AN INDEPENDENT INVESTIGATION INTO THE PURIFICATION CAPACITY OF SMALL-SCALE WATER PURIFICATION UNITS SUPPLIED IN SOUTH AFRICA

Volume 2

Development and Distribution of Information Pamphlet

Report to the
WATER RESEARCH COMMISSION

by

TG Barnard[1], CA Krüger[1], N Hodgkinson[1] and D Bartie[2]

[1] Water and Health Research Centre, University of Johannesburg
and [2] National Institute for Occupational Health

WRC Report No. 1994/2/13

ISBN 978-1-4312-0426-7

May 2013

Obtainable from

Water Research Commission
Private Bag X03
GEZINA 0031

orders@wrc.org.za or download from www.wrc.org.za

This report forms part of a series of three reports. The other reports are
An Independent Investigation into the Purification Capacity of Small-Scale Water Purification Units Supplied in South Africa. Volume 1: Laboratory Testing of Home Water Treatment Devices (WRC No. 1994/1/13);
To Buy a Water Filter or Not to Buy a Water Filter (WRC Report No. 1994/3/13 - available on WRC web site only).

EXECUTIVE SUMMARY

BACKGROUND AND RATIONALE

Recent failures in potable water delivery as well as outbreaks of waterborne diseases in South Africa have led to the public investigating the use of home water treatment devices (HWTDs) to ensure that their tap water is safe for human consumption. The increased metal concentrations in tap water in Carolina is one example of causes for public concern as evident from interviews aired on the MNet televisions show Carte Blanche. The sale and use of small scale water purification systems in the domestic and occupational setting is increasing rapidly, with the majority of these units sold over the counter in high street stores. Consumers buy these products in good faith on the basis of claims of their efficiency made during marketing and advertising campaigns, and with the expectation that the unit will remove, for example, 90-100% of all harmful microorganisms.

Public perception is based on the sensory quality of the water (taste, odour and appearance), interpretations of water quality information, and the trust that the consumers have in their water service provider. The general public seems to lack a complete understanding of the current water quality status and most people are not aware of the Blue Drop Certification Program, which regularly informs consumers about the drinking water quality management levels per service system in various cities and towns of South Africa, or the fact that they can monitor their water quality on a daily basis.

Realistically, in certain areas of South Africa there is sometimes a need for the further purification of tap water; however consumers lack the knowledge to make informed decisions when choosing the correct treatment option. The most important step for a consumer before purchasing a filtration unit would be to understand their needs, i.e. “I want to use it for removing excess chlorine, viruses, metals....” etc. This in itself leads to questions such as the choice of technology needed in their house, the limitations of the device they are considering, the ongoing maintenance and running costs, what type of source water should be utilized with the technology, flow rates, tap pressure requirements and most importantly the need for certification.

This study addressed these concerns with a knowledge dissemination strategy, starting with seminars and culminating in the release of a pamphlet guiding the consumer through the process of choosing the correct home water treatment device to meet his or her own needs.

This report gives an overview of the development of the information pamphlet, describing water quality in South Africa, giving tools to assist users with the selection of an appropriate HWTD and advice regarding the certification and regulation of HWTDs in South Africa.

The public feedback indicated that pamphlets were understandable and easy to follow and use. There was clear proof that the general public was not aware of the Blue Drop Certification Programme or the ability to access to water quality results via the “My Water” website. It highlights the fact that although people working in the water sector are doing excellent work it is not effectively communicated to the public. In cases where information is conveyed to the public, it should be done in such a manner that it is easily understandable to people not working in the water sector and more effort should be done to distribute information to the public.

There is a need for information dissemination exercises which should be adapted to the target audience and expected uses for the information. In this way the information can be used to assist and educate the public at all levels of age and education.

ACKNOWLEDGEMENTS

The authors would like to thank the Reference Group of the WRC Project for the assistance and the constructive discussions during the duration of the project.

This final report was peer-reviewed prior to publication by the following members of the Reference Group:

Dr JE Burgess	Water Research Commission
Mr C Swartz	Chris Swartz Water Utilization Engineers
Mr R Rajagopaul	Umgeni Water
Dr T Ceronio	CSV Water
Prof C Bezuidenhout	North West University
Ms L Coetzee	City of Tshwane
Mr C Fouché	South African Bureau of Standards
Ms S Jackson	eThekwini Municipality
Dr W van Zyl	Pretoria University

The authors would also like to thank the following people for their assistance with the media launch and public debate:

Prof Andre Swart	Executive dean: faculty of Health Sciences, UJ
Mr A Pieterse	University of Johannesburg (UJ)
Mr H Esterhuizen	Media liaison University of Johannesburg

The authors would also like to thank the following institution for their student and project funding assistance:

National Research Foundation	Student bursaries
UJ Research Committee	Co-funding of project

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION

Recent failures in potable water delivery as well as outbreaks of waterborne diseases in South Africa have led to members of the public investigating the use of home water treatment devices (HWTDs) to ensure that their tap water is safe for human consumption. The increased metal concentrations in tap water in Carolina are one example of causes for public concern as evident from interviews aired on the MNet televisions show Carte Blanche. Despite a report by Lang (2007) reporting an increase public perception that tap water is not safe for drinking purposes, a more recent report by Slabbert (2011) indicated that 81% of urban South Africans perceive their tap water as safe. Interestingly, Slabbert's study found that women were less confident in the water quality and were more likely to treat water at home or invest in purchasing bottled water than men. Given the fact that women are commonly the caregivers in homes it is understandable that the use of small scale water purification systems in the domestic and occupational setting is increasing rapidly. This is confirmed by the increasing number of manufacturers and suppliers of small scale water purification units (Ahammed and Meera, 2010; Kaiser, 2010).

The majority of HWTDs are sold over the counter in high street shops, and consumers buy these products in good faith on the basis of claims of their efficiency made during marketing and advertising campaigns, and with the expectation that the unit will remove, for example, 90-100% of all harmful microorganisms (Berney *et al*., 2008; Varbanets *et al*., 2009; Wright *et al*., 2006). Devi and co-workers reported that very often the claims made in the manufacturers brochures are not substantiated by independent research (Devi *et al*., 2008). Products are usually tested in-house by the manufacturer and mostly only for their capacity to remove traditional indicator bacteria (Manus, 2009). Within southern Africa consumers' rights seem to be lacking when considering HWTDs, as most of these products need only be approved by the South African Bureau of Standards (SABS), which seems to have limited policies in place when approving these particular products for public sale (Buren, 2010; SANS 1865, 2006; Unger, 2010; Water Quality Management System, 2009). Filter units supplied and installed in South Africa currently only need to conform to the South African National Standard (SANS) 1865:2006 for "Point-of-use drinking water treatment units". This standard relies on the criteria set out by SANS 241:2006, the same standard that governs local municipalities in South Africa. The majority of filter units currently sold in South Africa require that the water used for treatment must be municipally treated water and comply with SANS 241:2006 to produce filtered water that meets the same criteria, often at an alarming cost.

Slabbert (2011), Doria (2010) and Strang (2001) reported that public perception is based on the sensory quality of the water (taste, odour and appearance), interpretations of water quality information and the trust that the consumers have in their service provider. Owen and co-workers (1999) reported that public perception / concept about water quality is further influenced by *misconceptions or mistaken beliefs* (e.g. *Escherichia coli* causes cholera); peripheral beliefs (correct but not relevant, for example, run tap water prior to use to make sure it is fresh), *indiscriminate beliefs* ("water makes me ill", but without specifying the illness); *background beliefs* (water comes from rain, why treat it) and *valuations* (water is harmful). The general public seems to lack the complete understanding of their current water quality status and is not aware of the Blue Drop Certification Program, which regularly informs consumers about the drinking water quality management levels per service system in various cities and towns of South Africa, or the fact that they can monitor their water quality on a daily basis.

Realistically, in certain areas of South Africa there is sometimes a need for the further purification of tap water; however consumers lack the knowledge to make informed decisions when choosing the correct treatment option. The most important step for a consumer before purchasing a HWTD would be to understand their needs, i.e. "I want to use it for removing excess chlorine, viruses, metals...." etc. This in itself leads to questions such as the choice of technology needed in their house, the limitations of the device they are considering, the ongoing maintenance and running costs, what type of source water should be utilized with the technology, flow rates, tap pressure requirements and most importantly the need for certification.

Certification of water filtration units is critical, as it influences the overall quality and efficiency of any device. The National Sanitation Foundation (NSF) is the only globally recognized international testing and certification program for drinking water treatment units and is used as the *de facto* golden standard by European and American governments for the testing, certification and regulation of HWTDs. It is not a South African government requirement that HWTDs be certified by the NSF, resulting in the flooding of the market with units that are non-compliant with NSF standards. This however does not stop suppliers from displaying the NSF stamp on their products, increasing the risks of waterborne diseases by reducing the quality of the current municipal tap water available to the public.

This study addressed these concerns with a knowledge dissemination strategy, starting with seminars and culminating in the release of a pamphlet guiding the consumer through the process of choosing the correct filtration unit to meet his or her own needs. This report will give an overview of the study, from problem identification, through how to choose a water treatment device and the options available, assisting consumers to make an informed decision when considering the different types of water filtration technologies available in South Africa, certification and regulation in South Africa, ending with the knowledge dissemination strategy followed.

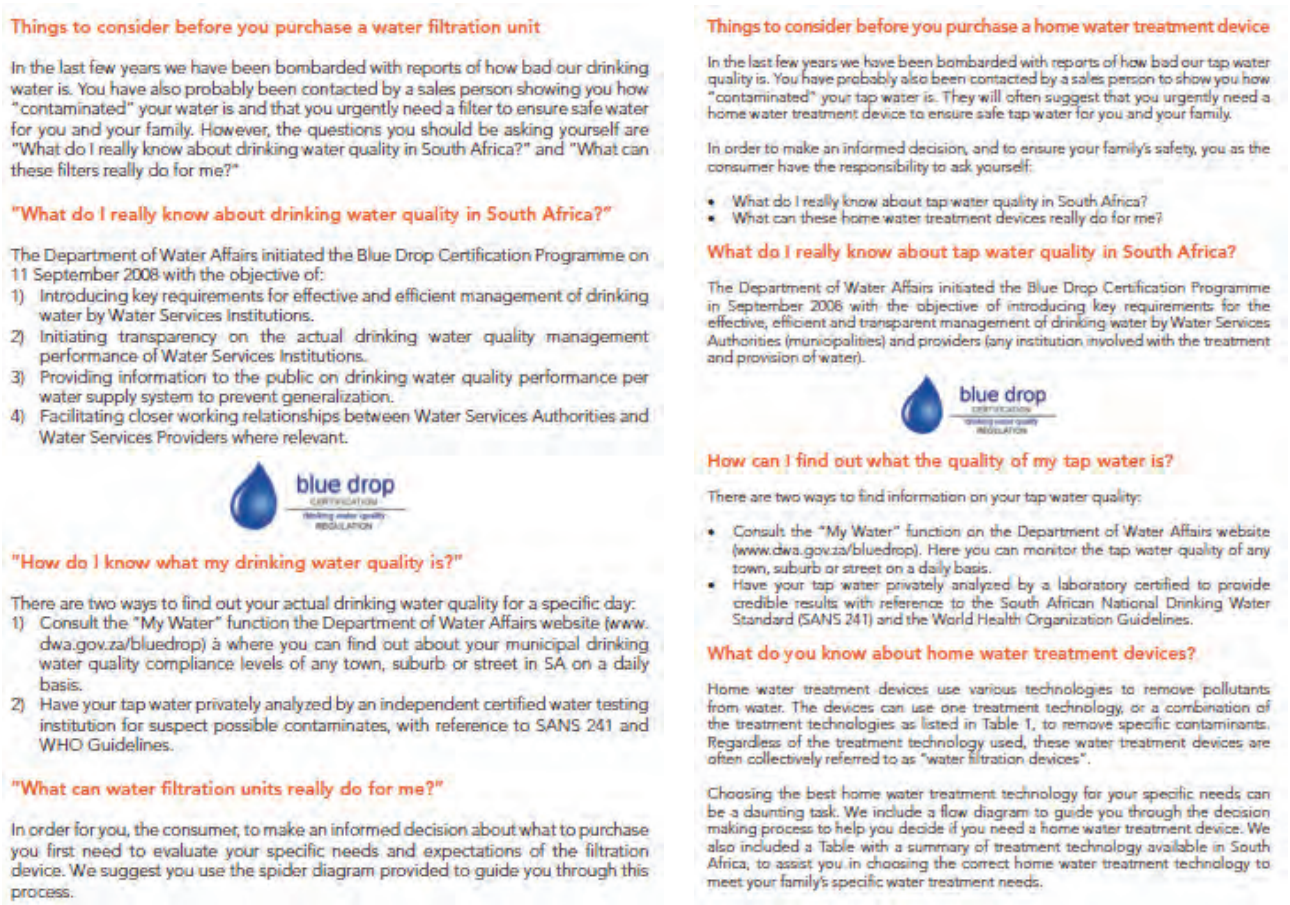
2. PAMPHLET DESIGN

Information to be included in the pamphlet was sourced from an overview of technologies available in South Africa and online sources of information on the selection of HWTDs. The basic information included in the pamphlet was aimed at giving the reader information on water quality in South Africa, how to decide whether they needed a HWTD, if so then what treatment technology to select, and lastly what to look out for when they purchased the HWTD. The purpose of the pamphlet was not to promote excellent water quality in all towns and cities but to assist people with making educated decisions when they chose their HWTDs.

2.1 South African Water Quality

Although Slabbert (2011) indicated that 81% of urban South Africans perceived their tap water to be safe to consume, the first part of the pamphlet was used to inform the reader of the water quality in South Africa. Importantly the "*Blue Drop Certification Programme*" was introduced to the reader so that they can be aware of not only what government and municipalities are doing to ensure safe potable tap water, but also that they can have access to the water quality data. Additionally the Department of Water Affairs (DWA) website "*My Water*" was introduced, to illustrate the measures taken ensure that the public have the opportunity to know the truth about the water quality in their distribution system. The research team felt that the public should also be reminded that they have the option to have their tap water independently tested if they are uncomfortable with the results displayed on the "*My Water*" website. The tone for the remainder of the pamphlet was set in this section, by introducing the concept of HWTDs.

The biggest challenge faced was not the information that had to be conveyed, but the *way* in which it was conveyed. An initial layout of the information was circulated to colleagues, friends and family for input and in almost all cases the feedback was that the team needed to work on the language used. As scientists or engineers working in the water sector we tend to forget that terms that used to be foreign to us have become a second language and we assume that everyone can follow discussions when we use these terms or definitions. A comparison of the first draft pamphlet is shown alongside the final pamphlet (Figure 3.1) to illustrate the difference between the two to ensure that people not working in the water sector could understand and use the information.



Things to consider before you purchase a water filtration unit

In the last few years we have been bombarded with reports of how bad our drinking water is. You have also probably been contacted by a sales person showing you how "contaminated" your water is and that you urgently need a filter to ensure safe water for you and your family. However, the questions you should be asking yourself are "What do I really know about drinking water quality in South Africa?" and "What can these filters really do for me?"

"What do I really know about drinking water quality in South Africa?"

The Department of Water Affairs initiated the Blue Drop Certification Programme on 11 September 2008 with the objective of:

1) Introducing key requirements for effective and efficient management of drinking water by Water Services Institutions.
2) Initiating transparency on the actual drinking water quality management performance of Water Services Institutions.
3) Providing information to the public on drinking water quality performance per water supply system to prevent generalization.
4) Facilitating closer working relationships between Water Services Authorities and Water Services Providers where relevant.

blue drop

"How do I know what my drinking water quality is?"

There are two ways to find out your actual drinking water quality for a specific day:

1) Consult the "My Water" function the Department of Water Affairs website (www.dwa.gov.za/bluedrop) à where you can find out about your municipal drinking water quality compliance levels of any town, suburb or street in SA on a daily basis.
2) Have your tap water privately analyzed by an independent certified water testing institution for suspect possible contaminates, with reference to SANS 241 and WHO Guidelines.

"What can water filtration units really do for me?"

In order for you, the consumer, to make an informed decision about what to purchase you first need to evaluate your specific needs and expectations of the filtration device. We suggest you use the spider diagram provided to guide you through this process.

Things to consider before you purchase a home water treatment device

In the last few years we have been bombarded with reports of how bad our tap water quality is. You have probably also been contacted by a sales person to show you how "contaminated" your tap water is. They will often suggest that you urgently need a home water treatment device to ensure safe tap water for you and your family.

In order to make an informed decision, and to ensure your family's safety, you as the consumer have the responsibility to ask yourself:

- What do I really know about tap water quality in South Africa?
- What can these home water treatment devices really do for me?

What do I really know about tap water quality in South Africa?

The Department of Water Affairs initiated the Blue Drop Certification Programme in September 2008 with the objective of introducing key requirements for the effective, efficient and transparent management of drinking water by Water Services Authorities (municipalities) and providers (any institution involved with the treatment and provision of water).

blue drop

How can I find out what the quality of my tap water is?

There are two ways to find information on your tap water quality:

- Consult the "My Water" function on the Department of Water Affairs website (www.dwa.gov.za/bluedrop). Here you can monitor the tap water quality of any town, suburb or street on a daily basis.
- Have your tap water privately analyzed by a laboratory certified to provide credible results with reference to the South African National Drinking Water Standard (SANS 241) and the World Health Organization Guidelines.

What do you know about home water treatment devices?

Home water treatment devices use various technologies to remove pollutants from water. The devices can use one treatment technology, or a combination of the treatment technologies as listed in Table 1, to remove specific contaminants. Regardless of the treatment technology used, these water treatment devices are often collectively referred to as "water filtration devices".

Choosing the best home water treatment technology for your specific needs can be a daunting task. We include a flow diagram to guide you through the decision making process to help you decide if you need a home water treatment device. We also included a Table with a summary of treatment technology available in South Africa, to assist you in choosing the correct home water treatment technology to meet your family's specific water treatment needs.

Figure 2.1 Snapshot of the first page of the pamphlet to show the difference between the first draft (left) and final printed version (right) of the section on water quality.

2.2 How to decide what filter to buy

This decision support section of the pamphlet was used to guide the reader through deciding whether to use a HWTD and what type of device to use. Data were gathered from sources including the NSF website and an online questionnaire that can be used by consumers to access their needs (Appendix A). The information was collated into a diagram (Figure 2.2) that not only proved too difficult to follow, but also impractical for inclusion into the pamphlet. Similar to the previous section, this had to be shortened into a user-friendly diagram (Figure 2.3)

The easy to use diagram was designed to assist the reader with deciding if he/she needed a HWTD and highlighted facts that the reader might not have been aware of that would have an influence on their choices. The diagram relies on the reader investigating their homes, for example the state of their plumbing, as well as general sanitation practices that could spread the cause of diarrhoea if that was one of the reasons for them considering purchasing a HWTD.

The reader was further urged to think about *what they wanted to change* about their drinking water quality, so that they could make an informed decision when deciding what type of device they would need. The example used was: if the user wanted only to remove chlorine from the water, they would not need a device that has UV disinfection as one of their options. This decision was linked to knowledge of the reader towards a specific technology or device, in terms of what would be needed after implementation (replacement of cartridges, impact on electricity bill, etc.) as well as the actual testing and certification of the product (also discussed below). The final diagram with notes used in the pamphlet is shown in Figure 2.3.

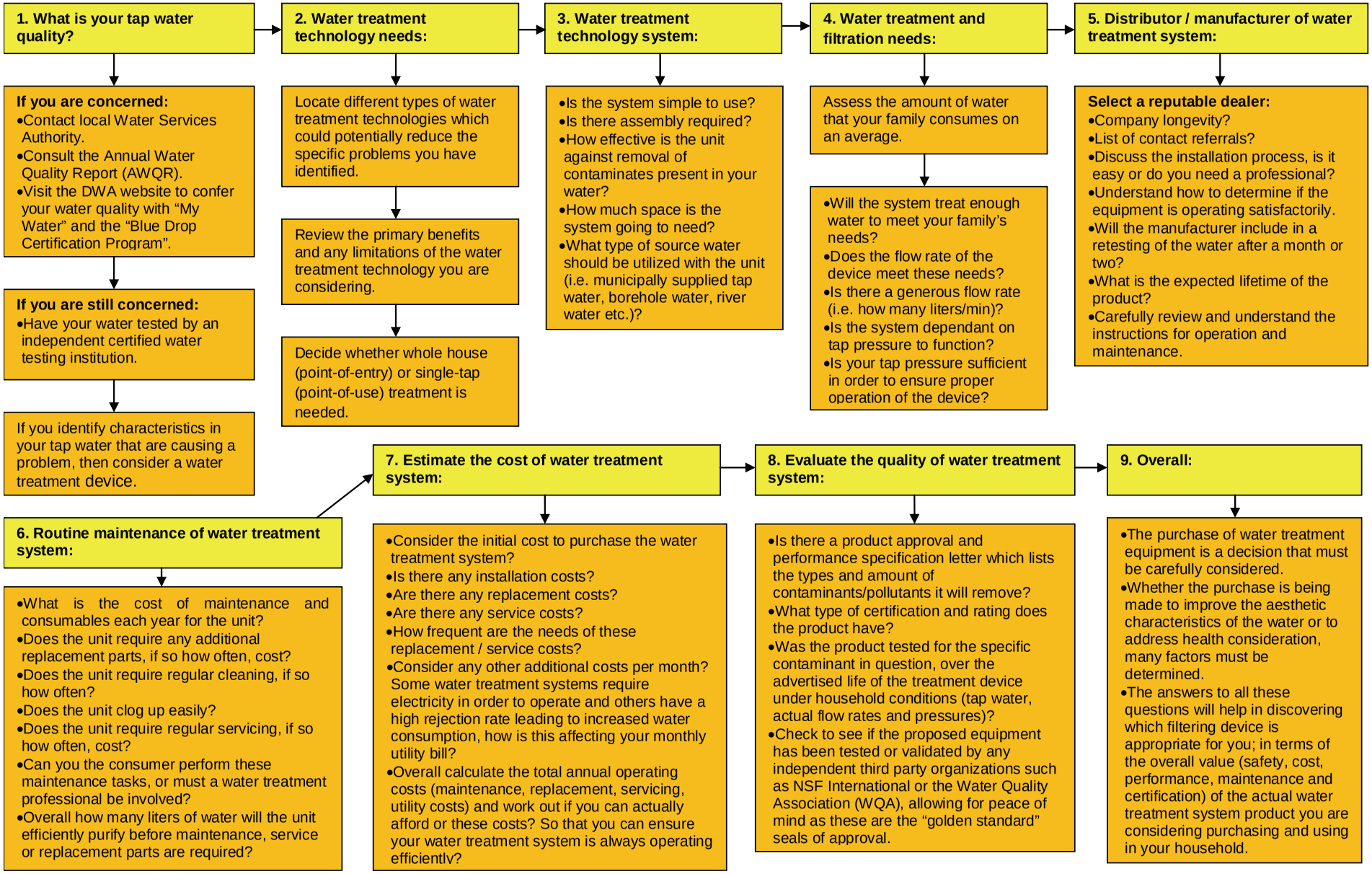


Figure 2.2 Original information diagram drawn up from the information gathered from various sources and used as the basis for Figure 2.3.

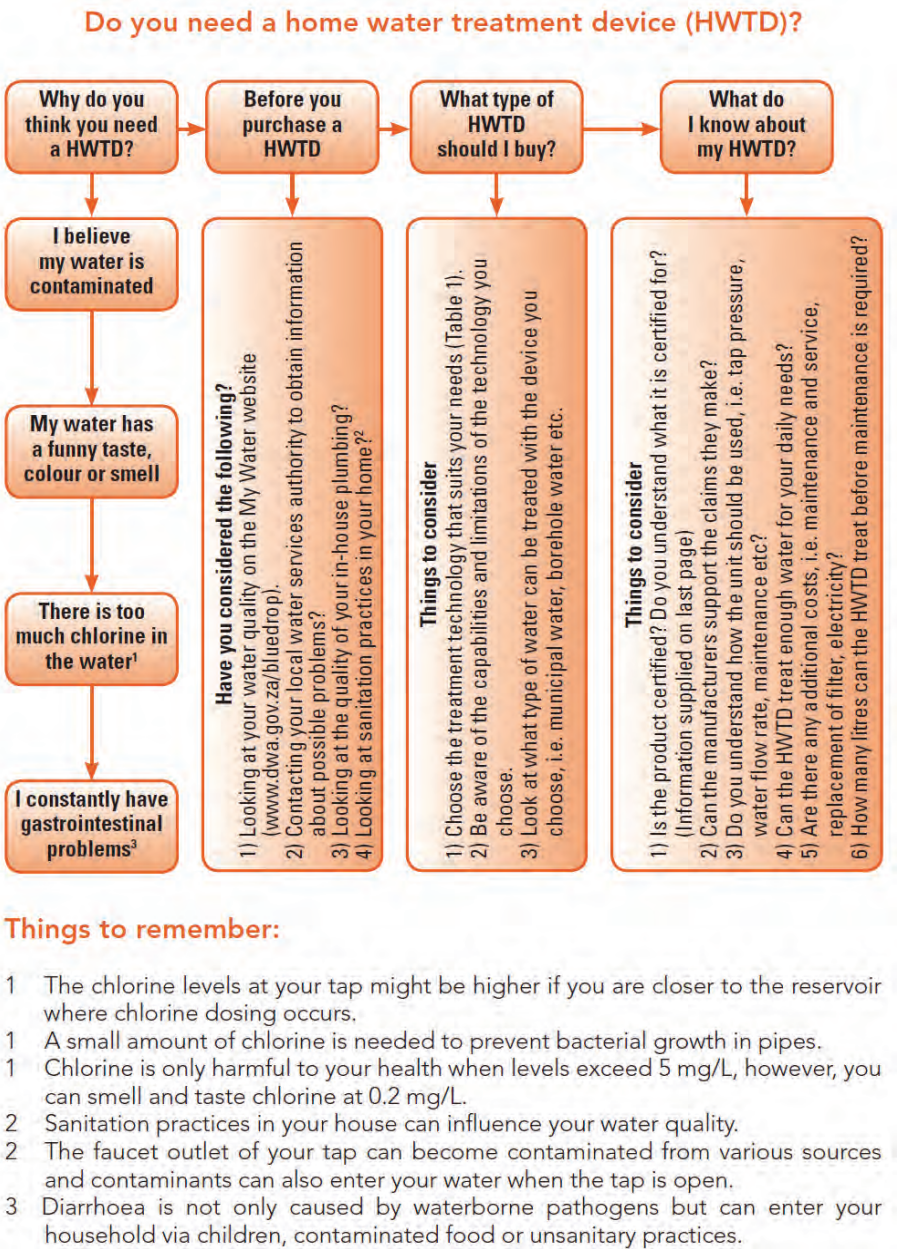


Figure 2.3 Snapshot of the second page of the pamphlet that contained the spider diagram and notes that can be used by the reader to make an informed decision if they decide to purchase a HWTD.

The spider diagram (Figure 2.3) made reference to a table shown on the third and fourth pages of the pamphlet that contains information about the different treatment technologies used in HWTDs. This table was compiled from information obtained from the NSF website (as referenced in Figure 2.4) as well as a survey of the typical technologies used in HWTDs available in South Africa as outlined in Appendix B (also refer to Volume 1, WRC research report 1994/1/13).

It was stated on the NSF website that people do not always understand what each type of treatment technology is used for, leading to circumstances where consumers buy expensive units to improve the taste of the water by removing chlorine. Similarly if the consumer wanted to remove metals from the water (as in the case of Carolina consumers), an activated carbon filter might not be the best choice. The table gave general information about the typical uses for the specific treatment options (i.e. what each can remove) as well as the limitations of these technologies (Figure 2.4). The research team believed that the use of this table alongside the information in the spider diagram (Figure 2.3) would give the reader sufficient information to decide on the treatment technology that will meet his/her needs.

Table 1: Different types of drinking water treatment technologies*

Device	Primary use	Limitations
Activated Carbon Filter	Removes chlorine, Volatile Organic Compounds (VOCs), radon, some Synthetic Organic Compounds (SOCs), and general taste and odour problems.	• Does not remove nitrate, bacteria or inorganic compounds. • Periodic replacement of activated charcoal required to prevent saturation of the charcoal and prevent bacteria build-up.
Reverse Osmosis	Removes more contaminants than any other treatment system except distillation, some organic chemicals (not volatile or semi volatile), pesticides, bacteria, viruses, uranium and radium.	• Does not remove all organic chemicals, such as chloroform. • Does not remove 100 percent of most chemicals. • Uses large amounts of water and in some cases electricity. • Not recommended for bacteria and dissolved gases.
Ion Exchange	**Cation Exchange Units** Removes positively charged ions, inorganic compounds, such as iron and manganese ions, arsenic, chromium, and hard water minerals – calcium and magnesium. **Anion Exchange Units** Removes negatively charged ions such as nitrates, bicarbonate, selenium, and sulphate.	• Removal of one type of ion replaced with another, for example iron removed may be replaced with sodium. • Periodic backwashing and regeneration required.
Microfiltration	Removes small particles and suspended solids such as ferric iron, clay, silt and sand, and some pathogens such as bacteria and viruses and colloids (suspended matter).	• Filter replacement based on concentration of contaminant, pressure head loss and water usage in the home.
Distillation	Removes dissolved minerals, trace amounts of metals, and some toxic organic chemicals.	• Might produce bland-tasting water. • Small capacity units produce limited quantity for drinking, cooking. • Large units require kitchen or adjoining space or small diameter plastic plumbing can be run to the faucet location from a basement unit. • Not effective against most volatile and semi-volatile chemicals and some bacteria.
Aeration	Dissolved gases like radon, carbon dioxide, methane, and hydrogen sulphide, as well as volatile organic compounds, like MTBE or industrial solvents. Aeration can be used for the precipitation and removal of dissolved iron and manganese.	• If iron and manganese are present in solid form, pre-treatment of the water to remove these particles before entering the aeration treatment and post-treatment may be necessary. • Waste air must be vented from the house in such a way as to prevent contamination of indoor air quality.
Ultraviolet Radiation	Efficient at inactivating vegetative and sporous forms of bacteria, viruses, and other pathogenic microorganisms.	• Not recommended if the untreated water contains high levels of total coliform bacteria, substantial colour or turbidity. • Does not improve the taste, odour, or clarity of water.
Ozone	Inactivation of pathogenic (disease-causing) organisms including bacteria and viruses, phenols (aromatic organic compounds), some colour, taste, and odour problems, iron and manganese, and turbidity.	• Not effective for large cysts and some other large organisms, inorganic chemicals and heavy metals.
Activated Alumina	Used primarily for removing fluoride and arsenic.	• May require a post-treatment system for bacteria removal and pre-treatment to oxidize 'arsenite" to filterable "arsenate".

*DPH (2009). **Publication No. 19 Private Drinking Water, Questions to Ask When Purchasing Water Treatment Equipment for Your Home.**www.ct.gov/.../Questions_to_Ask_When_Purchasing_WTE_for_Your_Home_03-09.pdf

Figure 2.4 Snapshot of the table comparing the different treatment technologies available in HWTDs in South Africa, their uses and limitations.

2.3 Product certification

The last section of the pamphlet dealt with the testing and certification of HWTDs to ensure that the devices perform according to the manufacturers' claims. The certification can be performed on the effectiveness of the treatment technology, the device components or for the system's quality management. Although the packaging of a device can display a logo for certification via a specified organization, it is important to understand what the certification means: it could mean that a device was certified for the components used but **not** for the effectiveness for the treatment of water. The research team felt that this information is important for the consumer, as one of the most commonly used criteria for HWTD selection is the claim of certification and the display of a certifier's logo. The section included in the pamphlet is shown in Figure 2.5.

Following discussions with researchers at the NSF it became clear that the NSF has set criteria for the labelling of HWTDs tested and certified by them. This included the inclusion of the NSF logo on the packaging as well as on the HWTD itself, and the ability to confirm this online on the NSF website. This gave the team a way of monitoring devices displaying NSF logos for authenticity. It should be noted that to illustrate how easy it is to copy the logos for use on the packaging of a device all logos were copied from the Internet. The question that arises is how many companies follow the same approach of simply copying the files from the internet and there should be a method to determine the authenticity of the logos used on HWTDs.

Figure 2.5 Snapshot of the section for certification showing some of the logos that could be included on the packaging as well as an explanation of the different types of certification.

2.4 Pamphlet distribution

The pamphlet was introduced to the public using a press release arranged with local newspapers so that the information could reach a wider audience. Reference was given to where the pamphlet could be downloaded from the Internet. Contact details of the research team were provided for the public to ask specific questions about HWTDs or water quality in South Africa.

The press release drew a lot of attention and members of the research team were invited to participate in radio and television interviews to further inform the public about water quality in South Africa and HWTDs. The response received was better than anticipated with the work highlighted in two television interviews and three radio interviews, along with numerous printed and online articles in newspapers and magazines.

The public feedback was extremely positive with most of the people that contacted the team expressing appreciation for the pamphlet and requesting electronic copies of it to distribute to family and friends. This supports Slabbert (2011) who found that there is insufficient communication of information to the public, and that there is a need for more public information. Printed copies of the pamphlet are still distributed during presentations and functions and are always met with interest and questions regarding the project results.

2.5 Conclusions

The feedback from members of the public regarding the pamphlet was extremely positive and corroborated Slabbert (2011) who reported that detailed, independent information was much needed and welcomed by the public. The development of the pamphlet proved to be more difficult than anticipated. One of the biggest decisions was the type of pamphlet to be used, for example Z-fold *versus* A4 folded in half, because of the need for a portable, copyable, printable but information-rich publication, but the team was guided by the information that needed to be included. The Z-folded pamphlet proved to be very useful and could accommodate more information than any of the other pamphlet folding or printing methods.

The public feedback indicated that pamphlet was understandable and easy to use. There was clear proof that the general public was not aware of the “Blue Drop Certification Programme” or the ability to access true water quality results via the DWA “My Water” website. It highlights the fact that although people working in the water sector are doing excellent work, it is often not effectively communicated to the public. Information should be conveyed to the public in such a manner that it is easily understandable for people not working in the water sector, and more effort should be made to distribute detailed but accessible information to the public.

3. REFERENCES

AHAMMED MM and MEERA V (2010) Metal oxide/hydroxide-coated dual-media filter for simultaneous removal of bacteria and heavy metals from natural waters. Journal of Hazardous Materials. **10**: 1016-1026.

BERNEY M, VITAL M, HULSHOFF I, WEILENMANN HU, EGLI T and HAMMES F (2008) Rapid, cultivation-independent assessment of microbial viability in drinking water. Water Research. **42**: 4010-4018.

BUREN EV (2010) What are the requirements? http://www.wqpmag.com/What-are-the-Requirements-article9850 (Accessed on 22/07/2010).

DEVI R, ALEMAYEHU E, SINGH V, KUMAR A and MENGISTIE E (2008) Removal of fluoride, arsenic and coliform bacteria by modified homemade filter media from drinking water. Bioresource Technology. **99**: 2269-2274.

HUNTER PR, NAVIER DZ and HARTEMANN P (2009) Estimating the impact on health of poor reliability of drinking water interventions in developing countries. Science of the Total Environment. **407**: 2621-2624.

KAISER H (2010) World Water Markets 2008 – 2015. http://www.hkc22.com/watermarketsworldwide.html (Accessed on 07/07/2010).

LANG S (2007) South Africa: A Tale of Ongoing Water and Sanitation Woes. http://ipsnews.net/news.asp?idnews=40268 (Accessed on 07/07/2010).

MANUS LAV (2009) Drinking Water Quality in Southern Africa. www.ewisa.co.za/literature/files/2009_127.pdf (Accessed on 07/07/2010).

SANS 1865. (2006) South African National Standard Point-of-use drinking water treatment units. http://www.stansa.co.za (Accessed on 13/08/2010).

TWAIN M (2009) The Water Story. http://www.themarketingguy.co.nz/Latest/THE-WATER-STORY.html (Accessed on 07/07/2010).

UNGER M (2010) Standards for Residential Water Treatment Products. http://www.wqpmag.com/Standards-for-Residential-Water-Treatment-Products-article11571 (Accessed on 22/07/2010).

VARBANETS MP, ZURBRUGG C, SWARTZ C and PRONK W (2009) Decentralized systems for potable water and the potential of membrane technology. Water Research. **43**: 245-265.

Water Quality Management System. (2009) Legislation and Regulation to Drinking Water Quality. https://www.wqms.co.za/infopages/202 (Accessed on 22/07/2010).

WRIGHT JM, MURPHY PA, NIEUWENHUIJSEN MJ and SAVITZ DA (2006) The impact of water consumption, point-of-use filtration and exposure categorization on exposure misclassification of ingested drinking water contaminants. Science of the Total Environment. **366**: 65-73.

APPENDICES

Appendix A The questionnaire used to gain information used for the construction of the pamphlet (SMI Analytical, 2011).

HOW TO CHOOSE A POU WATER PURIFICATION SYSTEM

Buying a Water Purification or Water Filtration System

Use this questionnaire sheet to prepare for a visit from a water purifier salesperson. If the salesperson will not answer all your questions expect something "fishy" with the deal.

Questionnaire Part A - Review your water treatment and filtration needs

1. Ask to have your water tested by a reputable laboratory for **Chemical and Organic contaminants/pollutants** and understand your results. If you have any questions contact the water laboratory and ask them about risks and other issues associated with your test results. Good laboratories should include a report with their analysis.

2. Review information about health and appearance impacts of your water contaminants/pollutants or pollutants. Make a Note of the special concerns and enquire about them or do further research to get a clear picture.

2.1 Review purification and filtration choices and list those that might be appropriate for your particular water based threats or contaminants.

3. How much water can the treatment system process before replacement parts or maintenance will be needed? _____ Litres

3.1 Have you installed a device to monitor your water consumption? Do you understand how to reasonably estimate when maintenance or servicing will be needed? ____ Yes ____ No

4. Are you able replace parts or maintain the water purification unit? Without the need for expensive call-out fees for routine maintenance? ____ Yes ____ No

5. Do you know what the cost of maintenance and consumables will be each year for the unit?

____ Yes ____ No

6. Other comments about the water purification system: _____

Questionnaire Part B - Estimate the cost of the purification system.

7. Water treatment or purification system, purchase and installation:

Cost of water treatment system .....R_____
Cost of installation .....R_____
Other costs.....R_____

8. Replacement costs:

Frequency of replacement/service needs.....R_____
Parts to be serviced or replaced .....R_____

Total annual service labour costs .....R_____

9. Any other special design considerations:

Additional electrical costs per month to operate water purification system.....R_____
Additional water costs per month per month to operate purification system.....R_____ (a lot of water purifiers have a high rejection rate leading to increased water consumption.)

10. **Total annual operating costs including maintenance and servicing.....R**_____

11. Is the manufacturer/supplier of the equipment reputable and reliable? ____ Yes _____ No

Questionnaire Part C - Evaluate the quality of the water purification system.

12. Is there a product approval and performance specification letter for the purification system which lists the types and amount of contaminants/pollutants it will remove? ____ Yes _____ No

13. How much space is the purification system going to need? _____

14. Does the purification system need specially treated water or other hidden and costly requirements to function properly? ____ Yes _____ No

15. How many litres of water does your family/household use per day? *(Base your estimates on: 3 litres per family member per day for drinking and cooking.)*

16. Have you compared the daily volume of water available from the purifier treatment system to the amount of water or drinking water your household/family will need? ____ Yes ____ No

17. Check the rate/volume of water flow that you require where the water treatment device will be installed. Does the flow rate of the device meet the needs of your family/household? ___ Yes ___ No

18. Have you carefully reviewed and understood the instructions for operation and maintenance that come with the potential treatment or filtration system? ____ Yes ____ No

(SMI Analytical, 2010)

Appendix B Information on the types of water treatment technologies available in South Africa, including specific requirements, advantages, disadvantages, and certification of the units and technologies.

Treatment system	Feed Water Quality	Advantages	Disadvantages	Maintenance / Operation	Dependence on Utilities	General Certification	Availability of the Technology in South Africa
Activated carbon	Filters municipal water only	• Works well in conjunction with other filtration systems • Long life (high capacity) • Removes: hydrogen sulphide, radon, chlorine, volatile organic compounds, pesticides, benzene, colours and odours	• Most will not remove heavy metals, cysts, asbestos or coliforms • Filters must be changed or filtering capacity will be compromised • Can generate carbon fines	• Replace filter annually • Flow rate 2 litres/min	Tap pressure	NSF and SANS	Internationally and locally manufactured and supplied
Uv sterilization	Used on municipal and borehole water	• Effective sanitizing treatment • Removes: iron and manganese and all bacteria, viruses and protozoan cysts	• Decreases human immune resistance to common water contaminants • Does not remove any suspended particles or ions to < 5 ppb of total organic carbon • Regular maintenance and care required • Short life as UV lamps need constant replacing	• Replace UV light every 6 months • UV light needs to be cleaned every 12 weeks • Filters 4 litres/min	Tap pressure and electrical supply	NSF	Internationally manufactured and supplied locally
Ion exchange resins	Filters municipal water only	• Re-generable (service deionization) • Relatively inexpensive initial capital investment • Softens water due to heavy metal removal • It controls the growth of algae, fungi and bacteria • Removes: dissolved inorganics, nitrate, sulphate, fluoride, iron, magnesium, calcium, manganese, chlorine, lead, mercury	• Does not effectively remove particles, pyrogens or bacteria • IER beds can generate resin particles and can become breeding grounds for bacteria • High operating costs over long-term	• Average longevity of IER beds 18 to 36 months • Filters 12 litres/hour	Tap pressure and electrical supply	NSF	Internationally manufactured and supplied locally

Treatment system	Feed Water Quality	Advantages	Disadvantages	Maintenance / Operation	Dependence on Utilities	General Certification	Availability of the Technology in South Africa
Ceramic filtration	Filters municipal water only	• Relatively cheap to manufacture and produce • If designed and used properly can remove up to 99% of indicator organisms and remove turbidity to values below WHO guidelines • Improves taste • Removes: rust, dust, silt, algae, suspended solids, bacteria, arsenic, iron, odour	• Very slow filtration rates • Filter maintenance and reliability depends on the user • Breakage during distribution or use can be a problem since ceramic filters are often fragile • Requires regular cleaning, as they tend to clog up • It is difficult to maintain consistency (quality control is an issue) • Major risk of cross contamination	• Clean regularly • Replace filter unit every 6 months • Filters 0.5 - 4 litres/day	Tap pressure	CE accredited and SANS 9001:2008 certified	Internationally and locally manufactured and supplied
Bio-sand filtration	Filters municipal water only	• Reduces turbidity and improves taste. • Low cost. • High flow rate • No on-going costs or replaceable parts. • Fabricated from local material and opportunity for local business. • Easy to maintain. • Removes: 99% of bacteria, between 85 to 99% of faecal coliforms and 100% of parasites, arsenic, manganese, iron, odour, 50 to 90% of organic and inorganic toxicant, as well as suspended sediment.	• Biological layer takes around 3 weeks to develop to maturity • High turbidity will cause the filter to clog and so require more maintenance • Cannot remove colour or dissolved compounds including salt • Can be difficult to move, since an average filter weighs 77 kg	• Requires that the filter be used on a regular basis • Filters 36 litres/hour • No replacement required, on-going.	Tap pressure	SANS	Locally manufactured and supplied

Treatment system	Feed Water Quality	Advantages	Disadvantages	Maintenance / Operation	Dependence on Utilities	General Certification	Availability of the Technology in South Africa
Reverse osmosis	Used on municipal and borehole water	• Removes: lead, sulphate, calcium, magnesium, sodium, pyrogens, colloids, dissolved inorganics, potassium, manganese, aluminium, chloride, nitrate, fluoride, boron, most microorganisms and organic chemicals	• Slow flow rates and requires storage tank • Does not remove viruses • Requires large volumes of water – it may take as much as 342 litres of water to recover 20 litres of usable water • Costly to purchase and maintain • Filters require constant cleaning and replacement as they can clog and become breeding grounds for bacteria	• Usually limited to a certain amount of litres per day rating. • Replace RO membranes annually. • Storage tank holds 18 litres • System will purify 200 litres/day • Clean regularly	Tap pressure and electrical supply	NSF	Internationally and locally manufactured and supplied
Nano filtration	Used on municipal and borehole water	• Produces highest quality water for least amount of energy investment. • Inexpensive method when compared to conventional methods • Softens water • Removes: sediments, decolourants, pesticides, heavy metals, pyrogens, microorganisms, multivalent ions, nitrates, extremely fine particles, hardness, natural organic matter, synthetic organic chemicals and micro pollutants.	• Filters require constant cleaning and replacement as they can clog and become breeding grounds for bacteria. • Will not remove dissolved inorganics • Has only a moderate retention for univalent salts • Requires source water pretreatment, to prevent clogging of membranes • Membranes are subject to scaling and fouling and often require modifiers	• Filters 1.9 to 3.8 litres/min • Average longevity 12 to 24 months • Clean regularly	Tap pressure	NSF	Internationally manufactured, not supplied locally

Treatment system	Feed Water Quality	Advantages	Disadvantages	Maintenance / Operation	Dependence on Utilities	General Certification	Availability of the Technology in South Africa
Ultra filtration	Used on municipal and borehole water	• Produces highest quality water for least amount of energy investment • Regenerable. • Reduces turbidity • Removes: sediments, extremely fine particles, colloids, pyrogens, viruses, cysts and microorganisms	• Forward-flush and back-flush cleaning cycles provide extended filter life • Filters require constant cleaning and replacement as they can clog and become breeding grounds for bacteria • Will not remove dissolved inorganics	• Clean regularly • Replace filters after 6 months • Filters 2271 litres/h	Tap pressure	NSF and SANS	Internationally and locally manufactured and supplied
Micro filtration	Used on municipal and borehole water	• Absolute filters • Removes: rust, dirt, herbicides, pesticides, trihalomethanes, chlorine, organic chemicals, lead, aluminium, asbestos fibre, pyrogens, sediment, turbidity, particles, bacteria, protozoa and viruses	• Filters require constant cleaning and replacement as they can clog and become breeding grounds for bacteria • Will not remove dissolved inorganics, chemicals, pyrogens or all colloidals • Potentially high expendable costs • Not regenerable	• Clean regularly • Replace filters every 6 to 8 months • Flow rate 2 litres/min	Tap pressure	NSF and SANS	Internationally and locally manufactured and supplied