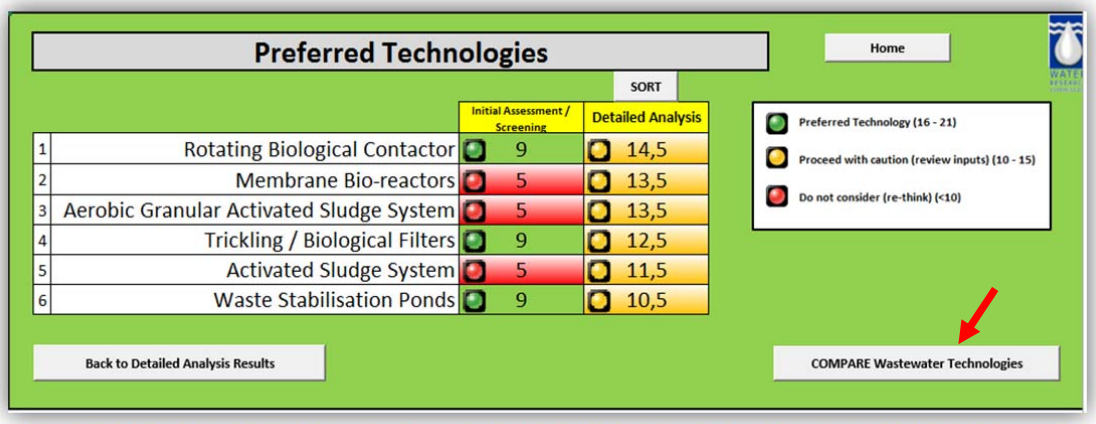
presented

- Only the detailed analysis column can be sorted at this stage of comparison

> - Consider the most preferred technologies listed under the detailed analysis
> - However, take note of the first order aspects
> - Identify the most suitable technology for your conditions

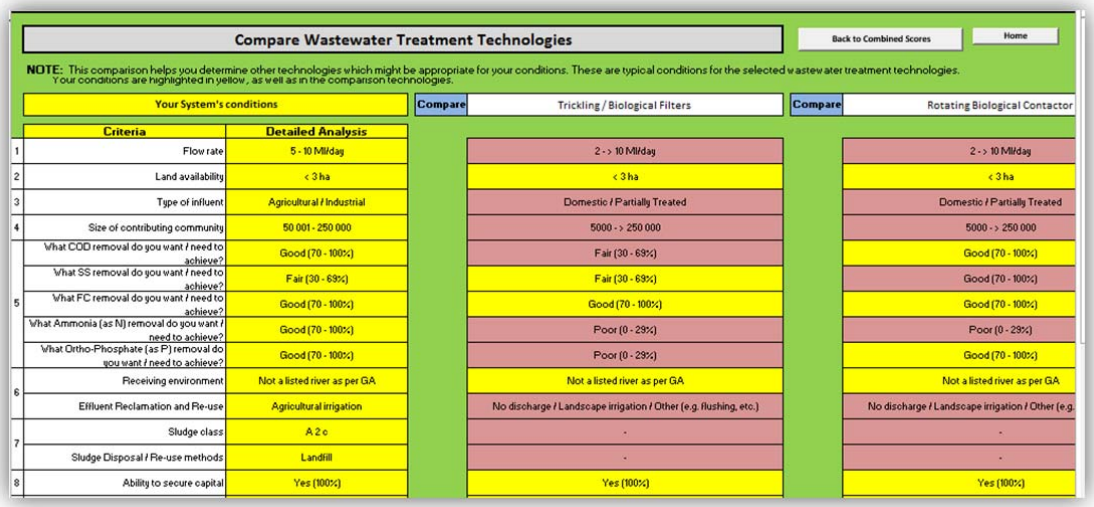
Step 6: Compare wastewater treatment technologies

- You may consider comparing your conditions (identified in the detailed analysis) with other wastewater treatment technology conditions to be able to make a suitable decision
- Click “compare wastewater technologies” at the bottom of the combined scores page as shown below. This assists in understanding the options should the current situation or conditions change.



- Your conditions provided in the detailed analysis will be highlighted under “detailed analysis” column
- There are “compare” highlighted cells in the columns towards the right
- Select the type of technology / technologies you would like to compare your conditions with, using the drop down menu next to the compare cells as shown below
- Once you have selected the type of wastewater treatment technology you would like to compare with, the most preferable conditions for that technology will be listed
- The conditions that are similar to yours are highlighted with the same colour as the detailed analysis column (i.e. your conditions)

- This provides a quick view of similarities and differences in the compared wastewater treatment



Compare Wastewater Treatment Technologies

Back to Combined Scores | Home

NOTE: This comparison helps you determine other technologies which might be appropriate for your conditions. These are typical conditions for the selected wastewater treatment technologies. Your conditions are highlighted in yellow, as well as in the comparison technologies.

	Your System's conditions		Compare	Trickling / Biological Filters	Compare	Rotating Biological Contactor
	Criteria	Detailed Analysis				
1	Flow rate	5 - 10 Ml/day		2 - > 10 Ml/day		2 - > 10 Ml/day
2	Land availability	< 3 ha		< 3 ha		< 3 ha
3	Type of influent	Agricultural / Industrial		Domestic / Partially Treated		Domestic / Partially Treated
4	Size of contributing community	50 001 - 250 000		5000 - > 250 000		5000 - > 250 000
5	What COD removal do you want / need to achieve?	Good (70 - 100%)		Fair (30 - 69%)		Good (70 - 100%)
	What SS removal do you want / need to achieve?	Fair (30 - 69%)		Fair (30 - 69%)		Good (70 - 100%)
	What FC removal do you want / need to achieve?	Good (70 - 100%)		Good (70 - 100%)		Good (70 - 100%)
	What Ammonia (as N) removal do you want / need to achieve?	Good (70 - 100%)		Poor (0 - 29%)		Poor (0 - 29%)
	What Ortho-Phosphate (as P) removal do you want / need to achieve?	Good (70 - 100%)		Poor (0 - 29%)		Good (70 - 100%)
6	Receiving environment	Not a listed river as per GA		Not a listed river as per GA		Not a listed river as per GA
	Effluent Reclamation and Re-use	Agricultural irrigation		No discharge / Landscape irrigation / Other (e.g. flushing, etc.)		No discharge / Landscape irrigation / Other (e.g.
7	Sludge class	A 2 c		-		-
	Sludge Disposal / Re-use methods	Landfill		-		-
8	Ability to secure capital	Yes (100%)		Yes (100%)		Yes (100%)

technologies as shown below

- Choose a technology appropriate for your situation or conditions.
- Take into consideration possible future changes (e.g. population, resources availability).

4. CONCLUSIONS AND RECOMMENDATIONS

- Users should consider the summarised findings from the assessment and consider the present and possible/likely future conditions related to the aspects considered. The decision should be made based on these together with the aspects mentioned in this guideline sections 2.2 and 2.3
- Outputs from the tool can easily be copied/pasted into a planning report (e.g. Water Services Development Plan (WSDP)/Integrated Development Plan (IDP))
- It is recommended that, should the conditions change, a review of the tool be conducted
- A need to profile and train users in the use of the tool has been identified. This may be done by conducting workshops and/or one-on-one training sessions depending on the nature of the need
- It is anticipated that, in the future, information gathered from interactions with DWS, WSAs and other water services sector partners including feedback related to desirable additional functionality/requirements, proposed method of implementation, determination of web-based tools usefulness, queries/issues noted, etc. will be collated and used to develop additional features/functions.

The following should be considered:

Make the community aware about the decision making process.

Make the community aware of their roles and responsibilities with respect to wastewater services.

Make industries/businesses/stakeholders aware of their impact on the wastewater systems.

Make industries/businesses/stakeholders aware of by-laws and consequences of enforcement.

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