Advancing the Web Enabled Water Research Commission Water Safety Planning Tools Through User Feedback

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Abstract
To drive progressive improvement in water and wastewater services provision in South Africa, the Department of Water Affairs (DWA) introduced an incentive based regulation scheme, via the implementation of Blue Drop Certification (BDC) for drinking water services and Green Drop Certification (GDC) for wastewater services. These programmes prescribe key requirements for effective and efficient management of drinking and wastewater by municipalities in South Africa. One of the foundations of BDC is the use of a Water Safety Planning approach to identify and manage risks. However, due to the challenges faced by municipalities in developing and implementing Water Safety Plans (WSPs) at municipal level, the Water Research Commission (WRC) of South Africa has assisted municipalities by developing both a WSP guideline document and associated spreadsheet-based and web-based water safety planning tools. These tools are closely aligned with international best practice and have been made available through the easily accessible and municipal-based electronic Water Quality Management System (eWQMS). These tools were launched in early 2011 and in the months that have followed, the tools have been widely used and the implementing team has received ongoing feedback regarding challenges faced by users and additional features required by users. This paper will present some of the learnings noted and provide details of continuous tool advancements to address user needs and challenges.

Keywords
Water Safety Plan tools, web-enabled tools, eWQMS

INTRODUCTION

Background

The provision of safe drinking water and effective sanitation are considered the most important determinants of public health. South Africa, like many developing countries, needs effective and efficient systems for providing water services if it is to rise above current challenges and provide high quality services to all its people. To improve the situation, South Africa's water sector partners undertook various initiatives to assist municipalities with water services operation and management. One of the initiatives was the introduction by the Department of Water Affairs (DWA) of an incentive-based regulation scheme, namely Blue Drop Certification (BDC) for drinking water services and Green Drop Certification (GDC) for wastewater services (in late 2008). When DWA introduced the need for development and implementation of Water Safety Plans (WSPs) by all Water Services Institutions (mostly municipalities) as a requirement of the BDC programme, the Water Research Commission (WRC) of South Africa saw the challenges faced by municipalities in developing and implementing WSPs, and therefore initiated projects to both develop a guideline document (Generic Water Safety Plan for Small Community Water Supplies (Thompson and Majam, 2009)) and associated spreadsheet-and web-based water safety planning tools to assist municipalities with water safety planning activities. These easy-to-use tools were made available via the electronic Water Quality Management System, eWQMS, the municipal web platform which is easily accessible to all municipalities in South Africa.

The Electronic Water Quality Management System (eWQMS)

The eWQMS is a novel Open Source Software based system which is accessible via the internet (http://www.wqms.co.za) and is able to guide (i) regulatory compliance by municipalities, (ii) the

timely supportive intervention in water quality failures, (iii) infrastructure improvement, and (iv) capacity development of staff. Importantly, the eWQMS is a management system for municipalities that has been developed using a "bottom up" approach with inputs by municipalities, the Institute of Municipal Engineering of Southern Africa (IMESA), the DWA and the WRC. The eWQMS has won national and international awards, including the International Water Association's Project Innovation European and Global Awards for 2008 (Category: Operations and Management). Its features include: (i) Management Dashboard (sample sites satisfying and/or failing water quality requirements), (ii) Compliance Overview (summary of legislative compliance), (iii) Data Analysis (dynamically generated tables and graphs), (iv) Monthly Summary Reports (automatically generated reports and associated archive), (v) Information (drinking-water related information and references), (vi) Infrastructure (capture details of water system infrastructure – basic asset register), (vii) Administration (configure and manage system set-up), and (viii) Risk Toolbox (municipalities can perform a self-assessment/health check of infrastructure, etc.). To assist municipalities, new tools are continuously added to the eWQMS.

METHODOLOGY

Development of the WRC Water Safety Planning Tools

A project was initiated by the WRC to primarily develop web enabled water safety planning tools via the municipal eWQMS. However, prior to developing web-enabled water safety planning tools, spreadsheet-based water safety planning tools were first developed to both help direct the project team and IT developers, and also guide stakeholder/user interactions, comments and feedback. The tools were designed using available national and international literature and best practice (e.g. WHO, WRC, etc.) (WHO, 2009; Thompson and Majam, 2009), and project team experience, and adapting these to South African conditions, thereby also being adaptable for the use in middle-to-low income countries in Africa and elsewhere. Using the draft spreadsheet tools, numerous workshops and discussions were held with potential users (including municipalities, DWA, research bodies, and consultants). Key requirements identified included (de Souza *et al*., 2010):

- Easy completion (similar to current risk assessment methodology on the eWQMS (as described by Mackintosh and Jack, 2008) or not differ much from the initially developed spreadsheet based water safety planning tools). It was also noted that as there are internet access limitations at some municipalities, spreadsheet versions of the tools are very useful.
- Provision of a summary of high priority risks and allow the user to rank the risks.
- The capacity to accept the users' comments (e.g. able to explain or justify a decision).
- Easy production of a report for upload to the DWA Blue Drop System (BDS) (http://www.dwa.gov.za/bluedrop).
- Acknowledgement, tracking or sign-off by appropriate manager of completed requirements.
- Should help ensure a cost efficient way to develop a WSP by municipalities (A shortage of skills often exists at South African municipalities, resulting in consultants being appointed to assist with or complete key tasks. By empowering municipalities with an appropriate WSP tool, municipalities can complete/develop WSPs by themselves).
- The approach and format should be based on available national and international best practice and guideline requirements (e.g. WHO, WRC).
- The tool should not provide the user with a superficial desktop study which is then regarded as a satisfactory, comprehensive WSP (i.e. it should emphasise the importance of conducting site visits/assessments; the tool is a starting point to understand what needs to be consider/address).
- The tool should assist municipalities with verifying that the WSP is operational, identifying their current progress in the WSP process, and where attention is still required.

Using the above requirements, and following additional and on-going discussions with the water sector to ensure that user needs were understood and met, draft web-enabled tools were developed and further refined. Following an extended time period for stakeholder comments and feedback, the web-enabled WSP tools were released at the end of January 2011. The project produced the following two tools (Jack and de Souza, 2012):

1. Water Safety Plan Tool (web-based and supportive spreadsheet-based tools, and allows development and tracking of a WSP
2. Water Safety Planning Status Checklist Tool (web-based and supportive spreadsheet-based tools, and allows the user to determine status of water safety planning processes - i.e. Where are we? What have we completed? What must we still do?)

Water Safety Plan Tool

As noted above, the WSP Tool allows a user to complete a WSP, and include the following sections: (1) Formulate the WSP team, (2) Describe the system (source, treatment, storage, distribution, point of use), (3) Assess/evaluate the water system (source, treatment, storage, distribution, point of use), (4) Hazard/risk assessment of the water system (source, treatment, storage, distribution, point of use) (see Figure 1 for spreadsheet extract and Figure 2 for web extract), (5) Summary of risks and associated prioritization (see Figure 3 for web extract) and (6) Identify control measures and associated corrective actions, responsibilities, timeframes, and costs (for subsequent WSP implementation) (see Figure 3 for web extract)).

	A	B	C	D	E	F	G	H	I	J	K	L
11	**Source Water**											
12		**Potential Hazards or Hazardous Events**	**Valid Hazard / Hazardous Event**	**Hazard Category**	**SANS 241**	**Hazard Name (Water Quality Determinand)**	**Likelihood**	**Rating**	**Consequence**	**Rating**	**Risk Rating**	**Risk Profile**
13		**Surface Water (Rivers and Streams)**										
14	1	Livestock, human activity at water source.	Yes	Safety	E.coli or Faecal coliforms	E.coli or Faecal coliforms	Moderately likely	0.5	Minor	2	1	Low Risk
15	2	Raw water turbid after heavy rain. May contain droppings of animals and birds.	Yes	Finances	Turbidity	Turbidity	Not applicable	0	Not applicable	0	0	No Risk
16	3	Dead animals.	No	Safety	N/A		Not applicable	0	Not applicable	0	0	No Risk
17	4	Droppings of animals/birds can introduce harmful micro-organisms into the water body.	Yes	Design	E.coli or Faecal coliforms	Giardia species, E.coli or Faecal coliforms	Likely	0.8	Catastrophic	100	80	High Risk
18	5	Low flow, high nutrient levels and warm conditions - can make cyanobacterial and algal growth more likely.	Yes	Water Quality Variability	Odour or Taste	Odour or Taste	Rare	0.1	Moderate	20	2	Low Risk
19	6	Falling water levels due to drought or drawdown of water body.	No	Operation	N/A		Not applicable	0	Not applicable	0	0	No Risk
20	7	Vandalism or sabotage may pollute the water with chemicals or microbes or damage equipment and infrastructure.	Yes	Design	N/A		Likely	0.8	Moderate	20	16	Medium Risk

Figure 1: Water resource risk assessment section of the spreadsheet-based WSP tool (Jack and de Souza, 2012)

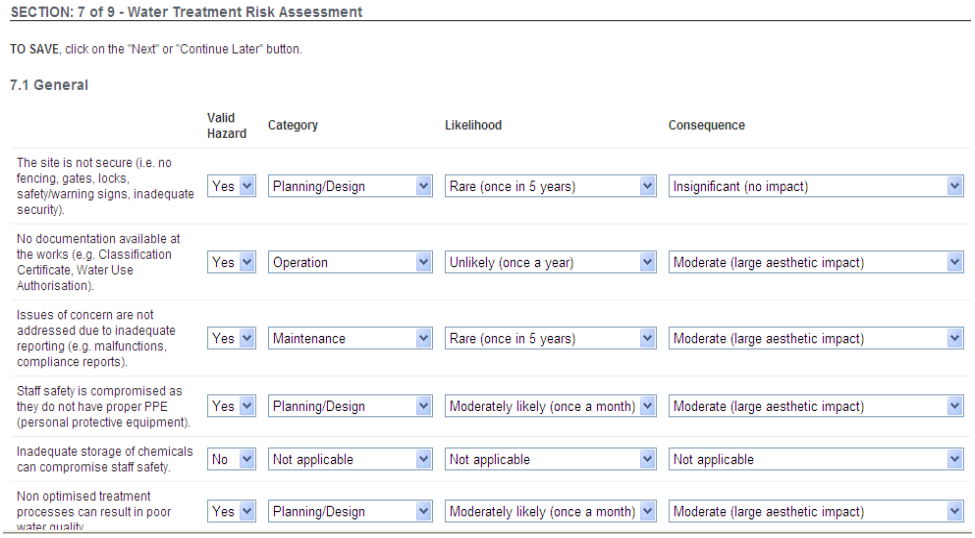


Figure 2: Water treatment risk assessment section of the web-enabled WSP tool (Jack and de Souza, 2012)

Water Safety Plan Summary Report

Risk Profile

No risk	The hazard is not applicable in this instance.
Low risk	These are systems that operate with minor deficiencies. Usually the systems meet requirements specified by the appropriate guidelines/standards.
Medium risk	These are systems with deficiencies which individually or combined pose a high risk. These systems would not generally require immediate action but the deficiencies could be more easily corrected to avoid future problems.
High risk	These are systems with major deficiencies which individually combined pose a high risk and may lead to potential health/safety/environmental/etc concerns. Once systems are classified under this category, immediate corrective action is required to minimize or eliminate deficiencies.

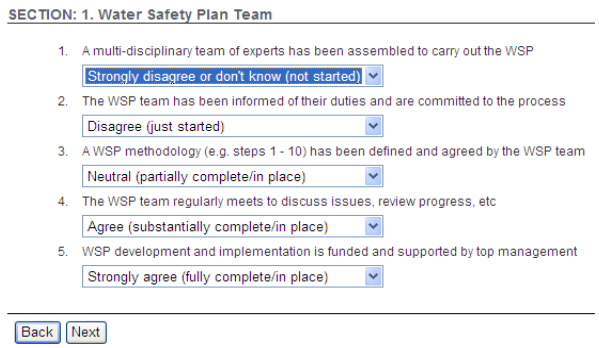
Risk Rating	Range
Low	0-10
Medium	11-56
High	57-100

Component	Hazard	Valid Hazard	Category	Risk Rating	Risk Profile	Control Measure in Place (if any)	Is the Control Measure Effective?	Corrective Actions	Who? (Responsible Person)	When? (Date)	Estimated Cost
9.8 Rain Water Harvesting	First flush of water can enter storage tank.	Yes	Planning/Design	35.00	Medium Risk						
9.8 Rain Water Harvesting	Bird/animal droppings contaminate water.	Yes	Maintenance	35.00	Medium Risk						
9.8 Rain Water Harvesting	Foliage collection over/along gutters and rooftops.	Yes	Operation	35.00	Medium Risk						
5.2 Boreholes	Groundwater may contain health related chemicals (e.g. arsenic, barium, fluoride,	Yes	Scientific Services	35.00	Medium Risk						

Figure 3: Ranked risks from the web-enabled WSP tool (and also highlighting how corrective actions can be captured) (Jack and de Souza, 2012)

Water Safety Planning Status Checklist Tool

In order to assist municipalities in understanding all aspects of water safety planning, and rapidly assessing their progress in these activities (i.e. Where are we and what do we still need to do?), a simple checklist tool was developed. This tool considers typical water safety planning steps and asks 5 key questions per step (see Figure 4 for web extract). Based on the answers, a score is calculated and a colour-coded "spider-diagram" output provided (see Figure 5 for web extract).



SECTION: 1. Water Safety Plan Team

1. A multi-disciplinary team of experts has been assembled to carry out the WSP
   Strongly disagree or don't know (not started)
2. The WSP team has been informed of their duties and are committed to the process
   Disagree (just started)
3. A WSP methodology (e.g. steps 1 - 10) has been defined and agreed by the WSP team
   Neutral (partially complete/in place)
4. The WSP team regularly meets to discuss issues, review progress, etc
   Agree (substantially complete/in place)
5. WSP development and implementation is funded and supported by top management
   Strongly agree (fully complete/in place)

Back Next

Figure 4: Completion of the web-enabled Water Safety Planning Status Checklist tool (Jack and de Souza, 2012)

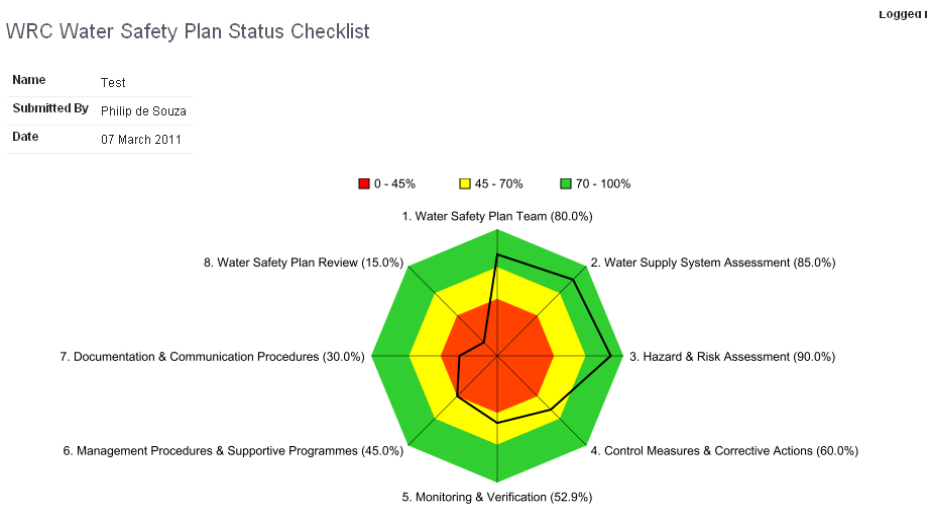


Figure 5: Spider diagram output from completion of the Water Safety Planning Status Checklist Tool, highlighting weaknesses in WSP implementation (Jack and de Souza, 2012)

By using the above tools, municipal technical staff develop a WSP, check their progress in implementing their WSP, and easily communicate such progress and any associated gaps to municipal management (e.g. Mayor, Councillors).

RESULTS AND DISCUSSION

Blue Drop Certification and the Status of Water Safety Planning in South Africa

South Africa has recognized and adopted the common worldwide view that water safety planning is the most appropriate methodology to identify and address water supply system associated risks and thereby effectively managing drinking water quality. In South Africa, most municipalities became aware of WSPs via the introduction of the need thereof through DWA's BDC programme (late 2008). The programme publicly reports on the drinking water quality management performance of municipalities and includes water quality compliance versus SANS 241 requirements (which is South Africa's National Drinking Water Quality Standard; SANS241-1 and SANS241-2), with excellent performance (overall score of 95% or greater) being recognised with conferment of Blue Drop Status by the DWA. Through this process, WSPs have been adopted in South Africa as a tool to fulfil the objective of ensuring safe drinking water supply through the use of a comprehensive risk assessment and management approach.

The first BDC assessments occurred in late 2008/early 2009 with 66% of municipalities participating (DWA, 2009). Although WSIs were encouraged to start developing and using water safety planning at this stage, development and implementation of WSPs by WSIs had zero weighting on the overall Blue Drop score.

The second round of BDC assessments occurred late 2009/early 2010 with 94% municipalities participating, and a substantial increase in the number of water supply systems assessed (from 402 to 787 assessments) (DWA, 2010). During the 2nd round of assessments, water safety planning carried a weight of 5% (i.e. the score for water safety planning activities in the overall Blue Drop score increased from 0% to 5%). Therefore, WSIs not developing and implementing water safety planning would find it very difficult to obtain or retain Blue Drop status (which requires an overall score of 95%).

The third round of BDC assessments occurred late 2010/early 2011 with all (100%) municipalities participating, and a further increase in the number of water supply systems assessed (from 787 to 914 assessments). During the 3rd round of assessments, the weighting associated with water safety planning increased further to 15%. In 2011, it was reported that 154 systems had WSPs in place, but no comment was noted regarding the quality of the WSPs provided, or the status of actual WSP implementation (DWA, 2011).

The fourth (and latest) round of BDC assessments occurred in late 2011/early 2012 with a decrease in municipalities participating (94%) but a further increase the number of water supply systems assessed (931 assessments) (DWA, 2012). Of the five BDC requirements, water safety planning related activities had the highest weighting:

1. Water safety planning (35%)
2. Drinking water quality process management and control (10%)
3. Drinking water quality compliance (30%)
4. Management, accountability and local regulation (10%)
5. Asset management (15%)

The increase in Blue Drop score weighting associated with water safety planning is summarised in Table 1.

Table 1: Increasing DWA Blue Drop score weighting for water safety planning over the four (4) assessment periods

Assessment Period (Year)	WSP Weight (as a percentage of total Blue Drop Score)
1 (2008/2009)	0%
2 (2009/2010)	5%
3 (2010/2011)	15%
4 (2011/2012)	35%

In the fourth round of assessments it was reported that of the 931 systems assessed, 579 water supply systems had water safety planning in place (i.e. 62%), and of which 269 were found to be complying well with international standards (i.e. 46% of those with water safety planning in place). Figure 6 provides a provincial breakdown of those numbers.

The BDC reports have demonstrated a gradual adoption and improvement in water safety planning activities in South Africa. The development of guidelines and tools to assist this has contributed significantly to this.

Key Observations from Use of the WRC Water Safety Planning Tools

The need for municipalities in South Africa to utilise water safety planning for drinking water quality management was largely influenced through inclusion thereof within DWA's incentive-regulation based BDC programme. In order for municipalities to obtain the relevant Blue Drop score for the WSP criterion, municipalities are required to provide proof that (i) a WSP inclusive of risk assessments from catchment to consumer has been developed, (ii) the WSP included defined roles and responsibilities, (iii) the WSP specified deadlines for management actions/commitment to fund implementation, and (iv) risk assessment findings had been implemented. The above shows that development of a WSP alone will not gain maximum scoring, and that actual WSP implementation is very necessary. Therefore, although water safety planning should not be about obtaining Blue Drop status, the introduction of the need for water safety planning by DWA has had a dramatic impact on the acceptance of water safety planning as an appropriate process to identify and manage drinking water quality associated risks, not least because the BDC scheme enables technical staff to justify financial decisions.

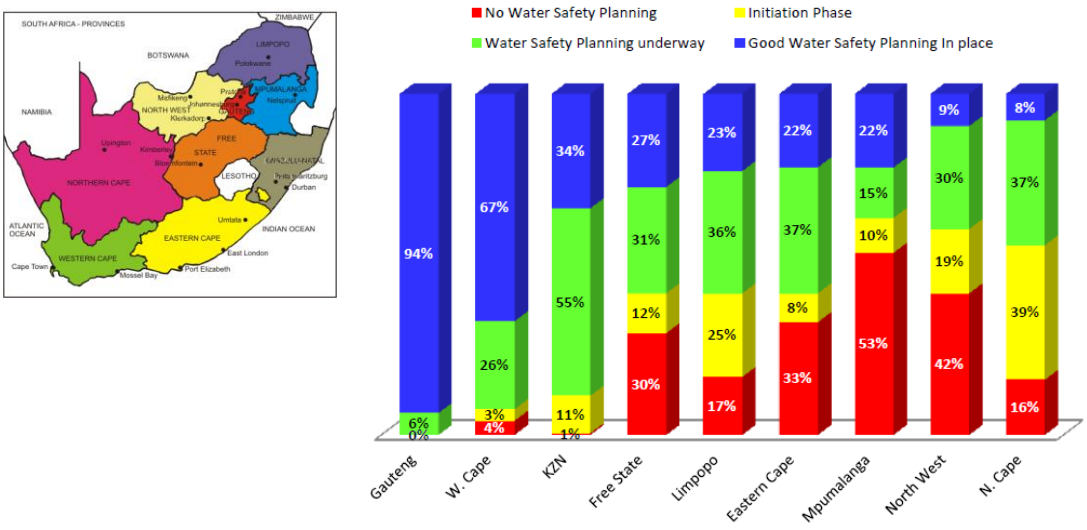


Figure 6: Current status of water safety planning in South Africa (DWA, 2012). W. Cape = Western Cape; KZN = KwaZulu Natal; N. Cape = Northern Cape.

Experience from workshops and associated training sessions held regarding the WRC water safety planning tools showed that:

- Implementation of WSPs is a challenge as many municipalities do not have enough sufficiently skilled operational and maintenance staff.
- Many of the initial WSPs only focussed on risks identified at the water treatment plants (i.e. did not consider the entire water supply chain).
- Where the WRC water safety planning tools were used, the municipalities were “forced” to consider the entire water supply system.
- Most municipalities acknowledged the value of managing drinking water using the WSP principles and gained an improved understanding of their challenges.
- Some municipalities were not aware of why they were completing a WSP, and in some instances even copied WSPs completed by other municipalities.
- On-going guidance to understand water safety planning, more easily complete a WSP and flag high risk issues was expressed by municipalities.

The benefits arising from using standard WSP tools developed through the WRC project have included the creation of a benchmark for water safety planning in South Africa, and allowed inputs from the entire water sector to ensure that "all applicable hazards/risks" are contained within a national database and are assessed by all municipalities. Municipalities therefore have access to a supported database where their peers and dedicated professionals share common experiences and challenges, resulting in a more appropriate, and therefore more widely accepted and used tool. The tools have also assisted with providing a common understanding/language, entrenching ownership of the WSP and addressing issues, assisted the audit/review process (similar format WSPs) and reduced costs (consultants are often used).

Web-based reporting systems and automatically generated risk assessment reports offer cost saving, time saving, reliability advantages and the potential for enhanced management oversight. A key weakness of the spreadsheet tool was found to be version control (especially if new hazards, corrective actions, etc. need to be added). In particular, key advantages identified from using the web-based water safety planning tools include:

- Enhanced sharing (multiple 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 – standard format in use which is continuously enhanced), 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 (the web-based tool is not as susceptible to user misuse and is hence less likely to “break” than the spreadsheet).
- Repository of information (hold much greater numbers of records than spreadsheets).
- Ability to conduct strategic analysis if sufficiently adopted (e.g. identify key threats/hazards/risks on a national basis).
- Less duplication (duplication of existing information in a new spreadsheet or creation of “copies” of existing spreadsheets – which is the latest/correct version?).

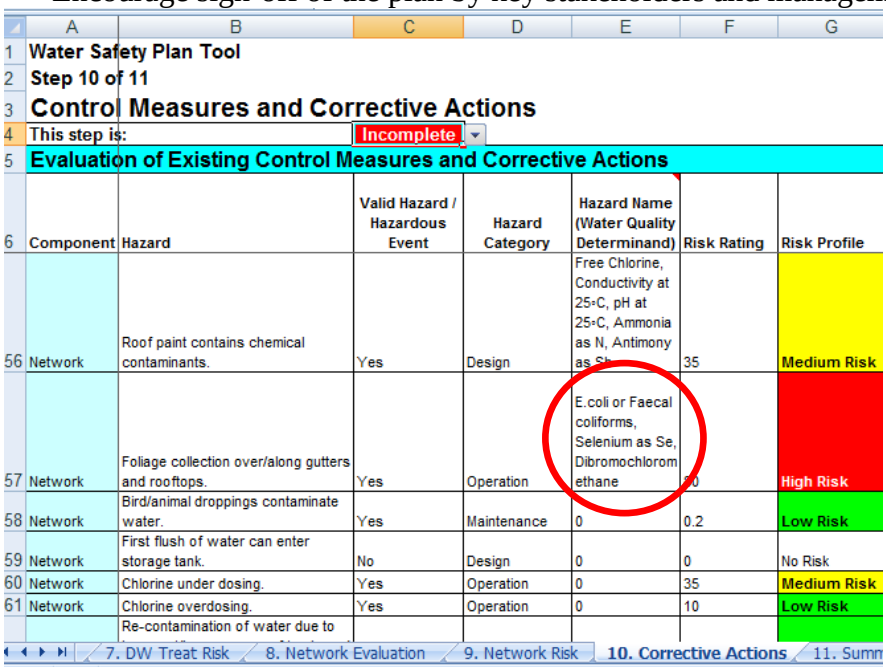
Although web-based tools have been shown to have numerous advantages over spreadsheet-based tools there are many municipalities that do not have appropriate IT infrastructure and have

welcomed the continued use of the spreadsheet-based tools. It is therefore necessary to ensure that both web-enabled and spreadsheet-based versions are kept up to date, and that there are appropriate communications with tool users.

Further Refinements and Enhancements to the WRC Water Safety Planning Tools

The project team continuously receives feedback from tool users (which includes municipalities, consultants and water boards) and this has led to a need to continuously review and refine or enhance the tools. Key tool requirements articulated by users and other sector stakeholders (such as DWA) have including the following:

- Need to further expand the hazards and hazardous events database (and should continue).
- The ability for the user to add site specific hazards/hazardous events (i.e. flexible, can be customised per water supply system).
- Include safety and infrastructure management related aspects (i.e. not water quality alone)
- Ability to link specific hazards (e.g. determinants that need to be monitored) to hazardous events (Figure 7). This will assist with developing appropriate risk based monitoring programmes as required by SANS 241-2 (2011).
- Provide examples of corrective actions/control measures (Figure 8).
- Allow calculation of residual risk (after implementation of corrective actions) (see Figure 9 for examples).
- Provide facility for a photo diary of hazards/risks identified through site visits that can be added to risk assessments (also serves as evidence) (Figure 10).
- Provide templates which can be used as a starting point for developing supporting programmes and management plans (e.g. risk based monitoring programme, incident management protocol).
- Encourage sign-off of the plan by key stakeholders and management (i.e. sign-off template).



Water Safety Plan Tool
Step 10 of 11
Control Measures and Corrective Actions
This step is: Incomplete
Evaluation of Existing Control Measures and Corrective Actions

	Component	Hazard	Valid Hazard / Hazardous Event	Hazard Category	Hazard Name (Water Quality Determinand)	Risk Rating	Risk Profile
56	Network	Roof paint contains chemical contaminants.	Yes	Design	Free Chlorine, Conductivity at 25°C, pH at 25°C, Ammonia as N, Antimony as Sb	35	Medium Risk
57	Network	Foliage collection over/along gutters and rooftops.	Yes	Operation	E.coli or Faecal coliforms, Selenium as Se, Dibromochloromethane	0	High Risk
58	Network	Bird/animal droppings contaminate water.	Yes	Maintenance	0	0.2	Low Risk
59	Network	First flush of water can enter storage tank.	No	Design	0	0	No Risk
60	Network	Chlorine under dosing.	Yes	Operation	0	35	Medium Risk
61	Network	Chlorine overdosing.	Yes	Operation	0	10	Low Risk
		Re-contamination of water due to					

7. DW Treat Risk | 8. Network Evaluation | 9. Network Risk | 10. Corrective Actions | 11. Summ

Figure 7: Aligning hazards/hazardous events with SANS 241 determinants to allow development of risk-based monitoring programme

List of Possible Corrective Actions (Control/Intervention Measures)

A	Policies, Plans and Procedures
A1	Water Master Plan prepared
A2	Sewage Master Plan prepared
A3	Stormwater Master Plan prepared
A4	Water Services Development Plan (WSDP) prepared
A5	Integrated Development Plan (IDP) prepared
A6	Water treatment works operating procedure and maintenance schedule prepared
A7	Reservoir operating procedure and maintenance schedule prepared
A8	Distribution network operating procedure and maintenance schedule prepared
A9	Sewage system operating procedure and maintenance schedule prepared
A10	Wastewater treatment works operating procedure and maintenance schedule prepared
A11	Human resources policy, plans and procedures prepared
A12	IT systems policy, plans and procedures prepared
A13	Institutional memory policy, plans and procedures prepared
A14	Emergency plans, plans and procedures prepared
A15	Disaster management policy, plans and procedures prepared
A16	Financial management policy, plans and procedures prepared
A17	Supplier/contractor contracts prepared
A18	Customer contracts prepared
A19	Customer information sharing policies, plans and procedures prepared

Figure 8: Extract from list of possible corrective actions provided for guiding appropriate interventions

- Need to present a summary of the information provided in the evaluation sections (and not only a risk assessment summary).
- Additional modifications for improving ease of tool use (e.g. having a direct link to the required section).
- Investigate development of other language water safety planning tools. South Africa has 11 official languages, and despite English being the common language of communication, understanding of technical topics in English is often lacking. Consideration is therefore being given to translating the tools into other South African languages, with the risk assessment summary and associated follow-up actions (WHAT, WHO, WHEN, HOW MUCH) being translated back into English in a bilingual output (to allow tracking of WSP implementation by DWA). In particular, an Afrikaans version has already been developed (Figure 11) for use in the Northern Cape, where water safety planning is currently most lacking (see Figure 6), and where language may be one of the barriers to more widespread adoption. Translation of the tools into other South African languages (e.g. Zulu) is also being considered.

CONTROL MEASURE VALIDATION					RESIDUAL RISK EVALUATION		
Corrective Actions	Who? (Responsible Person)	When? (Date)	Estimated Cost	Comment	Control Effectiveness %	Residual Risk Rating	Residual Risk Pro
Investigate, budget and Implement possible fencing and securing of fuel tanks.	Dave Poole	Jun-12	R 120 000.00	Investigate fencing of fuel tanks with palisades options	0%	80	High Risk
Increase public awareness of proper maintenance of storage containers	Dumisani Thabethe	Ongoing	To be determined	Customer Care to investigate possible awareness programmes	0%	70	High Risk
Increase public awareness of proper maintenance of storage containers	Dumisani Thabethe	Ongoing	To be determined	Customer Care to investigate possible awareness programmes	20%	56	Medium Risk

Risk Rating	Risk Profile	Control Measure in Place (if any)	Control Measure Effectiveness (%)?	Residual Risk Rating	Residual Risk Profile	Corrective Actions	Who? (Responsible Person)	When? (Date)	Estimated Cost?
0.2	Low Risk		80%	0.0	Low Risk				
35	Medium Risk		70%	10.5	Medium Risk				
80	High Risk	Yes, fence but old, gate often left open	30%	56.0	Medium Risk	Fix fence, ensure gate locked	P de Souza	14/04/2012	R 5 000
0.2	Low Risk		80%	0.0	Low Risk				
0	No Risk			0.0	No Risk				

Figure 9: Examples of how the calculation of residual risk could be incorporated into the updated tools

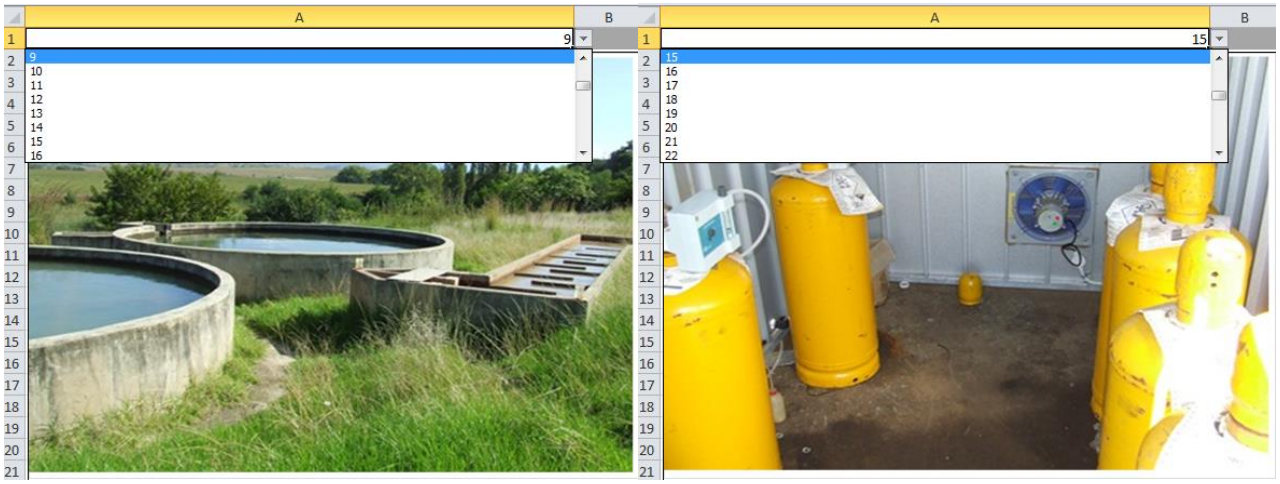


Figure 10: Photo diary captured within spreadsheet-based WSP tool

Opsomming Status en Rangorde							
Komponent	Gevaar	Geldige Gevaar	Kategorie	Risko Profiel	Beheermaatreëls in plek (indien enige)	Is die Beheermaatreël effektief?	Korrektiewe Aksies
Bron	Lewende hawe/boerdery, menslike aktiwiteite by die waterbron.	Ja	Ontwerp	Lae Risiko	0	Nee	Nuwe heining
Bron	Onbehandelde water is troebel na swaar reën. Dit mag mis bevat van diere en voëls.	Ja	Ontwerp	Medium Risiko	Effektiewe Monitering & behandeling	Ja	0
Bron	Dooie diere	Nee	Ontwerp	Medium Risiko	0	Nie van toepassing nie	0
Bron	Mis van diere/voëls kan lei tot die groei van gevaarlike mikro-organismes in die waterliggaam.	Ja	Ontwerp	Medium Risiko	0	0	0

Figure 11: Extract of risk assessment summary from Afrikaans version WSP tool

To address the above needs a follow-up WRC project was initiated to further refine and advance the developed WRC water safety planning tools. Some of these enhancements have already been developed or are currently being developed. User feedback from implementation of these enhancements and further developments arising will be the topic of subsequent papers.

CONCLUSIONS

The need for municipalities in South Africa to utilise water safety planning for drinking water quality management was largely influenced through inclusion thereof within DWA's incentive-regulation based Blue Drop Certification programme. Although water safety planning should not be about obtaining Blue Drop status, the introduction of the need for water safety planning by DWA has had a dramatic impact on the acceptance of water safety planning as an appropriate process to identify and manage drinking water quality associated risks. Considering the challenges faced by municipalities in South Africa (lack of human resources (skills and numbers), limited proactive maintenance, lack of funds, need to address service delivery backlogs, etc.), it is clear that municipalities require assistance with both development and implementation of WSPs. The development and introduction of appropriate tools to guide water safety planning activities and on-going refinement of these tools has contributed significantly to this rapid uptake and ensuring that appropriate water safety planning is occurring in South Africa.

ACKNOWLEDGEMENTS

The authors would like to thank the WRC for financial support of this project. The on-going input and feedback by municipalities, DWA and other sector role players to continuously refine and enhance the tools is greatly appreciated.

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