Towards a Guidance Document for the implementation of a Risk Assessment for small water supplies in the European Union

Overview of best practices

November 2011

KWR Watercycle Research Institute

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Title
Towards a Guidance Document for the implementation of a risk-assessment for small water supplies in the European Union, Overview of best practices

Project number
KWR A308715
EC Contract number: 070307/2010/579517/ETU D2

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We thank the following persons that provided comments to the draft version of this document.

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Executive summary

There are many small water supplies in the European Union and together these small supplies provide drinking water to a significant part of the European population. However, the quality of drinking water that is produced by these small water supplies is not always meeting the values for the various parameters laid down in the Drinking Water Directive 98/83/EC. In some situations there is also not sufficient knowledge about the quality of the water from small water supplies because they are inadequately monitored, or monitoring data is not reported.

With this document the European Commission strives to enable and stimulate improvement of drinking water safety for small supplies. The Commission decided that a collation of best practices on how to conduct a risk assessment for small supplies (less than 5000 persons) would be beneficial in particular in water supplies where capacity, financial resources, facilities for constructing and operating of traditional piped water supply is a limiting factor. The document provides motivation and inspiration for decision makers, legislators and practitioners to implement Risk Assessment and Risk Management (RA/RM) for small water supplies.

Implementing RA/RM for a water supply is part of a number of developments that are needed to improve public health and development in the long term. Development of RA/RM should be embedded in a process of change incorporating development of sanitation, hygiene, governance, financing, education, gender equality and training. It goes beyond the scope of this document to address al these issues, however they should be considered when starting a process of change. This document will focus on RA/RM approaches only.

This best practices document has two distinct parts. The first more political part of the document concerns the understanding/appreciation of the RA/RM approach and the adoption by authorities with the aim to produce a national strategy on RA/RM approach implementation. The second practical part of the document provides some examples of risk assessment approaches that can be used as inspiration to attain practical RA/RM approach experience. From the experience, authorities can develop their own tailored material for the implementation of an RA/RM approach to establish ongoing support.

There are different target groups for this Best Practices Guidance Document. The document can be used by those that want to encourage and motivate political decision makers to take action and start with the implementation of RA/RM for small water supplies. Another target audience can be found amongst those that want to produce guidance material on the practical aspects of RA/RM either at national or local level. The third target group is the expert, advisor or NGO that will use the document and the examples in the document to produce hands-on material for her or his situation.

Acronyms

WSP	Water Safety Plan
RA/RM	Risk assessment and risk management
MS	Member State of the European Union

Risk assessment and risk management terminology

The various documents on risk management don't always use the same terms or terms have a slightly different meaning. This is illustrated by the following terms that are frequently used; the descriptions were taken from the WHO WSP manual (2009) and the TECHNEAU [1]project (2007).

Hazard : Physical, biological or chemicals agent that can cause harm to public health (WHO).
Hazard is a source of potential harm or a situation with a potential of harm (TECHNEAU).

Risk: The likelihood of hazard causing harm to exposed populations, in a specific timeframe, including the magnitude and/or consequences of that harm (WHO). Risk is a combination of the frequency, or probability, of occurrence and the consequence of a specified hazardous event (TECHNEAU).

Hazardous event An event that introduces hazards(s) to, or fails to remove them from, the supply system (WHO). Hazardous event is an event which can cause harm (TECHNEAU).

Hazard identification is the process of recognizing that a hazard exists and defining its characteristics (TECHNEAU).

Hazard analysis is the process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for water safety and therefore should be addressed in the WSP.

[1] TECHNEAU: Technology Enabled Universal Access to Safe Water, www.techneau.org

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1 Introduction

1.1 Reason and background

Safe drinking water is essential for the health and well-being of citizens. Safe drinking water contributes to the development of a region by preventing impacts on economic efficiency due to illness linked to the lack of safe drinking water and associated health care costs. Member States have an obligation (DWD 98/83/EC) to provide clean and wholesome water to all citizens receiving their drinking water through a water supply serving more than 50 persons, through a smaller commercial water supply or through a supply which is public. Member States must follow a monitoring scheme for all these supplies and are under the obligation to report the results of the analyses to the Commission every three years. The reporting obligation to the European Commission is restricted to water supplies supplying more than 1000 m^3 of water per day or serving more than 5000 persons.

The reporting by the Member States on the quality of water supplied in large water supplies serving more than 5000 persons, shows that in general the implementation of the DWD has led to safe drinking water in the European Union. Many of the EU27 Member States have reached a high degree of compliance or are in the process of improving the quality of their water supplies.

Quite different is the situation for the quality of drinking water in small supplies (i.e. supplies serving water to less than 5000 persons). The quality of drinking water in these supplies is of a poorer quality in most EU Member States. EU-wide, not more than 60% of the smaller water supplies deliver water which is compliant with the DWD.

For the small water supplies very little or no RA/RM initiatives (either legal or volunatary) are being developed, except for small water supplies for which a legal obligation is enforced by local legislation. This can be an obligation to undertake a risk assessment or even a complete risk-based management approach.

The Commission is aware that basic management actions like undertaking a risk-assessment are rarely performed for the small water supplies. This is mostly due to a lack of general capacity on how to deal with water quality issues. In many small water supplies managers are ignorant of potential risks to water quality. Methods for RA/RM are not applied or the managers simply lack the knowledge or resources to perform these tasks.

1.2 Objective

With this document the Commission strives to enable and stimulate improvement of drinking water safety for small supplies. The Commission decided that a collation of best practices on how to conduct a risk assessment for small supplies (less than 5000 persons) would be beneficial in particular in water supplies where capacity, financial resources, facilities for constructing and operating of traditional piped water supply is a limiting factor. The document provides motivation and inspiration for decision makers, legislators and practitioners to implement RA/RM for small water supplies.

1.3 Position of the document

Implementing RA/RM for a water supply is part of a number of developments that are needed to improve public health and development in the long term. Development and implementation of RA/RM-in drinking water quality management should be embedded in an overall process of change towards safer water, incorporating development of complementary strategies in sanitation, hygiene, governance, financing, education, gender equality and training[2]. It goes beyond the scope of this document to address

[2] Progress and challenges on water and health: the role of the Protocol on Water and Health, Submission by the Bureau of the Meeting of the Parties to the Protocol on Water and Health to the Fifth Ministerial Conference on Environment and Health. UN, WHO Europe 2010

all these issues, however they should be considered when starting a process of change. This document will focus on RA/RM only.

RA/RM of drinking water supply is embedded in the Water Safety Plan (WSP) approach that is promoted and adopted world wide. Since the WSP approach has been well developed and applied, it is discussed in this document as an example of what should be part of RA/RM for drinking water supply. The WHO Guidelines for Drinking-water Quality, as the international scientific point of reference in drinking water supply and regulation, recommend WSPs as the most effective means of consistently ensuring the safety of a drinking water supply. WSPs require a risk assessment encompassing all steps in a water supply from catchment to consumer, followed by implementation and monitoring of risk management control measures and continuous reporting and updating. WSPs should be implemented within a public health context, responding to clear health-based targets and quality checked through independent surveillance[3].

There is no single practical implementation of the concept available that would apply to the whole European Union. WHO proposes a series of steps that support the introduction of WSP-type approaches on a country scale. Depending on the national/local context and the agency leading the implementation, these need not necessarily be pursued in the same order and certain steps may be less important or unnecessary.

WHO[3] proposes the following steps in establishing WSP-type approaches in a national policy:

1. Understand and appreciate the benefits of a WSP approach
2. Establish preliminary WSP vision
3. Attain practical WSP experience
4. Establish a national strategy to scale up WSP implementation
5. Establish for ongoing support of WSPs
6. Establish policy and regulatory instruments to support and enforce WSP implementation
7. Implement WSPs and verify their effectiveness.
8. Review overall WSP experiences and share lessons learned.

A national decision by governments to encourage or require implementation of RA/RM is a first step to improve public health. Next, the water suppliers or owners/operators of the water supplies have to appreciate and to implement the concept.

This best practices document has two distinct parts. The first more political part of the document concerns the understanding/appreciation of RA/RM (Step 1) and the adoption by authorities with the aim to produce a national strategy on RA/RM implementation (Step 4). The second practical part of the document provides some examples of risk assessment approaches that can be used as inspiration to attain practical RA/RM experience (Step 3). From the experience, authorities can develop their own tailored material for the implementation of RA/RM to establish ongoing support (Step 5).

1.4 Target groups of the Best Practices Guidance Document

Decision makers

Those that want to motivate political decision makers to initiate actions to implement RA/RM for small water supplies can use the first part of the document. Decision makers need to be convinced of the benefits of RA/RM for drinking water in order to make it happen. Thus, this document highlights the added value of a risk based strategy at a national level.

[3] Think big, start small, scale up. A road map to support country level implementation of Water Safety Plans. WHO, IWA 2010.

Developers of national or regional guidance
The second target audience is those that have the intention or task to develop national or local guidance on how to perform a risk assessment/risk management for small water supplies in their local situation. There is no "one size fits all" example but the document provides examples from various sources on how situation specific material can be developed.

Practitioners, advisors, NGO's
The third group consists of those that want to apply RA/RM in practice or that want to develop supporting materials for practical implementation of RA/RM. The second part of the document provides a guide to practical RA/RM materials that can be used directly or adapted to the local situation. Their focus can be more on providing tailored knowledge to the people in the field that have to perform RA/RM.

PART 1

IMPORTANCE OF RISK MANAGEMENT
OF SMALL WATER SUPPLIES

AND CURRENT STATUS

2 Small water supplies in the EU

2.1 Small and very small water supplies in the EU

Most of the 27 Member States of the European Union have small and very small water supplies within their territory. Many small supplies in Europe are situated in the often remote rural areas. Together they supply a significant part of the European Union with drinking water. They normally supply the resident population and businesses in small dwellings, agricultural areas but also second houses/summer houses, campsites, festivals and temporary populations as migrants, people in peri-urban areas around large towns and cities.

In the WHO document[4] "Small-scale water supplies in the pan-European region" the following is recorded on small supplies. "The definition of a small-scale water supply can vary widely within and between countries. Frequently, small-scale water supplies are defined on the basis of legislative specified criteria, such as population size, quantity of water provided, number of service connections or the type of supply technology used". And "small-scale water supplies can be categorized by two criteria: the group of people responsible for their administration, management and operation; and the group of users of the supply". Examples given in the WHO text are:

1. Private or individual wells: point sources, such as boreholes, dug wells, spring or rainwater collection, potentially piped into the dwelling or yard, which typically serve a single family or a small number of households (for example, farms, hamlets, and which are operated by the users themselves.
2. Community-managed supplies: systems administered and managed via self-responsibility by the community members (for example, cooperatives) who are also the users of the water. Community-managed water supplies range from point sources (such as dug wells, boreholes or springs) from which community members collect water and carry it home, to more sophisticated systems which may involve treatment, storage and piped distribution into dwellings or yards.
3. Public supplies: systems administered and managed by a distinct public entity (such as a municipality or water board association) responsible for the provision of drinking water to the public in a spatially limited area (for example, a small municipality or town).

This study primarily focuses on the small and very small water supplies that are described in 1 and 2 above. However, the results can also be applicable to larger supplies that face similar challenges.

In this document we refer to small water supplies in the sense of the directive. Some member states make a different distinction. For example in de UK the distinction is made between private and public supplies, where either can be large or small.

Even though no official definition exists that clearly states what small and very small water supplies are there is consensus between regulators and experts what we are talking about. The Drinking Water Directive only makes reference to the volume (in m^3) of drinking water delivered per day or the number of persons supplied. For the sake of communication and harmonization, we propose the following nomenclature for this report:

Type of water supply	Size of WSZ	DWD
"Large" water supplies	> 1000 m^3/day supplied or > 5000 persons served	Covered by DWD and MSs have reporting obligation to the EC
"Small" water supplies	10 - 1000 m^3/day supplied or 50 - 5000 persons served	Covered by the DWD but MSs have no reporting obligation to the EC
"Very small" water supplies	< 10 m^3/day supplied and < 50 persons served	Can be exempted from the DWD requirements and no reporting obligation to the EC

[4] Small-scale water supplies in the pan-European region, Background-Challenges-Improvements. WHO 2011.

Where there is no reporting obligation to the EC, Member States still have an obligation to report to the public on the quality of their drinking water. Also no exemptions are allowed when water is supplied as part of a public or commercial activity.

A number of attempts have been made to collect information on small and very small water supplies. The very first one was the study done by WEKNOW in 2005: "Small systems large problems: A European inventory of small water systems and associated problems". In this study to which 26 European countries (Member States and non-EU countries) answered, it was estimated that at least one in 10 Europeans (40 to 50 million people) receive their daily drinking water from (very) small supplies. The study used the definitions of small and very small supplies in the table. Following the WEKNOW[5] study, the European Commission issued a written request to the EU Member States for aggregated statistical information on (very) small water supplies[6]. That survey (of 2008) confirmed the first estimate made in the WEKNOW study: very small supplies served 47 million people (9% of the EU population) and small supplies served 65 million people (13% of the EU population). The large supplies supply drinking water to 388 million people (78% of the EU population).

2.2 Water quality problems associated with small water supplies

The large water supplies in the EU for which the Member States have a reporting obligation not only to their citizens but also to the EU (> 1000 m^3/day) in general have a high compliance rate with the requirements of the drinking water directive. This implies that most parametric values in the DWD are met in a high percentage of samples taken. The situation for small and very small water supplies is significantly different. The WEKNOW study and the information collected during the 2008 Commission survey on small supplies highlighted a number of water quality problems associated with small and very small water supplies.

In the three size categories inventoried in the Commission 2008 survey:

- in the category 10 to 100 m^3/day only 55% is fully compliant,
- in the category 100-400 m^3/day only 64% is fully compliant,
- in the category 400 to 1000 m^3/day only 66% is fully compliant.

But that is not the only problem small water supplies have to face. In many cases the small water supplies are not adequately monitored even though there is a legal obligation in the DWD to do so. For the three categories respectively 21%, 16% and 11% of the small water supplies is not sufficiently monitored or not monitored at all.

The quality of the water supplied by very small water supplies and private wells is largely unknown. When asked, most Member States do not have a clear picture of the number of such supplies within their territory let alone the quality of that water. As was already clear from the WEKNOW study and the Commission 2008 study, national authorities lack information on the occurrence and monitoring of small water supplies and the quality of the water they supply. That implies that the quality of the water supplied to a significant proportion of the European population is not adequately monitored, and that potential health risks are not recognised.

The water quality problems in small and very small water supplies can be divided in four categories[5 6]:

- Microbiological contamination
- Man-made pollution such as nitrate and pesticides
- Naturally occurring constituents of geological nature such as arsenic, iron, manganese and sulphate.
- Organoleptic parameters such as colour, taste, odour and turbidity.

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[5] WEKNOW Web-based European Knowledge Network On Water. Small systems large problems (European survey on small and very small water supply systems), 2005 Adriana Hulsmann

[6] This study is not in the public domain, as agreed with the MSs.

As very small supplies can be exempted from the provisions of the Directive and small supplies do not have to be reported on to the EC there is the risk that these supplies could be neglected and lead to risk to health. However, drinking water supplied in the EU should offer the same level of protection to the users of such supplies regardless of the size (CWDW98/83/EC). The responsibility for the maintenance and the quality of water from such supplies can and will vary between supplies and between MS.

3 Costs and benefits

3.1 Introduction

The primary goal of RA/RM for drinking water supply is the prevention of health risk and to achieve a safe and wholesome drinking water supply. Or in other words: to achieve an increased and reliable level of compliance with the requirements of the Drinking Water Directive, a lower incidence (non-compliance) rate and an increased awareness and targeted management of possible risks to water supply.

Primary prevention of risk to human health through their drinking water is not a matter of balancing costs against financial benefits but a common guiding principle and agreement that healthy water is essential for the functioning of a community. To properly express this in an economic way, not only reduced production cost for drinking water supply should be included, but also aspects as higher productivity, lower health care costs and eventually economic development of a community. Hunter *et al.* (2009)[7] pointed out that in general it economically makes sense to prevent illness through drinking water.

Health related benefits of providing safer drinking water through risk assessment and risk management will require some time to materialize as benefits are often long term and not always directly visible. This particularly applies to potential cost savings and health gains; on the contrary, however, experience has shown that reduced incident rates can be achieved as a "quick win" from introducing RA/RM.

3.2 Costs

Currently, there is not much validated information available on the cost of preparing, implementing and maintaining a WSP or RA/RM for water supplies. Costs for implementing RA/RM are not well defined, and some activities could be considered simply good practice. Costs that are attributed to implementation of RA/RM may include:

- Developing a RA/RM strategy at the national or company level
- Training of operators, managers, inspectors
- Preparing support materials (checklists, forms, manuals)
- Performing the RA (updating system information, sampling, meetings, field visits)
- Communication in the company or the community
- Developing RM (operational procedures, improving system infrastructure, monitoring)
- Possible costs for investments for system improvement and upgrade
- Reporting and updating

The scarce information that is available relates to large water supplies, such as the COWI study[8]. During this Impact Assessment Study a number of water suppliers were interviewed. From the interviews it became clear that the effort (financial and human input) required for the development, implementation and maintenance of risk-based management plans is not attributed in a harmonized way. This makes it very difficult to give an indication of the effort required. For the large and very large water supplies in the study the cost (financial and human) was in the range of less than 1% of the selling price of water (0.08-0.68%) for the upfront cost made in the first year for preparation and implementation.

Time and effort required to implement RA/RM very much depend on the experience of the water supply management and operational staff, the amount of data available for the supply, the size and complexity of the supply and other quality control systems that have already been adopted. Large and

[7] Hunter P.R. et al. An assessment of the costs and benefits of interventions aimed at improving rural community water supplies in developed countries. Science of the total environment, 2009

[8] COWI A/S Updated economic assessment of impacts of the revision of Council Directive 98/83/EC on the quality of water intended for human consumption, 2011.

complex systems will require a greater time input than small and simple systems. However, at the same time larger systems typically have more comprehensive data on the supply and more skilled staff and therefore although the time taken may be greater, if calculated on a per capita or volume of water produced the plan preparation might be more efficient. WHO (2005)[9] indicates up front effort (preparation and implementation) in man months is somewhere between 2 to 3 man months till 12 to 18 man months, for mostly large and very large supplies.

RA/RM typically emphasizes improvements of operational practice. Activities to reduce risk are likely to also improve asset management, protect capital investments and lead to reductions in aspects such as unaccounted for water, thus improving the cost-return ratio of water production. Activities include not only the assessment of risks but should directly lead to risk management.

The larger water utilities will most probably already have a quality management system in place (e.g. HACCP or ISO) that can be used to further develop for RA/RM. For small water suppliers and especially small private supplies efforts required (human and financial) could be relatively high, but they should be set off against the greatly improved water safety. It can be more effective to carry out a joint assessment for a number of small water supplies collectively and then produce risk management plans for each. Some water suppliers use external consultants which will of course increase the cost. Other water suppliers see the work as normal practice at little additional cost.

Portugal has provided exemplary information on cost of preparing and implementing a RA/RM plan by a utility. Information for a large water supply in the Algarve gives the following estimates: Preparation of the concept took 11 calendar months with 395 man days input. The implementation of the concept took 4 calendar months with 58 man days input. At the moment Portugal organizes training sessions for the owners/operators of small and very small water supplies.

Little information on effort needed is available for small water supplies. **Scotland** has produced very comprehensive guidance material and standard formats for risk assessment and uses these for private water supplies. After an initial investment to produce the supporting materials at national level (total cost 74.000 pounds sterling), a comprehensive training program was needed to prepare the local authority staff who have a duty under the national legislation to carry out risk assessments or assist owners and users in completing risk assessments. One local authority reported that a private water supply risk assessment can take up to a day and a half to complete.

In Lenzburg, **Switzerland**, a town with a population of 7000 people, one person prepared and implemented RA/RM of the water supply over a period of one year as part of his normal work.

The following qualitative observations were made from the COWI[8] survey amongst a number of European water utilities:

- Economic benefits (in terms of cost savings such as less costs for monitoring and sampling) have only rarely been mentioned as an argument for entering into the process.
- Starting points (baselines) may differ from one supply to the other. Thus, costs and benefits of implementing RA/RM will depend on whether this can build on past relevant processes such as HACCP.
- Implementation of RA/RM includes costs to initiate the process, contract external assistance for the process, carry out the risks assessments, identify corrective actions and produce documentation and operational plans for implementation plus a possible audit.
- After the implementation annual costs of operating the system is needed for operational monitoring, documentation, audits etc.

[9] Chapter 15 of WHO, Davison et al. Water Safety Plans Managing drinking water quality from source to consumer. WHO/SDE/WSH/05.06 2005

3.3 Benefits

For small-scale water supplies in rural communities, Hunter et al. (2009)[7] estimated cost-benefit ratios based on cost of improvement interventions in small-scale water supplies aiming at reducing acute diarrheal illness and the value of preventable disease measured by direct cost and indirect cost of illness prevented by these interventions. For the pan-European region, the return on investment of one US dollar results in a mean return of between 2.8 to 21.3 US dollars. Hunter continued that "In conclusion the financial benefits (as measured by direct and indirect costs of illness prevented) outweigh the costs of improving these supplies. Once the costs of irritable bowel syndrome are taken into account, the cost benefit ratio is even more clearly advantageous towards intervention. Ignoring the very real problems associated with small community systems in developed countries does not make good economic sense".

CDC[10] recently published an overview paper on the evaluation of the impacts of water safety plans in which it is argued that the impacts of WSPs must be placed into a larger context beyond simply health. Simply focusing on water quality and health improvements in the context of a WSP process will overlook a number of important intermediate outcomes that can provide a better picture of the significance and the success of RA/RM. Implementing Water Safety Plans can lead to many positive changes, from intermediate outcomes such as increased communication and collaboration among stakeholders, cost savings in day-to-day operations to ultimate impacts like improvements in health. Not all of these changes will occur immediately or simultaneously and health improvements in particular become apparent long after other outcomes. Despite difficulties in measuring health impacts and the extended time frames for those impacts to become apparent, the efforts to improve drinking water safety will ultimately yield health benefits.

The CDC[10] paper distinguishes four categories of beneficial outcomes: institutional, operational, financial and policy changes, where different outcomes typically occur at different time scales. Institutional outcomes often being the first ones to become apparent followed by operational and financial changes and, ultimately policy changes. The outcomes will eventually lead to impacts such as improvements in water quality and related improvements in human health, but also to other impacts on service factors such as quantity, continuity of supply, coverage and cost.

CDC[10] lists the following outcomes from the WSP process:

- Institutional changes
  - Increased communication and collaboration among stakeholders
  - Increased knowledge and understanding of the water supply system among water supplier's staff and other stakeholders
  - Improved staff perception and attitudes towards their roles and responsibilities
  - Increased training (increased knowledge, discipline and ownership among staff for their specific roles).

- Operational changes
  - Improved system infrastructure (through system infrastructure assessments, water quality assessment and monitoring plans)
  - Implementation of improved procedures for operations and monitoring.

- Financial changes
  - Cost savings through identification and implementation of more efficient procedures
  - Cost recovery: higher willingness to pay because of increased consumer satisfaction
  - Increased donor support and investment (better foundation for more efficient and targeted investment in drinking water systems).

- Policy changes
  - Informal knowledge sharing and promotion of WSP

[10]CDC, A conceptual framework to evaluate the Impacts of water safety plans. Centers for disease control and prevention, Atlanta. 2011. http://www.cdc.gov/nceh/ehs/gwash/Publications/WSP_Evaluation_Framework.pdf

- WSP as norms of practice (once established and with apparent benefits) transformed into best practices and integrated in guidance material
- Formal regulatory requirements for WSP, finally the WSP might be incorporated into drinking water regulations and become mandatory.

WHO[11] describes the benefits of the concept for the water suppliers. There are some key benefits to the water supplier to have RA/RM in place:

- Demonstration of "due diligence";
- Improved compliance with water quality legislation;
- Rationalizing and documenting existing operational procedures, leading to gains in efficiency, improvement of performance and quicker response to incidents;
- Better targeted for and justification of long-term capital investments based on risk assessment;
- Improved management of existing staff knowledge and identification of critical gaps in skills for staff;
- Improved stakeholder relationships.

WHO (2011)[4] states that the economic benefits from investing in small-scale supplies and from developing appropriate policies programs and regulations are significant. This is because of the prevention of waterborne illness and deaths that will result in the avoidance of associated health costs, enhances the potential for education and business development and an increase in the long-term sustainability of small communities.

In the COWI[8] study water suppliers were asked what according to their experience the key benefits of RA/RM were. First of all mention was made of improved safety, better preparation for events and better knowledge of the system. Personnel within different parts of the water supply company got more insight in and appreciation for each others tasks and cooperation between them increased. In general people became more aware of aspects related to the production of safe drinking water outside their own part of the job. It was also mentioned that operation and management can be done in a more efficient way which saves costs and results in better protection of health, more efficient treatment and operation. In one of the interviews it is mentioned that: "*The main benefit is the holistic approach, the new vision, and new things discovered that are now covered in the risk based management approach*." Thus, a holistic risk based management approach helps identify weak points and prioritize them. Portugal mentioned as the key benefits: "RA/RM is a driving force for improvement, assist to avoid organizational inertia and reduces public health threats. It provides for the establishment of a method to evaluate risks, set platform communications with stakeholders concerning water quality issues and helps the organization to focus on critical issues that become well know to the parties involved".

One of the potentials of introducing RA/RM can be cost savings mainly with respect to potential reduction in monitoring and sampling efforts. Even though some utilities in the COWI study identified cost savings as a potential benefit others describes that potential cost savings never were the driver when making the plans. For instance one of the respondents describes that it does not contribute to cost savings, but that it has introduced better operations.

Generally, the respondents mention that better public health protection is seen as the main benefit of RA/RM. If the number of outbreaks and non-compliance is reduced then the number of consumers exposed to danger of illness is also reduced. Thus, if fewer outbreaks are achieved the costs of peoples illness is reduced. Furthermore, contamination of drinking water not only affects public health but also society in general, for example industry, hospitals and health care, schools, emergency and response activities, and food retail sales and restaurant businesses.

[11] WHO Guidelines for drinking water quality Fourth edition 2011.

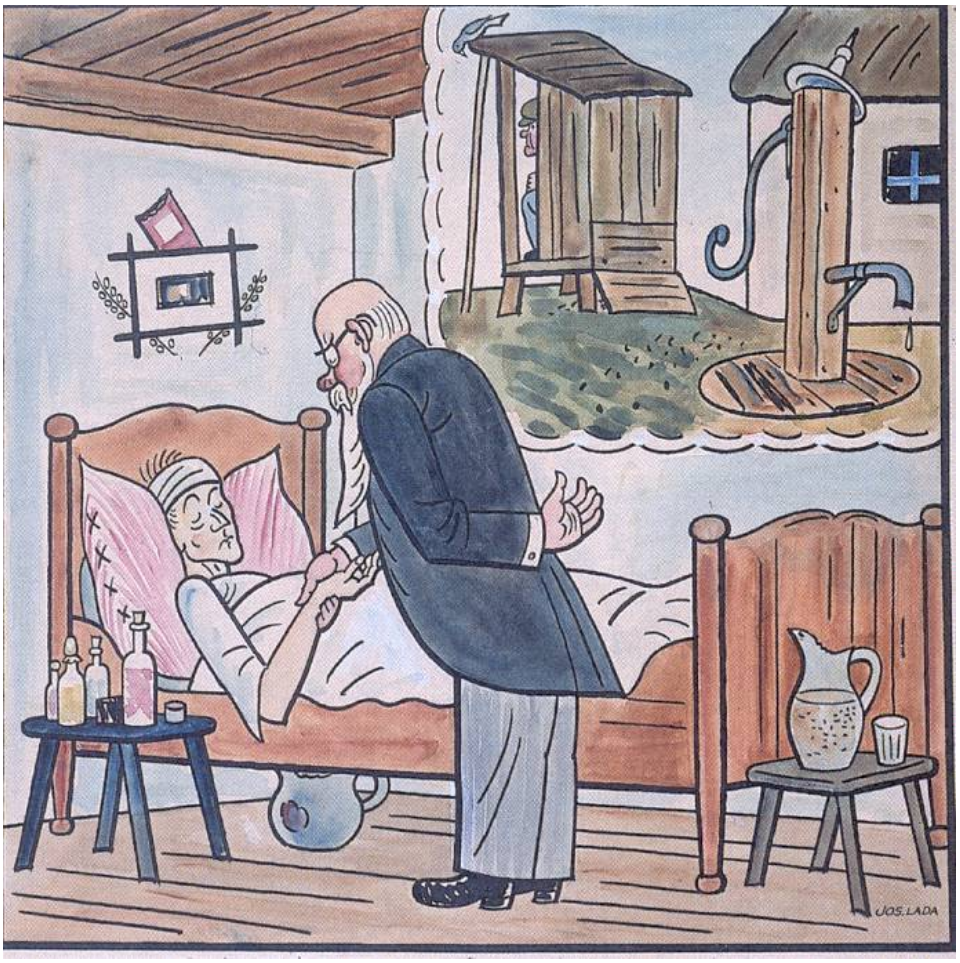
It is difficult to find quantitative information on the impact of RA/RM for drinking water has on human health or financially. However, as stated in the introduction, primary prevention of risk to human health through their drinking water is not a matter of balancing costs against financial benefits. Benefits go beyond health and finance, as discussed in this paragraph.

The Scotland case

As part of the COWI[8] study, a local authority (Council) in Scotland was interviewed to learn more about the costs and benefits of the risk based approach for private water supplies, i.e. those which are not supplied by the national water utility. Scotland has over 19,000 private water supplies, and legislation requires local authorities to complete risk assessments for all supplies which provide >10m^3 per day (or serve 50 or more persons), or, regardless of the volume used, are supplied or used for a commercial or public activity. Local authorities are also required to assist in completing risk assessments for any other private water supply on request. The inclusion of the requirement for risk assessment in the legislation is intended to assist in the reduction of risk to health from private water supplies. The local authority completes the source to tap risk assessment and any sampling and analysis that is required by the legislation, but the control of hazards, operational monitoring and corrective actions are the responsibility of the supply owners and users. A grants system which is funded by the Scottish Government and administered by local authorities is in place to provide up to £800 per property for private water supply improvement, which is paid once the local authority is satisfied that work to improve the supply has been completed. Practical guidance (Private Water Supplies: Technical Manual) for the implementation of the legislation was issued along with the legislation, and local authorities were involved in the preparation of the guidance. This national guidance is very detailed and comprehensive and at the same time very operational. Development of standard forms for risk assessment are included in the guidance.

The length of time that it takes to complete a risk assessment depends on the size and complexity of the supply and also the location of the supply. For more remote areas, travel time becomes longer and hence the costs may increase. The local authority which was interviewed stated that it can take up to a day and a half to complete a risk assessment, but many can be completed in an hour.

It is clear that substantial resources have gone into the process of preparing the legislation and guidance at national and local level and there are very good experiences and lessons learned which may be of relevance to Member States in carrying out risk assessments on small supplies. The grants scheme has had a significant effect on improving many private water supplies. While health benefits are still difficult to assess, it has been reported by the interviewed local authority that the raising of awareness of risk to owners and users of private water supplies that is generated through the risk assessment process is an important benefit in ensuring real and lasting water quality improvements.



Author picture: Josef Lada 1937. Description: "To what avail is my cure, when the well is next to the manure". Photo credit: Prague Water Supply and Sewerage Company.

4 Enabling environment

Implementing RA/RM at scale and thus improving health in the long term through water supply requires an enabling environment. National and regional authorities in the Member States can play an important role in the creation of an enabling environment for implementing RA/RM in drinking water supply. This chapter provides some elements of enabling environments. How these are best implemented, however, will of course depend on the national circumstances. The enabling environment consists of a number of aspects such as institutional support, stakeholder involvement and facilitating human, financial, organizational and community resources.

WHO[3] suggests a number of building blocks that collectively may create a structural enabling environment. All measures and programs at different levels need to be adapted to national and local circumstances.

- Appropriate national or regional drinking water quality policies, programmes and regulations, especially focused on the needs of small supplies.
- Financial support programs targeting water supplies in rural areas, including better access to financial markets for the necessary investments.
- Dedicated awareness-raising programs for decision makers at national, regional and local level, involved in regulation, surveillance and management of drinking water quality and small scale water supply.
- Establishment of vital support structures to capacitate, train and aid operators of small supplies.
- Strengthening of local surveillance and information systems by establishing procedures for drinking water quality monitoring systems and sanitary inspections and best sampling procedures and laboratory methods for routine sampling and microbiological and chemical analyses. Disease detection and response mechanisms, communication mechanisms and increased cooperation between local stakeholders to better detect outbreaks.
- Outreach and communication campaigns to increase local understanding in rural areas, especially targeting parents of young children on how to protect them.

To effectively capacitate operators of small supplies, WHO (2011) suggests a number of short-term supporting actions and measures, such as training programs with particular focus on the practical aspects of water safety plans. To use understandable guidance materials available in local languages, to establish regional or national support centers for additional expertise and professional support, to arrange regional and national networks for cooperation, communication platforms support and exchange of knowledge. The operators primarily need the (financial and political) support from local decision makers and active involvement of local stakeholders.

Since RA/RM is a stakeholder based process, one of the primary resources is the institutional partners involved in the RA/RM process. In order to successfully implement RA/RM, the stakeholders have to provide specific resources such as time commitment of staff, facilities to hold meetings or workshops, and materials and equipment for those events, all of which represent inputs.

Ways to involve the local community

It is very important to ensure community involvement in the process [12] so that proposals are demand-based and there is support for implementation. In addition, there must be access to technical support to identify problems and solutions, including engineering design and cost estimates.

Engagement of the community especially in the case of (remote) small rural communities is one of the main conditions for success. The output of stakeholder involvement will improve awareness in the

[12] SIKKIM Village water safety planning.Training manual, Sikkim rural drinking water, Institute of Rural Development 2010 http://www.wsp.org/wsp/sites/wsp.org/files/publications/SIKKIM_Training_Manual.pdf

community on the importance of water quality issues and the relationship with health issues and well-being. A higher awareness will help the community in protecting and improving their own water supply and to take responsibility for it. Local people have the best knowledge of the area to help in identifying, assessing and managing the risks and hazards. It will be easier to identify the needs of the community and to balance the importance of safe water supply against other competing needs such as housing and education.

There are many stakeholders in the whole water supply chain from source to tap. Examples are the rural community of the particular site including self-help groups, local water and sanitation committees, environmental protection and catchment agencies, farmers, house owners, local engineers and fitters, forestry guards and workers, land owners and estate managers, industrial sector if any, consumers and their organizations, community councils, local and regional authorities and their training and technical support units and NGOs. It is not always necessary to include all of these organizations in the whole process but there should at least be regular communication with them and they should be aware of the impact of their contributions to the RA/RM activity.

The community as a whole can be engaged in a number of ways. It is generally more efficient and effective to identify suitable members of the community to represent the community's interests as part of a RA/RM team. Other methods of engagement include, for example[12], public meetings, participatory techniques as e.g. transect walks and sub-group (corner) meetings by service area or interest group (women, poor, farmers)[13], also called walking the system and community/social mapping.

A survey in Scotland[14] revealed that it is not always easy to involve stakeholders as PWS (Private Water Supplies) were not widely perceived by owners/users of the supplies to be a potential health threat through microbiological contamination. Despite the poor microbiological quality of many supplies., improvement of PWS did not appear to be a high priority for most owners/users. The responsibility for managing the PWS was generally and clearly seen as primarily that of the owner and there was a persistent attitude of 'self-help' or personal competency amongst owners/users who appeared content that they should and could make their own judgments on PWS-related risks, and could use their own skills, or expertise available within their own local communities, to address most problems that might arise.

Another approach to stakeholder involvement in the preparation and the implementation of water safety plans is used by the NGO Women in Europe for a Common Future (WECF). They produce material to be used by schoolchildren and their teachers. Children are open to new information and eager to learn. Through the children the parents will be informed and very often made enthusiastic. WECF[15] has produced a standard shoe box with all information, games and test material (for nitrate in the water supply). The tool box can be adapted to the local situation.

[13] Source WHO document Water Safety Plan manual for small community water supplies. 2009

[14] Private Water Supplies [Scotland] Regulations 2006: understanding Engagement of Owners and Users. 2009

[15] WECF Developing water safety plans involving schools.2009 + Water safety plans in pictures

5 Inventory of current practices of RA/RM for drinking water in EU Member States and European countries outside the EU

5.1 Introduction

During the 2003 Drinking Water Seminar the EU Member States were encouraged to gain experience with RA/RM for drinking water. Some MS had already started with the introduction of a risk-based approach before the seminar, following the WHO publications on the subject. There are quite some differences between the twenty seven EU Member States and non-EU countries in Europe with respect to the status of implementation of RA/RM for drinking water. This chapter presents the current status and progress in Europe. Where information is available, RA/RM for small water supplies in the various countries will be elaborated on.

In a small number of countries the national legislation for drinking water quality now specifies a requirement for water suppliers to implement RA/RM to the production and distribution of drinking water. These vary from a general requirement for water safety plans to be implemented to very specific requirements as to how RA/RM should be carried out and reported. Other countries are considering the inclusion in national legislation and others strongly recommend RA/RM.

5.2 The current situation in Europe

Anno 2011, eight years after the drinking water seminar, it is interesting to make an inventory where Europe stands with respect to RA/RM for drinking water and more specifically for small water supplies.

There are a number of ways for MS to gain experience with RA/RM for drinking water. Some MS carry out research into risk assessment for drinking water and/or try out the concept as pilots on selected water supplies. Other MS positively encouraged risk assessment for public (and private) water supplies, but the concept is still voluntary and not (yet) embedded in national legislation. The most far-reaching option is mandatory risk assessment that is anchored in the national legislation. MS that have drinking water in their food legislation often require HACCP in their legislation for all food products, including drinking water. A national requirement for RA/RM for drinking water does not necessarily include the small and very small water supplies.

European countries, both EU and non-EU countries, were asked to provide information on the status within their territory. The enquiry showed that some countries have not yet started with RA/RM, where others already have the concept included in national legislation. The majority of countries are somewhere in between those two options, with some countries strongly recommending the adoption of RA/RM for drinking water. As said before, countries do not always include or specifically mention the small water supplies in their national legislation/recommendations.

Countries that already have a risk based approach in legislation (or HACCP in some cases) are: Switzerland, United Kingdom, Netherlands, Norway, Estonia and Slovenia. Switzerland requires RA/RM for all water supplies where water is provided to third parties. In Slovenia the system is based on HACCP and is for all systems serving more than 50 persons. The Netherlands does not address small water supplies, whereas United Kingdom and Norway do. In France the approach is mandatory for large water supplies (>5000 persons).

In Switzerland water is regulated through the law for food and water protection, which includes a risk assessment/risk management concept. Every operator of a water supply that provides water to third parties must draw up a self-checking concept and thereby operate a simple quality assurance system.

The water protection law obliges the confederation to assess the water quality of stretches of water both above and underground.

In Norway all operators of water supplies serving more than 50 people or 20 households must produce a WSP. In Slovenia where water is under food legislation, a HACCP system is required for water supplies serving more than 50 persons. In Estonia risk assessment is legal and mandatory for all aspects of drinking water quality, but in reality it was only enforced for the sum of THM in the city Narva (67000 consumers) and for radioactivity (total indicative dose) in several water works. Treatment operators of drinking water must guarantee routine and thorough inspection of drinking water in its water supply system.

The United Kingdom has national legislation that embeds RA/RM for the different regions, England, Wales, Scotland and Northern Ireland. In Scotland, local Councils are obliged to keep a register of all private water supplies to premises in their area and to carry out source to tap risk assessment on all private water supplies which provide >10m^3 per day (or serve 50 or more persons), or, regardless of the volume used, are supplied or used for a commercial or public activity. Local authorities are also required to assist in completing risk assessments for any other private water supply on request .

	Name of legislation	Source of information
England	The Water Supply (Water Quality) Amendment Regulations 2007 (as amended in 2010) [Public Water Supplies] The Private Water Supply Regulations 2009	www.dwi.gov.uk/stakeholders/legislation www.legislation.gov.uk/uksi/2009/3101
Wales	The Water Supply (Water Quality) Regulations 2010 [Public Water Supplies] The Private Water Supplies (Wales) Regulations 2010	www.dwi.gov.uk/stakeholders/legislation www.legislation.gov.uk/wsi/2010/66
Scotland	The Water Supply (Water Quality) (Scotland) Regulations 2001 [Public water supplies] The Private Water Supplies (Scotland) Regulations 2006	www.dwqr.org.uk/technical/regulatory-framework www.legislation.gov.uk/ssi/2001/207
Northern Ireland	The Water Supply (Water Quality) Regulations (Northern Ireland) 2007 (as amended) [Public Water Supplies] The Private Water Supplies Regulations (Northern Ireland) 2009	www.doeni.gov.uk/public_water/regulations_guidance/regulations.htm www.legislation.gov.uk/nisr/2009/413

The Netherlands has included RA in the national drinking water legislation. It is mandatory for large water supplies, but not for small water supplies. The obligation is included in the "Drinkwaterbesluit" and is directly linked to the Inspection Guideline "Assessment of the microbiological safety of drinking water"[16]. There is also a separate RA/RM obligation for *Legionella* but only for enterprises with lodging or accommodation e.g. campsites. There are compulsory monitoring programs for "private sources", in the Netherlands these are all linked to public and commercial activities such as campsites.

In some countries special attention is given to risk management for small water supplies even though RA/RM is not yet in the legislation. Portugal has ten pilots on risk assessment for water supplies. Portugal is considering a legal obligation for small water supply zones. Finland is considering a mandatory risk-based approach for small water supplies serving less than 5000 persons. The Czech Republic does both research and pilots also for small water supplies. A monograph on the results of a national project WaterRisk has been published (in Czech). In the Czech Republic there is guidance on WSPs but it is not yet embedded in legislation. The process, on how to develop water safety plan with some examples, is in detail provided there. Germany has a risk based system in place in large water supplies and research has started on a similar approach for small water supplies and for water inside buildings. DVGW-Hinweis W 1001, is the basis for the RA/RM for drinking water in Germany (also available in English). This guidance can also be used for small water supplies even though it was not

[16] Inspectorate guideline; Assessment of the microbial safety of drinking water, VROM-Inspectorate 1st January 2005, the Netherlands

specifically developed for small water supplies. Germany is currently working on a guidance document for operators of small water supplies < 5000 inhabitants. The Federal Environment Agency, Germany, is currently publishing a guide for owners and operators of private wells which also incorporates risk assessment and risk management elements.

Ireland does not have RA/RM in the legislation but they recommend it for both private and public water supplies. Austria also promotes the concept but again it is not in the national legislation. In Iceland 68% of population receives drinking water from water supplies with WSPs in place because of HACCPlegislation. Hungary will include in the national law (2012-2014) that water supplies serving more than 5000 people need to have prepared a WSP. Denmark is still discussing if the concept will be made mandatory or voluntary. In the meantime water suppliers can use risk-based management on a voluntary basis. In Cyprus there is not yet activity on risk-based management but the approach is used by some individual water suppliers. Italy has started research into the application of risk based approaches for drinking water. The Flanders region of Belgium has started a working group on risk-based approaches for drinking water. In Malta the national water supplier has employed a professional organization to start on the subject. Sweden reports pilot studies for large water supplies. Latvia has one pilot in Riga, which is for a large water supply. Luxembourg mentions pilots without further details. Romania prepared a water safety plan for a large WSZ as a pilot study. Romania has a methodology for assessing the health risks of drinking water. This methodology was distributed to authorities involved and also to the drinking water suppliers. The Ministry that is responsible for derogations demands a health risk assessment study for all water supplies that ask for a derogation. The Slovak Republic has not implemented RA/RM in national legislation but the Water Research Institute does research and pilot studies into the concept. Bulgaria and Poland report that they have not yet started. Information is still missing for Greece, Spain and parts of Belgium (Walloon and Brussels).

5.3 Conclusions

The conclusion of this inventory is that a few MS/countries actually have embedded (parts of) RA/RM in their national legislation. In the UK, Switzerland, Norway and Slovenia this requirement also includes small water supplies.

Some MS do not have the requirement included in their drinking water legislation but they have an obligation to have a risk assessment/risk management or a WSP mostly for large water supplies. Many MS are considering the inclusion of RA/RM in national legislation.

The majority of MS are gaining experience with research projects and pilot studies. Even though not yet in legislation many countries promote and recommend RA/RM and a number of them are producing guidance material on how to carry out a risk assessment or have already published such guidance. A small number of MS have not yet started with promoting RA/RM but there are reports that (large) water suppliers have started on a voluntary basis.
Special attention for RA/RM for small water supplies is noticed in: United Kingdom, Norway, Slovenia (mandatory), Ireland, Portugal, Finland, Germany and the Czech Republic.

It is encouraging to see that RA/RM is seen as the way forward especially for the small water supplies and private wells.

PART 2

EXAMPLES OF

RISK ASSESSMENT AND RISK MANAGEMENT

GUIDANCE MATERIALS

6 Risk assessment/risk management

6.1 Developments in risk management of water supplies

In early history man has used any available water for drinking. As populations started to grow in settlements and cities, outbreaks of disease through drinking water started to occur as the water became more contaminated. Drinking water risks were initially managed by using 'safe' sources such as groundwater or water from uncontaminated sources, and this is still practice in many situations. Where no clean sources were available, additional measures such as water treatment were implemented. Initially, people only became aware of poor water quality by the emergence of diseases. After the discovery of micro-organisms and the link between the occurrence of specific organisms (coliform bacteria and later on *E. coli*) and illness, the 'indicator concept' has been widely applied. This provided the means to recognize contaminated water even if illness was not apparent. The end product testing for fecal indicators led to major improvement of water supply safety and is still an important tool to manage drinking water safety. However, end product testing has some shortcomings[17]:

- Microbiological detection methods are often slow and thus have limited capability for early warning. If water quality monitoring provides evidence of microbial contamination, in most cases, the water has already been distributed and consumed. End-product testing, therefore, is "too little too late".
- There is a limited relationship between individual pathogens potentially present in drinking water and indicator organisms (e.g. *E. coli*) widely used for defining standards within end-product quality based drinking water legislation. This is reflected by the fact that waterborne disease outbreaks have occurred in the absence of *E. coli*. In particular, bacterial indicators have limited relationship to viral and protozoan pathogens (e.g. due to different sensitivity to disinfection) and the importance of these pathogens is becoming increasingly apparent.
- Water volumes tested against water quality standards are insignificantly small if compared to the total amount of water produced and sample numbers are rarely statistically representative of the water being tested.
- Taking into account the nature of micro organisms in drinking water, the statistic significance of the results of end-product monitoring is often limited.

Historically, end-product testing has been one of the key elements within legislation for managing the delivery of safe drinking water, and ostensibly for the protection of public health[17]. This is reflected by the Drinking Water Directive 98/83/EC (DWD) and its predecessor DWD 80/778 EEC, and many of the national drinking water legislations within Europe that primarily rely on compliance monitoring against water quality standards based on samples taken at specified minimum frequencies. Over recent decades, this approach has given clear guidance and a great impetus to the development of the water supply sector in European countries that has resulted in a high level of drinking water quality and supply infrastructure. From the consumers' perception this approach has successfully led to high confidence in drinking water safety.

The occurrence of outbreaks of drinking water related illness over the past decades has illustrated the shortcomings of end-product testing. Primary reliance on end-product testing is presently considered as not sufficient to provide confidence in good and safe drinking water. As a logical step in the evolution of an approach safeguarding the supply of safe drinking water that has the trust of consumers, discussions started in the drinking water sector about the added value of risk assessment and risk management strategies analogous to the principles of the HACCP (Hazard Analysis and Critical Control Point)

[17] Scientific Synthesis report Drinking Water Seminar December 2003 Brussels Position paper on Risk Approach for Drinking water. Risk based approaches; the next step in the evolution of the drinking water directive. Michel Gibert, Guy Howard, Adriana Hulsmann, Gertjan Medema, Oliver Schmoll, Frans Schulting and Riku Vahala.

approach that is widely used in the food industry. This move is not surprising as water is considered as a food product in many countries. Initial steps were taken in Switzerland and in 1994 the first publication on using HACCP principles in drinking water supply was published (Havelaar, 1994)[18].

Various water utilities started to apply these ideas to assess the safety of their systems. In 2004 worldwide attention for risk management "from source to tap" was raised by the Bonn charter (IWA 2004) and the third edition of the WHO Guidelines for drinking water quality (WHO 2004). Both referred to the need for a "water safety plan" approach to manage drinking water risks. The "water safety plan" was by then the term used for the interpretation of HACCP for drinking water supply. Another important global event was the IWA/WHO Water Safety Plan Conference, 12-14 May 2008, Lisbon, Portugal. In 2009 IWA and WHO published the WSP manual (WHO 2009) that encompasses all steps needed to produce a WSP for a water supply system. Over the same period from 1994 to 2009 many other manuals, frameworks and guidance documents for risk assessment and risk management have been produced. Most include the same steps as the WSP manual, although differences exist in the terminology, order or execution of these steps.

The growing tendency towards a holistic approach of drinking water quality, reaching from source/caption to the consumer, is apparent in many countries. In Switzerland, Australia, New Zealand, France, the UK and the Netherlands, for example, there has been a shift of emphasis within drinking water legislation towards a preventative or quality assurance approach. It encompasses comprehensive risk assessment and quality management strategies that account for a holistic approach from catchment to consumer, and that move away from excessive reliance on end-product testing towards a preventative focus in controlling processes and infrastructure. These developments are described in more detail in Chapter 5.

6.2 Relevance of RA/RM for small water supplies

RA/RM is especially beneficial for small water supplies for a number of reasons. Water quality control through end product testing may have limited effectiveness for small supplies. The frequency of sampling is very low (often once or a few times a year) whereas water quality can be very variable. Small supplies are especially vulnerable to short events such as heavy rainfall, thaw and contamination by cattle. Such events are easily missed by infrequent sampling, but they can have a high impact on health. RA/RM should recognize such events beforehand and measures can be taken to prevent negative consequences.

RA/RM increases awareness among stakeholders. For small supplies, a relatively large proportion of the population can be regarded as stakeholder having a strong impact on water quality. Personal behavior and activities of community members such as their sanitation, agricultural practices and herding affect their own water quality more directly than in a large water supply. The RA/RM will therefore include community involvement and stimulate community action.

RA/RM will raise awareness about health risks also from other fields. The issues of good sanitation, personal hygiene, water conservation and environmental protection are all linked to water safety. A RA/RM approach can thus lead to improvements in these fields too.

RA/RM allows for an iterative process of improving water safety. Small water supplies generally lack the resources to perform a 'full-blown' risk assessment and to implement all improvements at once. In RA/RM risks are prioritized so that the most important risks can be handled first. Since the RA/RM process is regularly reviewed, each cycle will deal with the next level of risk. Each new cycle builds on the previous one, so that knowledge grows, better information becomes available and the RA/RM process itself becomes more efficient.

[18] Havelaar, A. H. 1994 "Application of HACCP to Drinking Water Supply." Food Control **5**: 145-152.

The implementation of RA/RM may seem daunting for owners and users of small water supplies particularly where funding, expertise and human resources are limited. However, the main elements that they should apply will be the same albeit in a more simplified form. The best approach is to concentrate on the main points of identifying hazards and then mitigating risks in the most sustainable and cost effective way possible. For example, if cattle or sheep have access to a spring or stream used as a water supply, the hazard of faecal contamination would be immediately obvious from a site visit and would represent a significant risk to the safety of the water supply. The most effective sustainable control would not be occasional monitoring of the water for faecal bacteria; it would be prevention of animal access to the water by erection of a sturdy fence and the monitoring would be regular checking that the fence was intact and effective. Obviously not all hazards are so straightforward and external expertise and analysis will be required for help with those less easily detectable.

6.3 RA/RM as part of a development process

Poor drinking water quality is generally not the only issue that challenges small communities. Issues like poor financing constructions for public services, poor sanitation, education, knowledge, hygiene, organization, inspections and enforcement all compromise the sustainable supply of safe drinking water. Implementing RA/RM for water supply will only have a short term effect if the other issues are not also dealt with.

In the specific European Union legal and regulatory background, the setup and implementation of RA/RM is generally the responsibility of the water supplier though it typically involves supporting actions by other stakeholders that are often regulated through other Directives. This may be particularly important when identifying hazards and control measures within catchments where the water supplier does not own the land, and hence has no direct control of activities potentially polluting drinking water sources (e.g. in agriculture, industry). Equally important, in many cases the water supplier does not exert control over plumbing practices and materials used in installations in private or public buildings that potentially impair drinking water quality at the tap.

6.4 Key elements of RA/RM

As most RA/RM approaches follow the same steps, only the widely adapted Water Safety Plan approach is described here. The WHO Guidelines for Drinking-water Quality 3rd edition (2004) define Water Safety Plans as the most effective means of consistently ensuring the safety of drinking water supply through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer.

Water Safety Plans have three key components which are guided by health-based targets and overseen through drinking water supply surveillance. The key components are:

- **System assessment** to determine whether the drinking water supply chain (up to the point of consumption) as a whole can deliver water of a quality that meets health-based targets. This also includes the assessment of design criteria of new systems;
- **Identifying control measures** in a drinking water system that will collectively control identified risks and ensure that the health-based targets are met. For each control measures identified, an appropriate means of operational monitoring should be defined that will ensure that any deviation from required performance is rapidly detected in a timely manner; and
- **Management plans** describing actions to be taken during normal operation and incident conditions and documenting the system assessment (including upgrade and improvement), monitoring and communication plans and supporting programmes.

The Water Safety Plan Manual (WHO 2009) describes the following parts of the WSP process:

Preparation

1. Preliminary actions, including assembling the WSP team

System assessment

2. Describe the water supply system

3. Identify hazards and hazardous events and assess the risks
4. Determine and validate control measures, reassess and prioritize the risks
5. Develop, implement and maintain an improvement/upgrade plan

Operational monitoring

6. Define monitoring of the control measures
7. Verify the effectiveness of the WSP (does the system meet the health-based target?)

Management and communication

8. Prepare management procedures
9. Develop supporting programmes

Feedback and improvement

10. Plan and carry out periodic review of the WSP
11. Revise the WSP following an incident.

Different scales of water supplies require different modes of implementation. For most large utility supplies many of the elements that comprise RA/RM may already be part of the supplier's good practice or may be integrated in existing quality management systems (e.g. ISO 9001). Thus setting up and implementing RA/RM should not pose major difficulties. The situation may be different for small or medium sized water supplies. Here the range of skills, expertise and resources required to perform comprehensive system assessment and to implement management plans is not necessarily covered within single supplies. Thus, the way forward using the RA/RM approach for small and medium sized supplies is different compared to large utility supplies but the principles remain the same.

7 Methodology used to select RA/RM guidance examples

7.1 Collection of literature and documents

An inventory of available relevant guidance documents and frameworks for RA/RM of water supply was made. Documents were collected from within Europe and outside Europe. The study focused on examples in the English language, although some examples in other or multiple languages were also included. Starting from the authors' database, guidance documents were identified in publications, conferences and through internet and literature research. The Peer Review Group members and other contacts in the international drinking water network were asked for additional key guidance materials. All EU Member States and a few non-EU countries were asked for their guidance materials. All the collected guidance materials were included in the long-list in Annex I. The materials in the long-list were assessed in a systematic way to provide an overview of what materials are available and which might be suitable for the shortlist. Paragraph 7.2 describes the long-list assessment of guidance materials. A number of selection criteria were defined to help identify materials that best suited the objective of the study and would be included in the shortlist. These selection criteria will be shortly discussed in Paragraph 7.3.

The resulting (draft) shortlist was discussed with the EC and the Peer Review Group. This led to some adaptations of the list and the presented information. Although the shortlist represents good examples, other materials in the long-list can be similarly good. These were excluded to keep the shortlist concise and to prevent very similar materials to appear on the shortlist.

7.2 The Longlist assessment

All documents on the longlist were assessed to get a systematic overview of which aspects of RA/RM were addressed, and the context of the guidance material. The overview was used to select example guidance materials for the shortlist. All materials were assessed for the following items:

Steps of RA/RM

- WSP team
- system description
- hazard analysis and risk assessment
- control measures
- improvement plan
- monitoring control
- verification
- management
- support programmes
- periodic review

Issues addressed

- generic or specific
- size of the water supply
- source of raw water (surface water, groundwater, other)
- treatment
- distribution (network)
- consumer (secondary distribution, household storage)
- integrated approach (stakeholder and community involvement)
- chemical hazards
- microbiological hazards
- continuity of supply
- governance issues (water supply services, cost recovery, inspection ….)

- expertise level (required knowledge for RA/RM)

Status of the guidance material
- embedded in national law
- voluntarily/encouraged
- pilots or research

7.3 Criteria to select examples for the Shortlist

The long-list assessment made clear that many guidance materials used in Europe are based on the WSP guidance material produced by WHO or on HACCP principles that are very similar. The study strived to show various examples of how these principles can be implemented in specific situations (country, type of water supply service, target audience, technological level etc.). Examples should be significantly different from each other. On the basis of the following criteria a shortlist of examples of risk-based guidance materials was made. Examples should:

1. be specifically suitable for small water supplies
2. provide guidance on the steps to undertake risk assessment and risk management. In addition materials may provide useful background information, case study examples and (references to) documents with technical information the targeted end-users of the guidance materials should be able to carry out the risk assessment for their supply
3. be available in English, although some exceptions were made to illustrate the possibility or need to adapt materials to the local language
4. address the key elements of RA/RM in Paragraph 6.5
5. preferably use an integrated approach, including all stakeholders and the community
6. preferably include examples of how RA/RM steps are performed
7. preferably have forms or templates that can be used to fill in during the RA/RM steps.

7.4 Analysis of the shortlisted documents

The shortlisted materials were analyzed and described in more detail to provide the concise and uniform overview of the guidance materials in Annex II. Organizations that want to implement RA/RM can use this overview to find examples of guidance materials for situations similar to their own. The example materials can form the basis for developing specific guidance materials. The descriptions contain the following items:

Basic data
Audience
Size of the document
Information
Templates
Examples
Elements
Basis
Legal status
Characteristics for application:
Water supply size range
System complexity
System type
Technology level
Required expertise
Economic setting

Content summary

- Background information on the situation
- Target group of the manual
- Type of water supply
- Comments on the design and contents

Summary table

Assessment criteria	**Comments**
WSP team	
System Description	
Hazards and risks	
Control measures	
Improvement plan	
Monitoring control points	
Verification (audit)	
Management	
Support and training	
Periodic review	
Revise WSP	
Integrated approach	
Examples included	
Forms/Templates	
Other observations	

8 Shortlist of selected examples

8.1 Introduction

Small water supplies are not only characterized by the quantity of water or the number of people served. Depending on the setting there are various challenges that small supplies and their operators need to face. The WHO WSP manual for small communities (shortlist nr. 3) notes that *small community supplies and their operators:*

- *Are often isolated an/or remote, and operators lack ready access to expert assistance*
- *Face seasonal variations in water quantity and quality, or seasonal demands*
- *May receive limited management and technical support from water-user committees or government line agencies*
- *Have limited and inconsistent financial resources to invest in improvements and repairs*

From the inventory of guidance documents it became clear that there are also other settings for small communities. In some regions there is strong governance and financing schemes are available, for example in Scotland. In France many of the small supplies are owned and/or operated by large water supply companies that have skilled employees to perform risk assessment and risk management.

The goal of the current study was to provide best examples of risk assessment guidance documents. It is clear that the best document will be different for different situations. Therefore the shortlist of documents was compiled to cover the different settings that can be expected for small water supplies.

The documents in the shortlist were assessed and described per document. These descriptions can be found in ANNEX II. The full documents are provided on CD and can also be accessed through the internet.

8.2 Issues addressed in guidance documents

Size of the water supply

Chapter 2 discussed how small water supplies can be defined. Although the principles of risk assessment are the same for all sizes, guidance needs to adapted to the target audience which will differ with the size of the supply. Especially very small, e.g. private household supplies can be different, as the manager and the user are often the same. Also at this level often alternative sources are commonly used, such as rainwater. Guidance should provide these users with concise information, creating awareness, providing basic technical knowledge, simple checklists and practical advice on how to manage safety. The Australian water handbook (shortlist: 2) and the WECF WSP involving schools (shortlist 1) are directed at such supplies. Other guidance documents contain a dedicated part to very small supplies, such as the New Zealand DWSNZ guidelines Chapter 19 (shortlist: 8), parts of the Scottish Private water supply manual (shortlist: 9) or the WHO WSP guidance rural systems (shortlist: 4). For larger (small) supplies a differentiation of guidance for size is not needed. Most of the documents in the shortlist can be used for supplies serving over 50 people.

Elements of water supply

RA/RM guidance should cover all elements of water supply, from source to tap, including the catchment, secondary transport and in-house storage and use. Most guidance documents cover the catchment, groundwater and surface water sources, treatment and piped distribution. Some guidance is directed at only specific elements that are relevant on a national level. The Austrian and Finnish guidance only add treatment to that (shortlist 5, 6). The Irish, Scottish and French guidance (shortlist: 7, 9, 11) includes all elements but pays little attention to stand pipe types of supply with secondary transport and in-house storage. The other guidance documents (shortlist 3, 4, 8, 1) are (also) directed at developing countries or in-house systems and include guidance on secondary transport and in-house storage.

Technical and risk assessment knowledge
Sufficient knowledge is needed to provide safe water and to perform the risk assessment. **Large** water supplies have the means to hire and educate technicians and specialists that can manage safe supply for the whole community. They can be fully dedicated to water supply. The people in the community don't need knowledge, as they can simply open the tap and safe water runs out. They have little knowledge of their impact on water sources. Possible impacts are managed through sanitation, waste water treatment and inaccessible protection zones around drinking water sources. Guidance on risk assessment only needs to focus on identifying and managing risks by the small group of people responsible. The WHO WSP manual has provided the basis for larger utilities to develop RA/RM materials for their systems (See example France shortlist: 11).

Management of **small** water supplies is generally not the main activity of the people responsible for safe water supply, for example when the supply is managed by the community. They have limited knowledge of water supply operation and risk management and little resources (time and money). Some guidance documents provide elaborate explanations of water supply design, operation and maintenance (Scottish guidance manual, shortlist 9). This makes the guidance document very comprehensive (660 pages) The report is divided into sections and feedback from local authorities is that the manual has worked well for them. The draft WHO guidance for rural supplies (shortlist: 4) is an example of a modular approach. Each chapter can be given to risk assessors as a stand-alone guidance document for a specific situation. The draft is expected to be updated by the start of 2012. Other documents focus on the risk assessment issues assuming the operator or risk manager has sufficient knowledge of water supply. Sometimes the operator is directed to other manuals and guidelines on proper water supply design, operation and maintenance.

Awareness and hygiene
Awareness of drinking water risks is the first step in risk management. For small supplies this awareness should not only concern the water supply manager, but also the water users. The kind of information needs to be very different however. Community members need clear and concise explanations of health risks in common language. The WECF and WHO documents (shortlist 3 and 1) contain examples of simple information and ways to create awareness in the community. Local technical staff should already be aware of drinking water safety, but may not be aware of the importance of 'small' events or deviations. They need to refresh their knowledge and requires more technical guidance on what's important. The Scottish manual (nr 9 on the shortlist) provides this kind of information. More professional organizations may need to make their managers aware of the importance of risk management to free the resources. They should be directed towards scientific studies that they can use to improve their risk management. The WHO WSP manual is an example of a guidance document for this level.

Community involvement
Community members can have a large impact on the safety of their water. On the one hand they may need to transport and store the water safely or use alternative sources such as rainwater or a local spring. When in-house water treatment is applied they are responsible to carry that out correctly and consistent. On the other hand they may impact the drinking water sources by their activities such as inadequate sanitation, live stock herding (manure management) and agriculture (pesticides). In these cases guidance for risk assessment needs to address both the water supply manager and the community and many aspects need to be addressed:

- awareness of importance of safe water
- proper operation and maintenance of their water supply system (including all sources)
- safe (secondary) transport, in-house storage and use of water
- personal hygiene
- risk assessment and management
- preventing risks from activities (safe sanitation)
- organizing governance of the water supply

Clearly this is a lot of information for people whose primary activity is not safeguarding water supply. This is the knowledge and information contradiction; when the water supply is less developed, more information needs to be provided but the intended users have little affiliation with water supply. Guidance should than be directed at the 'community process' to improve water supply safety. Materials need to be well targeted without excess or irrelevant information. The Australian Water handbook (shortlist: 2), the WECF WSP involving schools (shortlist: 1) and the WHO WSP guidance for rural systems (shortlist: 4) provide guidance for such approaches. The WHO guidance for small communities addresses various levels of information and community involvement.

Governance

'*Governance shapes the way a service or set of services are planned, managed and regulated within a set of political, social and economic systems to ensure sustainable services*' (Harpe, 2010)[19]. Safe water supply requires good governance to ensure that sufficient resources are available (financing), sources can be protected (political decisions on land use), water quality is monitored and water safety is audited (legal) and water supply duties and rights are clear to those involved (social). For small supplies in Europe the governance varies per Member State. Most affluent countries have clear national regulations and governance is hardly an issue for risk assessment guidance. The guidance documents from Austria, France, Finland and Australia (shortlist: 5, 11, 6 and 10) pay little attention to governance. Mostly stakeholder involvement is addressed for source water protection, and regulations for monitoring and reporting (auditing) are discussed. The Scottish legislation links financing of improvements to risk assessment through grants. In guidance for less developed countries (WHO documents, WECF, shortlist: 3, 4, 1), or remote settings (New Zealand and Australia water handbook, shortlist: 8, 2), governance is a main issue. Importance of a healthy financial structure (water supply charge) and the roles and responsibilities of community members are addressed in these documents.

Language

Originally this study would only deal with guidance documents in English. However, managers of small supplies may often not understand English. Therefore some examples of other languages were included. Foreign languages included in the shortlist are German (5) and French (11). The WECF document (1) is also available in Russian and Romanian. Ideally managers would receive guidance in their native language to avoid mistakes or misunderstanding of terms. Even in English, terms may only be applicable to specific regions, e.g. 'soakages' in the water handbook is only used in Australia. The RA/RM terminology used can also differ between materials.

Templates or software?

Most of the guidance documents contain templates that need to be filled in and sometimes processed to evaluate risk. For short checklists and in poorly developed settings this can be sufficient. Several guidance documents provide 'software' to fill in checklists and evaluate the outcome (e.g. Irish *Cryptosporidium* hazard spreadsheet, Australian Water handbook, longlist 7a, shortlist 2). Some guidance documents only consist of software (France, shortlist: 11). These products generally also facilitate the description of the water supply. The advantage of software is that the assessment is easily updated, especially for more complex supplies. A disadvantage of software can be the lack of computers or the ability to work with them. So far software appears to be only available as Beta version (test version), and is therefore subject to bugs and has limitations. Both checklists and software facilitate the auditing of risk management.

Risk scoring guidance

Risk scoring needs to be done per site to prioritize risks and to check whether risks are sufficiently managed. Most guidance documents leave it to the risk assessor to score the likelihood and severity of consequences based on their knowledge. Often the WHO risk matrix (WHO 2009) is then used to prioritize risks. The quality of the risk assessment and the prioritization depends on the level of

[19] Harpe, J. de la, 2010 Strengthening local governance for improved water and sanitation services, accessed IRC Delft, The Netherlands www.irc.nl

knowledge and experience of the operator or risk manager. Even well trained, experienced staff find it difficult to assess likelihood and consequences of risks. Addition guidance on risk scoring could be beneficial to the RA/RM. The Irish *Cryptosporidium* risk screening methodology (longlist: 7a) goes beyond the risk matrix. Based on the local conditions, each hazard in the checklist gets a pre-set score. Risk reducing elements or measures can receive a negative score. The total score is summarized and the height determines the level of *Cryptosporidium* risk at the site. This strongly supports the risk manager, who may not have a clear sense of the consequences. For example disturbance of settling can lead to significant health risk, but the operator only sees an increase in turbidity. The Scottish private water supply manual (shortlist: 9) uses a similar scoring mechanism based on the WHO system.

Uniformity for auditing
Some documents are clearly directed at creating a uniform report from various sites to make auditing easier (shortlist: 9, 11, 6, 7). The advantage for the auditor is clear. The manager or operator may however not take the risk assessment seriously and simply fill in the ticks to satisfy auditing. Also such checklists need to be tailored to the local situation and may miss site-specific risks. Ireland's approach to the Water Safety Plan overcomes this scenario by allowing any additional site-specific hazards to be added to the hazard identification worksheet and therefore to be risk scored accordingly. It is essential that the person responsible for water supply makes an 'own' risk assessment, as going through the process of risk assessment is more important than the final risk evaluation report.

8.3 Improving RA/RM: a tiered approach

The level of risk management that can be applied depends on the available resources (financial, skill, expertise, time). Providing advanced risk-management software to a manager of a poorly developed system will not be effective. A tiered approach toward risk management is therefore suggested for these systems starting with a simple, basic RA/RM guidance materials. The RA/RM process is a cyclic or iterative process and with each cycle the quality and safety of the system can improve. As the system improves, more advanced RA/RM with appropriate guidance materials can become possible. This tiered approach is illustrated in the following figure. For each tier the most important issues are highlighted, along with the guidance documents from the Shortlist that best fit that level of RA/RM. This should not be seen as a strict framework, but more as a rough guide.

Users of a poorly developed water supply system should first be made aware of the importance of safe drinking water. This requires simple information in the local language. Secondly the water supply needs to be organized to enable change. Local governance should cover tasks and responsibilities of stakeholders and the community, financing and water supply services. Introducing RA/RM principles in the community will help identify the most important risks and measures to reduce them. When this has been achieved, a higher level of knowledge is needed to further improve water safety. This can be done by providing technical information about water supply and training professionals. Experiences can lead to developments on a national level, organizing national governance and providing institutional backup. Support by experts and knowledge exchange can further improve water safety. Finally the focus can be shifted to uniformity and efficiency of the risk assessment, allowing easy auditing and comparing different system.

8.4 Conclusion

Guidance materials for RA/RM of water supply need to be tailored to the specific situation. The shortlist of guidance materials provides examples of guidance materials for water supply systems at various levels of development. This overview can be used as a guide to appropriate examples for RA/RM guidance materials.

Guidance materials for RA/RM in the shortlist linked to the level of development of the water supply. With each cycle of RA/RM the system can become more developed and a higher level of RA/RM becomes appropriate.

Shortlist of examples of risk assessment guidance documents[20]

Source/country	
1. WECF	Developing water safety plans involving schools.2009 + Water safety plans in pictures. 2008
2. Australia	The Water Handbook. 2007 A guide for management of small water supplies in Australian Aboriginal settlements
3. WHO	Water Safety Plan manual for small community water supplies. Nepal 2009
4. WHO, India	Guidelines for water safety plans for rural water supply systems. 2009
5. Austria (in German)	Richtlinie W 88 Anleitung zur Einfuhrung eines einfachen Wasser Sicherheitsplanes 2008
6. Finland	Operation and maintenance of small water work 2008
7. Ireland	EPA Drinking Water Advice Note No. 8 Developing Drinking Water Safety Plans. 2011
8. New Zealand	3a A Framework on How to Prepare and Develop Public Health Risk Management Plans for Drinking-water Supplies 3b Draft Guidelines for Drinking-water Quality Management for New Zealand Chapter 19
9. Scotland UK (cut down to suitable parts for EU)	Private water supplies. 2006 A technical manual and various supporting documents
10. Australia	Australian guidelines for water recycling and augmentation of drinking water supplies. 2008
11. France (in French)	Aide a l'evaluation des risques microbiologiques dans les petites unites de production/ distribution d' eau potable. Manual Utilisateur 2009 including CD with software

[20] Full references are given in the long list in Annex I

9 References and background

Aguas do Algarve 2010 Water safety plan implementation case study Aguas do Algarve PT; PPT

APSU 2006 Water safety plans Bangladesh experiences from pilot projects.

CDC 2011 A conceptual framework to evaluate the Impacts of water safety plans. Centers for disease control and prevention, Atlanta. 2011.

COWI A/S 2011 Updated economic assessment of impacts of the revision of Council Directive 98/83/EC on the quality of water intended for human consumption.

DVGW 2005 *W1d – Richtlinien für die Qualitätsüberwachung in der Trinkwasserversorgung* that appears to be linked to W1002. DVGW mentioned that based on W1001 a new guideline for small supplies is being prepared.

Europa Fachhochschule Fresenius 2003 Qualitätsmanagement der österreichischen Trinkwasserversorgung. Ermittlung von Einflussfaktoren für ein Vorhersagemodell für die Trinkwasserqualität. (Quality management of the Austrian drinking water supply. Determining factors for a predictive model for drinking water quality).

Europa Fachhochschule Fresenius 2003 Abschätzung der Umsetzbarkeit des Water Safety Plan (WSP) der WHO in der österreichischen Wasserversorgungsanlagen (WVA) am Beispiel der WVA Tulln. (Estimate the feasibility of the Water Safety Plan (WSP) of the WHO in the Austrian water supply systems (WCL) by the example of WVA Tulln.).

Gibert et al. 2003. Scientific Synthesis report Drinking Water Seminar December 2003 Brussels Position paper on Risk Approach for Drinking water. Risk based approaches; the next step in the evolution of the drinking water directive.

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Hunter P.R. et al. 2009 An assessment of the costs and benefits of interventions aimed at improving rural community water supplies in developed countries. Science of the total environment. **407** 3681–3685

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IWA 2004 The Bonn charter for safe drinking water.

IWA 2007 Development and implementation of water safety plans for small water supplies in BanglaDesh. Benefits and lessons learned.

Jacob, S. et al 2010 Maïtriser le risqué microbiologique dans les petites unites de distribution d'eau. Ogeris, un outil de gestion preventive (Manage the microbial risk in smal water supplies. Ogeris, a preventive management tool); TSM numero 12

Richter et.al. 2009 Sicherheit der Trinkwasserversorgung gegen bedrohungen. Ein internationales thema auch fur sicherheit. DVGW conference Wat Berlin 2009.

MWH 2010 Cost Benefit analysis of the Private Water Supplies (Scotland) Regulations 2006.

National Federation of Group Water Schemes Ireland. 1999. Water for Life. A training programme for group water scheme operators.

Samorka 2006 Blue print WSP preliminary edition. Mini water quality safety plan for small communities – five steps-.

Samorka 2010 Maria J. Guunarsdottir Study of water safety plans at sixteen Icelandic waterworks.

Scotland 2009 Private Water Supplies [Scotland] Regulations 2006: understanding Engagement of Owners and Users.

Scottish executive and J.K.Fawell 2005 Development of drinking water safety plans in Scotland.

Scottish Government Social Research 2009 Private Water Supplies (Scotland) regulations 2006. Understanding engagement of owners and users.

SIKKIM 2010 Training manual for village water safety plans.

Staben et.al. 2008 Implementation of a technical risk management concept based on WSP. A benefit for German water supply? IWA World Water Congress Vienna 2008

TECHNEAU 2007 Generic Framework and Methods for Integrated Risk Management in Water Safety Plans http://www.techneau.org/fileadmin/files/Publications/Publications/Deliverables/D4.1.3.pdf

UNEP/WHO 1997 Water pollution control, a guide to the use of water quality management principles.

VROM 2005 Inspectorate guideline; Assessment of the microbial safety of drinking water, VROM-Inspectorate 1st January 2005, the Netherlands.

WHO 1997 Guidelines for drinking water quality volume 3. Surveillance and control of community supplies.

WHO 2000 Tools for O&M status of water supply and sanitation in developing countries.

WHO & IRC 2000 Operation and maintenance of rural water supply and sanitation systems.

WHO 2004 Guidelines for drinking water quality. Third edition.

WHO/SDE/WSH 2005 Chapter 15 of Water Safety Plans Managing drinking water quality from source to consumer.

WHO 2007 Support for the development of a framework for the implementation of Water Safety Plans in the European Union 2007

WHO 2009 Water Safety Plan manual for small community water supplies.

WHO 2010 Think big, start small, scale up. A road map to support country level implementation of Water Safety Plans. WHO, IWA.

WHO Europe 2010 Progress and challenges on water and health: the role of the Protocol on Water and Health, Submission by the Bureau of the Meeting of the Parties to the Protocol on Water and Health to the Fifth Ministerial Conference on Environment and Health. UN,

WHO 2011 Small-scale water supplies in the pan-European region. Background Challenges improvements

WHO 2011 Guidelines for drinking water quality. Fourth edition.

WSP World Bank 2010 Water Safety Plans for Rural Water Supply in India. Policy Issues and Institutional Arrangements.

I Long-list of RA/RM materials

Document nr.	Title of the document and year produced	Country or organizations
1	Developing water safety plans involving schools - a WECF manual. 2009 and Water Safety Plans in pictures. 2008	WECF www.wecf.eu Women in Europe for a Common Future
2	The Water Handbook. 2007 A guide for management of small water supplies in Australian Aboriginal settlements	Alice Springs Desert knowledge Cooperative Research Centre CRC http://www.desertknowledgecrc.com.au
3	Water Safety Plan manual for small community water supplies. Nepal 2009	WHO
4	Guidelines for water safety plans for rural water supply systems. 2009	Sulabh International Academy of Environmental Sanitation , supported by WHO India www.whoindia.org
5	Richtlinie W 88 Anleitung zur Einfuhrung eines einfachen Wasser Sicherheitsplanes. 2008 (Manual for the introduction of a simple water safety plan)	OVGW Vienna Austria www.ovgw.at
6	Operation and maintenance of small water Works.Environment Guide 2008	Finnish Environmental Institute SYKE, Helsinki Eija Isomäki et. al. http://www.environment.fi
7	**7a: EPA Risk screening methodology for *Cryptosporidium*** 7b: EPA Drinking Water Advice Note No. 8 Developing Drinking Water Safety Plans. 2011	Environmental Protection Agency, Ireland www.epa.ie
8	Small drinking water supplies Preparing a PHRMP. 2005 and A framework on how to prepare and develop PHRMPs for drinking water supplies. 2005 Both part of Draft Guidelines for drinking water quality management for New Zealand.	Ministry of Health, New Zealand http://www.moh.govt.nz
9	Private water supplies. 2006 A technical manual and various documents	The Scottish Executive, june 2006 www.scotland.co.uk
10	NWQMS: Australian guidelines for water recycling and augmentation of drinking water supplies. 2008	Australian Government www.ephc.gov.au
11	Aide a l'evaluation des risques microbiologiques dans les petites unites de production/distribution d' eau potable Manual Utilisateur 2009 including CD with software (Tool for microbiological risk assessment in small units of production / distribution of drinking	ASTEE/OGERIS ASTEE - Association Scientifique et Technique pour l'Eau et l'Environnement www.astee.org

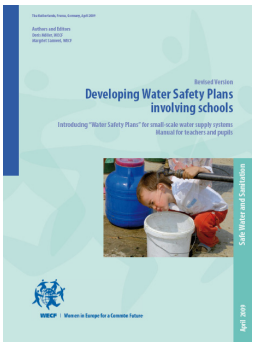
	water)	
12	Recommendations for a simple quality assurance system for water supplies WQS 2003	SVGW/SSIGE Schweizerischen Verein des Gas- und Wasserfaches www.svgw.ch
13	Technische Mitteilung Hinweis W 1001/August 2008 DVGW Regelwerk, Sicherheit in der Trinkwasserversorgung Risikomanagement im Normalbetrieb. (Technical note for guideling W 1001. DVGW Rules, security of water supply risk management during normal operation)	DVGW Germany www.dvgw.de
14	Managing drinking water quality from catchment to consumer. 2005	Davison et al WHO/SDE/WSH/05.06
15	Water safety plan workbook for drinking water: materials for training of trainer. 2007	Singapore, WHO Western Pacific Regional Office2
16	Training workbook on water safety plans for urban systems. 2008	WHO Western Regional Office
17	Water Safety Plans for hand tube wells in rural water supply systems. 2010	WHO \DPHE-ITN Dhaka
18	A guide to hazard identification and risk assessment for drinking water supplies. 2004	CRC for water quality and treatment
19	HACCP strategies for distribution system monitoring hazard assessment and control. 2007	USEPA
20	Australian Drinking Water Guidelines. Community Water Planner - A tool for small communities to develop drinking water management plans. 2005	NHMRC Australian Government
21	Managing safe water. A field guide. 2005	Australian Government NHMRC
22	Guidance for providing safe drinking water in areas of federal jurisdiction. 2005	Ministry of Health Canada
23	Guidance for safe drinking water in Canada from intake to tap. 2001	Ministry of Health Canada
24	From source to tap. 2002 The multi-barrier approach to safe drinking water	Canadian council of Ministers of the Environment
25	From source to tap. 2004 Guidance on the multi-barrier approach to safe drinking water	Canadian council of Ministers of the Environment
26	Technical manual section 4 Risk assessment of private water supplies. 2004	UK Government
27	Drinking water safety plans guidance Papa Westray Community water supply May 2010 + all protocols	Scottish executive
28	Water Safety Plan Manual step by step risk management for drinking water suppliers 2008	WHO/IWA
29	Excel framework used in Portugal (in	ERSAR

	PT and UK language). 2010 (including example Aguas do Algarve)	www.ersar.pt
30	Water Safety Plans for RWHS in rural water supply, 2006	DPHE-ITN Bangladesh
31	Sikkim Training Manual for Village Water Safety Plans. 2010	WSP World Bank + Sikkim rural management and development Department India www.wsp.org

II Introduction to guidance materials

1: WECF. Developing water safety plans involving schools

Women in Europe for a Common Future: Training material issued 2009. Introducing Water Safety Plans for small scale water supply systems. Manual for teachers and pupils and leaflet "Water Safety Plans in pictures".



Basic data

Audience	NGO, schools, community, children and teachers
Size of the document	40 pages (leaflet 2 pages)
Information	Aspects of water safety for laymen
Templates	Yes
Examples	Yes
Elements	Catchment, source, distribution, in-house, water storage
Basis	WSP Manual WHO/IWA 2009
Legal status	No legal status, approach is promoted to NGOs for Eastern Europe

Characteristics for application:

Water supply size range (approx. households)	From individual supplies to 5000 households
System complexity	Simple
System type	Groundwater/spring + Surface water
Technology level	Hydraulic, mechanical, (electronic)
Required expertise (own or hired)	Laymen, communities unfamiliar with water supply
Economic setting	Low to medium developed

Background information

WECF has been active in rural areas in Europe for many years. They especially focus on areas with very basic water supply and sanitation (e.g. pit latrines), where in the short term no significant funds will be available for improvement of the situation. The approach involves (teachers and) schoolchildren as they are open to new knowledge and approaches, eager to learn and through the children the parents will be most likely become involved. The approach is very different from other examples as it is based on the participatory approach of the local population and on learning by doing. Women, health workers, mayors and even police officers play an important role in the construction and implementation of the WSP. WECF has produced a basic tool- kit box for schoolchildren that besides the manual also includes some test strips for nitrate analysis, games and posters. The document is available in English, Russian and Romanian

Target group
The document is intended for NGOs, schools, communities and is specifically aimed at the involvement of children through schools. It is most appropriate in situations where control by authorities is limited and in rural settings. It recognises the importance of a broad knowledge of water safety, protection and hygiene in this setting. Links are made to other activities (latrines, agriculture) and how they impact the water system.

Type of water supply
Very basic water supplies including groundwater, springs, surface water and also rainwater are discussed. People are typically self-reliant and manage their own systems.

Comments on the design and contents
Design
First attention is paid to the importance of safe water, and the role that schools can play in improving water safety by educating the young. Then a programme to perform risk assessment with school children is presented, and extra information is provided to the teacher. Active learning is put central in this process. Finally suggestions are made to improve situations and tackle problems. Examples and templates are provided in the annexes.

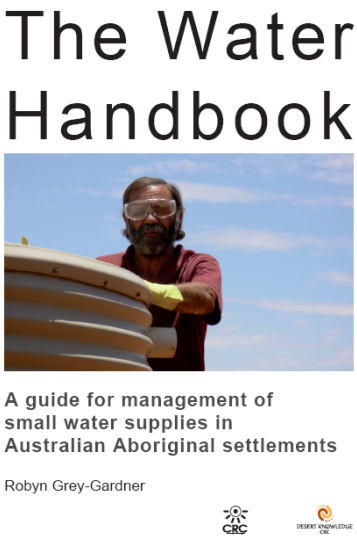
Contents
The text contains understandable descriptions of risks and how they can be managed. It focuses on anthropogenic influences (nitrates, pesticides and microorganisms from humans or animals). The guidance to perform risk assessment by situation analysis and use of simple techniques is very practical. It is typically a first step to reduce risks by creating awareness in the community. The document is very suitable for situations where water supply risks are most relevant in EU and where little resources are available and little governance is provided.

Scorings table

Assessment criteria	Comments
WSP team	NGO, school and community
System Description	Maps, schemes
Hazards and risks	OK
Control measures	OK
Improvement plan	OK
Monitoring control	OK
Verification (audit)	Not addressed, there is no water supply authority
Management	OK
Support and training	OK
Periodic review	Is not planned
Integrated approach	Health professionals, farmers…
Examples included	OK
Forms/Templates	OK
Other observations	Simple techniques for the assessments Is part of a tool-kit box for children

2: The Water handbook

A guide for management of small water supplies in Australian Aboriginal settlements, Desert Knowledge CRC 2008, Alice Springs Australia. Including software: Community Water Planner - A tool for small communities to develop drinking water management plans



Basic data

Audience	Small communities in remote desert environments (Aboriginals)
Size of the document	36 pages
Information	Community process of preparing a water management plan, hazards in CWP software
Templates	Yes, using the sustainable livelihood Pentagon approach
Examples	Some examples given but not a full system example
Elements	Catchment, source, treatment, distribution, in-house system
Basis	Australian Drinking Water Guidelines' Framework for the management of Drinking Water Quality
Legal status	n.a. Guidance status

Characteristics for application:

Water supply size range (approx. people)	<100 persons
System complexity	Simple to basic
System type	Groundwater/source, surface water, alternative sources
Technology level	Hydraulic, mechanical (electronic)
Required expertise (own or hired)	Layman (craftsman), education is addressed
Economic setting	Low to medium resources

Background information on the situation in Australia

The Desert Knowledge Cooperative Research Centre (DKCRC) (that produced the handbook) is an unincorporated joint venture with 28 partners whose mission is to develop and disseminate an understanding of sustainable living in remote desert environments, deliver enduring regional economies and livelihoods based on Desert Knowledge, and create the networks to market this knowledge in other desert lands.

This handbook is an additional product of a project funded by the Australian Government and Centre for Appropriate Technology.The settlements residents or councils have a duty of care to ensure the water supply is fit for drinking.

Target group of the handbook
The handbook is directed at remote Aboriginal communities in a desert environment. This handbook is to help people working with, and living in small remote settlements to develop a water management plan. The focus is on remote settlements that are isolated from major or regional centres and have an Aboriginal population of one hundred or less and up to twenty dwellings. As there is often no possibility to actually monitor the quality of the water emphasis is put on prevention of pollution.
The methodology seems appropriate for any small community with limited governance (due to remoteness or government practice). The residents are the target of the handbook, as they are the managers of the water supply. A locally-driven approach is used directed at preventive measures to reduce risks.

Type of water supply
The document is directed at small water supplies using groundwater/spring or surface water including 'additional' sources used by residents (e.g. rainwater). Given the target audience, the focus is on simple systems, although more advanced technologies are addressed.

Comments on the design and contents
Design
The aim of the handbook is to share ideas and practical tips on establishing and maintaining safe water management practices for small water systems, to provide guidance in developing small settlement water management plans and to supplement information currently available. The handbook draws from the Australian Drinking Water Guidelines; "Framework for the Management of Drinking Water Quality". The approach is suitable for small supplies in relatively simple systems using groundwater from boreholes, rainwater and surface water and soaks. [Soakages were traditionally important sources of water for Australian Aborigines in the desert, being the most dependable source in times of drought in Australia.].

The handbook describes the process of making a water management plan. It is very much directed at involving the community. The actual making of the plan is supported by the Community Water Planner software (CWP). The document is very practically written to give hands-on advice on how to perform risk assessment steps (e.g. take photos at each point of the supply). The process consists of four steps:

1. Describe the water supply
2. Match community water needs and aspirations
3. Strategy to manage the water supply
4. Enacting the plan

The four steps are completed with participant involvement from the start of the process and a review at the end. This is one of the strongest points of the approach used. The residents are the central decision-makers, it is a locally driven approach with emphasis on preventive measures and relies on residents as managers of the water supply. There is a strong engagement and cooperation of all stakeholders that have and interest in water supply. Responsibilities are all well defined.

The Framework for the Management of Drinking Water Guidelines, outlines a preventive approach to managing risks associated with the supply of drinking water and provides direction for the design and implementation of water quality management systems.

Contents
The principles of sustainable livelihoods are used to identify opportunities and constraints in the community for water supply. This is illustrated in the sustainable livelihood pentagon. The pentagon shows the natural resources, human skills, financial opportunities, social networks and physical equipment as a 'spider web' graph. The needs and plans of the community are thus inventoried apart from the current water supply system.

It addresses the typical situation of small settlements, such as additional water sources used by households. The community opportunities and constraints are the starting point for the water supply plan. Issues like available skills, funding and natural resources are addressed in conjunction with water quality and quantity.

The handbook contains short checklists of most important water supply survey issues, and refers to more elaborate information in other documents for reference.

Creating a water management plan is aided by the Community Water Planner, a software tool. The collected information about the water supply and water needs is entered in the tool. Some information can lead to additional questions from the tool to direct attention towards possible risks. The plan is very much directed at the roles and responsibilities of the stakeholders to manage the water supply and protect water quality.

In enacting the plan, programs to improve water supply are addressed, such as training and capacity building.

Scorings table

Assessment criteria	**Comments**
WSP team	OK
System Description	OK
Hazards and risks	Limited support for the risk assessor
Control measures	Limited support for the risk assessor
Improvement plan	Limited support for the risk assessor
Monitoring control	Limited support for the risk assessor
Verification (audit)	Not addressed
Management	OK
Support and training	OK
Periodic review	OK
Integrated approach	Engagement of all stakeholders throughout the process is strongly recommended
Examples included	Some examples
Forms/Templates	Yes
Other observations	Community assets pentagon identifies opportunities and constraints for water supply More focus on process than on technology

3: Water safety plan manual for Small Community Water supplies

WHO 2009

Basic data

Audience	Technical experts that assist communities
Size of the document	60 pages
Information	Process of WSP development involving the community
Templates	Some examples can be used as templates
Examples	Practical examples from around the world
Elements	Source, treatment, distribution, standpipe
Basis	WHO/IWA WSP manual and WHO GDWQ V3 Surveillance and control of community systems
Legal status	Guidance document

Characteristics for application:

Water supply size range (approx. people)	Not defined
System complexity	Simple to complex, although examples are generally simple systems
System type	Ground water, surface water, rainwater and others
Technology level	Hydraulic, mechanical, electrical
Required expertise (own or hired)	Basic to expert knowledge
Economic setting	Low and medium developed and affluent countries

Background information on the situation

The document was developed to bring the WHO/IWA WSP manual closer to the small communities. It follows the same WSP steps and explains haw the process can be done in the setting of a community water supply. The community supply is defined by its characteristics rather than its size:

- isolated or remote setting
- face seasonal variation of water quality or quantity
- limited management and technical support from government
- limited financial resources

The document builds on other similar documents, such as the Australian Water Handbook, and combines them into a universally applicable approach. As a result the manual contains examples from all

over the world. The discussed document is an advanced draft version. No final version could be traced and it might not exist.

Target group of the manual
The manual states that it is directed at experts that work with communities. The document contains enough information for people that run a water supply system to improve their situation. The manual does not provide technical information about how to run a water supply system. It does contain many examples of most common hazards and means to control them. It is really directed at risk assessment and risk management.

Type of water supply
The document describes the generic process that can be applied to all types of water supply. The examples and lists of common hazards deal with groundwater/springs, surface water and rainwater harvesting.

Comments on the design and contents
Design
The manual first describes the need for a WSP and the basic principles of safe water supply. Then the manual provides guidance on how to implement a WSP following the steps of Plan-Do-Check-Act. For each step of the WSP the manual describes how the community can perform that step. Examples and checklists of common issues or solutions are provided along with tips how to overcome problems in the WSP process. The use of images, cartoons and text boxes make the document appealing to read.

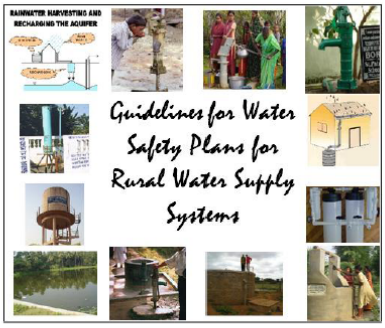
Contents
The document is really focused on the WSP process rather than providing technical information. The examples and tips are very practical and at the same time, the need to think or your own situation is always highlighted. The information provided supports this own initiative.

Scorings table

Assessment criteria	**Comments**
WSP team	OK
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	OK
Monitoring control	OK
Verification (audit)	OK
Management	OK
Support and training	OK
Periodic review	OK
Integrated approach	OK
Examples included	OK
Forms/Templates	OK
Other observations	

4: Guidelines for Water Safety Plans for Rural Water Supply systems

A study by Sulabh International Academy of Environmental Sanitation, India
Supported by WHO, India Issued in 2009



Sulabh International Academy of Environmental Sanitation,

Supported by WHO, India

Basic data

Audience	Key stakeholders, project managers, workers and consumers
Size of the document	222 pages
Information	Basic system information and tables with hazards and measures
Templates	Yes included
Examples	Yes included
Elements	Source, treatment, distribution, in-house
Basis	WHO/IWA WSP manual
Legal status	Guidance document for India and part of the Indian Guidelines for rural communities (National Rural Drinking Water Programme)

Characteristics for application:

Water supply size range (approx. people)	<5000 and one example >5000
System complexity	Simple systems for water harvesting, treatment and distribution
System type	Mostly groundwater, also surface water, ponds and rainwater
Technology level	Hydraulic, mechanical, electric (some advanced techniques are discussed)
Required expertise (own or hired)	Basic to advanced knowledge, fitting to the applied technology
Economic setting	Low to medium developed

Background information on the situation in India

The document is written for the rural situation in India that has little to no relevance to the European situation. The reason this document is proposed for inclusion in the European best practices document are the good examples for WSP in many different settings. The guidance document is part of the National Rural Drinking Water Programme Guidelines (2009-2012) issued by the Indian Government. The Department of Drinking Water Supply has shifted the focus from source development and installation of water supply system for providing drinking water supply in rural households to focus on development of village security plans which also include village safety plans for water supply systems.

Target group

The document aims at the professional and various stakeholders in the rural water supply chain. The Guideline is prepared with the aim to provide guidance to key stakeholders, project managers, workers and consumers at different levels, for evolving situation specific good practices for planning and implementation of the WSP approach.

Type of water supply
The Guidance Document addresses many different types of water supply systems:

- Gravity fed systems in hilly areas
- Dug well based rural areas
- Pond based rural systems with appropriate treatment
- Rain water harvesting systems through surface storage
- Groundwater recharge systems
- Roof top rain water harvesting systems
- Water disinfection
- Arsenic removal plants
- Defluoridiation
- Iron removal systems
- Pump and tank water supply for single villages
- Multiple village pipes water systems with conventional treatment for surface waters.

Comments on the design and contents
Design
The document is based on the WHO Guidelines for Drinking Water Quality (2004) that concludes that the end-product testing is not sufficient to guarantee safe drinking water to consumers. Instead, WHO recommends planning and implementation of effective WSP for ensuring safe drinking water. It ensures the processes involved in delivering safe drinking water are operated properly and are under full control at all times. It will minimize the chance of failure through oversight or lapse of management.
The approach is based on HACCP rules and includes understanding of the system, systematic and detailed assessment and prioritization of hazards and associated risks, putting appropriate control measures in place to reduce risks to an acceptable level and monitoring of barriers or control measures.

The document discusses typical water supply systems (or components such as specific treatment technologies). Each chapter describes one system and is written as a separate document containing:

- Introduction
- Description of the technique/system and challenges
- Guidance to describe the local situation
- Table with examples of hazards and scoring (likelihood X severity),
- Monitoring
- Examples of critical limits
- Supporting programs
- Verification and validation
- Action plan for improvement

This design is very practical as the end-user only needs to read the chapter(s) that are relevant for his situation. For the whole document this leads to a lot of repetition, since every chapter explains the whole process again. Not every chapter is uniform and balanced and the applied risk levels can be different between chapters. The text is a mixture of information (technology), guidance for situation assessment and examples. It's not always clear what the examples are. The hazard identification tables seem to be examples. Numerous problems are identified and scored. However, it provides little information on how to determine scores (e.g. the likelihood of flooding of a borehole was scored 'Major' and consequence was also scored 'Major', the score however depends very much on the local situation). This is a lack of information as the target audience has limited knowledge. Also it is unclear how the risk scores are used. Some technologies seem inappropriate for rural settings. See for example the long introduction of disinfection including ozone and chlorine gas. Such techniques are not feasible for rural areas.

Contents
All the steps from the WHO Guidance Manual are included in the approach for various water supply systems and also for a number of frequently used treatment methods in small supplies such as removal of arsenic, fluoride, iron and of course disinfection. Of added value in this document are the descriptions of water supply through harvesting of rainwater. The approach is integrated, however, some of the institutional recommendations for the construction and implementation at various governmental levels (national, regional, local) are specific to the Indian situation. The clear description of roles and responsibilities at the community level could also apply to European communities.

Interesting is also the identification of constraints such as: limited data availability, unplanned developments, poor sanitation impacting on safe water supply (human excreta disposal and solid waste management), lack of system knowledge, insufficient equipment and availability of human resources. The planned WSP for achieving safe drinking water must also address these problems, including capacity building/training and resource mobilization.

Comments
The Guidance Document is written for the Indian situation and contains extensive information at the introduction text on the institutional arrangements that are very specific for India. This part is not relevant for the situation in Europe. We recommend that this whole introduction part is ignored by the reader/user and that they limit themselves to the guidelines for the various systems.

Another comment is the language where the 'Indian" English is not always easy to understand or even incorrect: "*iii) Do not drink water which is not properly infected.*" (p131)

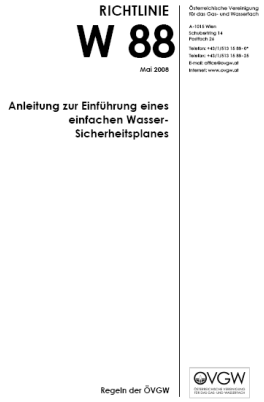
Examples of hazards and risk scoring seems inconsistent/incomplete e.g. contamination of source (pond)=moderate consequence (which seems low since a single faecal incident by an infected person can easily infect the whole population if no treatment is in place) and leaking distribution pipe is Major risk (although pressure may prevent intrusion, and intrusion is likely to be small).
Examples of critical limits seem practical (no latrines in catchment…)

Scorings table

Assessment criteria	**Comments**
WSP team	OK
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	OK
Monitoring control	OK
Verification (audit)	OK
Management	OK
Support and training	OK
Periodic review	OK
Integrated approach	OK
Examples included	Examples lack explanation of choices
Forms/Templates	OK
Other observations	A large number of water supply types are included in the document Very 'Indian' both in organizational aspects as the sometimes difficult English

5: Austria Anleitung zur Einführung eines einfachen Wasser-Sicherheitsplanes

Richtlinie W88 Anleitung zur Einführung eines einfachen Wasser-Sicherheitsplanes.
Regeln der ÖVGW Österreichische Vereinigung für das Gas- und Wasserfach. May 2008
The document is only available in the German language.


RICHTLINIE
W 88
Mai 2008

Anleitung zur Einführung eines einfachen Wasser-Sicherheitsplanes

Regeln der ÖVGW

Basic data

Audience	Operators of small water supply systems
Size of the document	40 pages
Information	The approach comes across as a top down exercise and not an integrated approach involving all stakeholders/consumers
Templates	Yes included
Examples	Yes and pictures in the text
Elements	Source to tap
Basis	WHO recommendations and many principles and concepts of the HACCP method
Legal status	Guideline for operators not mandatory

Characteristics for application:

Water supply size range (approx. people)	Small systems
System complexity	Relatively simple treatment
System type	Groundwater spring water
Technology level	Low - medium
Required expertise (own or hired)	Low-medium
Economic setting	Not applicable

Background information on the situation in Austria

Drinking water is in accordance with Austrian law a food stuff and is thus covered by food legislation. The water supplier/operator is in charge of the correct operation of the water supply installation and is responsible for the quality of drinking water. The operator has to assure through his quality assurance actions that the water quality meets the legal requirements for drinking water at all times. There is a system of self-control embedded in Austrian legislation. The guideline offers a manual and support for the implementation of a product and process oriented quality management system, with which regularly all processes of a water supply service can be checked and improved. .

Target group

The guideline is a master profile for the organization and systematization of drinking water related management practices. The guideline defines the terms hazard identification and risk evaluation, which mark the staring point for setting up a system management. The guideline particularly applies to small drinking water facilities.

Type of water supply
Even though the size or the number of persons served is not specified the guideline is focusing on small water supplies. The focus is very much on groundwater and spring water sources and not on surface water sources, this because all drinking water in Austria comes from groundwater and spring water sources.

Comments on the design and contents

Design
The guideline is a clear work instruction in eight steps, illustrated with examples and supplemented with sample forms. It is a reference document for setting up a system for self-checking.

Contents
The approach is described in eight steps:

1. Description of the organization of the water supply and the personnel involved.
2. Description of the water supply system
3. Inventory of potential hazards and the critical contamination points
4. Direct measures to remove or measures to reduce the hazards
5. Instructions for creation and updating
6. Instructions of the control of critical points
7. Instructions for daily monitoring and evaluation of results
8. Annual assessment of water quality, supply systems, processes and organization, proposals for improvements and implementation.

Comments
The document is very practical and will appeal to the operators of small water supplies (groundwater and spring water) as the examples are recognizable and transparent. The first step of the approach also includes the inventory of the skills of the personnel and the needs for additional training.

The approach includes normal conditions but also crisis and disaster management. Reference is made to other Austrian Guidelines and recommendations e.g. in the case of emergency supplies and crisis situations.

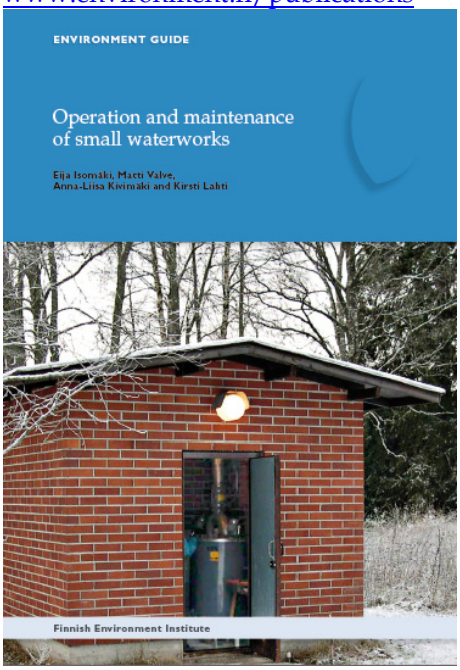
The improvement could be to have a more integrated approach involving more stakeholders than just the operators/personnel running the plan. Also there is no mention of a WSP team that is to be set up to prepare the plan. It comes across as a one person top down exercise focused on proper operation of the plant and control of potential hazards. Also no external audit is mentioned.

Scorings table

Assessment criteria	**Comments**
WSP team	Multi-disciplinary approach is not highlighted
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	OK
Monitoring control	Mentioned, but no real guidance
Verification (audit)	Not mentioned
Management	OK
Support and training	OK
Periodic review	OK
Integrated approach	Top down approach, no involvement other stakeholders
Examples included	Clear drawings as examples in the document. Check list for hazards included
Forms/Templates	Yes
Other observations	Seems to be for groundwater and spring water supplies only not for surface water supplies

6: Operation and maintenance of small waterworks

Environment Guide Eija Isomäki, et.al. SYKE, Finnish Environment Institute, Expert services department Helsinki 2008
Published in Finnish, Swedish and English
www.environment.fi/publications



Basic data

Audience	Operators of small water supplies
Size of the document	130 pages
Information	Guidance for water supply operation and risk assessment
Templates	Yes included
Examples	Yes included
Elements	Groundwater, treatment, distribution
Basis	Educational material, guidebook for operators and other water works staff
Legal status	Guidance and educational material not obligatory

Characteristics for application:

Water supply size range (approx. people)	Small water works (size not specified)
System complexity	Groundwater systems without or with treatment steps. Different simple and more complicated treatment processes are addressed.
System type	Groundwater
Technology level	Medium to high (when more complicated treatment is used)
Required expertise (own or hired)	Qualified operators/engineers. Legal requirement in Finland.
Economic setting	Small water cooperatives and supplies owned by municipalities. From medium to higher development.

Background information on the situation in Finland

Finland does not yet have a legal obligation for a risk-based approach in national legislation. However, Finland is considering a mandatory risk-based approach for small water supplies serving less than 5000 persons.

Target group
In Finland all persons working at water works distributing drinking water and employed in tasks in which they may be in position to influence the quality of drinking water must proof their qualifications. Operators must pass a test. This guidebook is a good basis for operators and other staff working at water works and in the distribution system. There was a need in Finland for a special, practically oriented guidebook focusing on subjects as operation, maintenance, monitoring and control procedures and water quality research. The material was also needed as educational material due to the newly introduced national requirements of a proven knowledge and understanding of hygienic aspects for operators and other water works staff. Personal needs to be qualified under the Finnish Health Protection Act.

Type of water supply
The guidebook has a focus on small water works using groundwater sources. The level and type of treatment depends on the quality of the groundwater source. The treatment can include steps as disinfection up till membrane filtration and catalytic filtration.

Comments on the design and contents

Design
The guidebook is a comprehensive introduction to a number of important aspects of water supply from groundwater sources. It is well written and user friendly. It presents an overview of all steps in water supply, including the importance of groundwater protection zones, and includes many illustrations and checklist to both ascertain good practice and to identify potential risks to the quality of drinking water. There is no involvement of stakeholders other than the operator/owner of the water supply.

Contents
The content is user-friendly, complete and well designed addressing the following issues:

- General information on groundwater
- Quality control of drinking water supply (including the role of surveillance agencies)
- Water quality information, hygienic quality, threats to quality and groundwater monitoring
- Water works technology, intake, materials in contact with drinking water, treatment processes.
- Water distribution systems (not at consumer)
- Water works maintenance
- Routine operational monitoring
- Emergency situations at small water works
- Included many checklists and data protocols.

Scorings table

Assessment criteria	Comments
WSP team	No is more aimed at operators
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	OK
Monitoring control	OK
Verification (audit)	OK
Management	OK
Support and training	This is the primary training material + additional training foreseen
Periodic review	OK
Integrated approach	Does not involve other stakeholders
Examples included	OK
Forms/Templates	OK
Other observations	Materials in contact with drinking water are addressed Impacts of climate change are addressed

Comment:
The guidebook is meant as it says to offer guidance to the identification of potential risks and to ensure good practices in the small water works. It is not a full introduction to the more comprehensive concept of a risk-based approach. It does e.g. not involve the institutional setting for that or the need to involve a larger group of stakeholders. It is a personnel handbook to be used by the operator.

The guidance document also addresses aspects as material in contact with drinking water and their potential impact on the quality of the water and the potential impact of challenges posed by climate change such as, floods and droughts.

7a: Ireland. Appendix 1 Risk screening methodology for *Cryptosporidium*

in: the Handbooks on the implementation of the Regulations for Water Services Authorities and Private Water Suppliers for public and private water supplies, Section 10, 2010.

The Irish EPA Handbooks (one for Public Water Supplies and one for Private Water Supplies) include a section (Section 10) on the implementation of a Water Safety Plan for Water Services Authorities for public and private water supplies andAnnex 1 to Section 10 outlines a risk scoring method for Cryptosporidium screening.

This analysis only describes the Appendix 1 to Section 10

Basic data

Audience	Local Authorities for all Public Water Supplies and Private Water Suppliers and Local Authorities in respect of Private Water Supplies.
Size of the document	40 pages
Information	Checklists including severity of risks and effectivity of measure
Templates	Yes
Examples	No, but clear explanations
Elements	Catchment, source, treatment
Basis	WSP Manual WHO/IWA 2009
Legal status	Recommended for use by EPA in Ireland

Characteristics for application:

Water supply size range (approx. households)	2-5000
System complexity	Simple up to complex
System type	Groundwater/spring + Surface water
Technology level	Hydraulic, mechanical, electronic, PC
Required expertise (own or hired)	Water operation basic knowledge (local operator)
Economic setting	Medium developed or higher

Background information on the situation in Ireland

The EPA in Ireland has adopted the WHO water safety plan approach to ensuring drinking water is both safe and secure. Water safety plans are not legally required for either public or private supplies in Ireland to date but the EPA recommends that they are put in place by all water suppliers. However, the EPA are only the supervisory authority for public water supplies which is why they are insisting on them in public water supplies.

The draft Advice Note on water safety plans which includes the risk assessment to be used as part of the WSP has been produced by the EPA. It gives an overview of the steps involved in constructing a water safety plan and an outline of what it should contain in the Irish context. The Advice Note has not published yet and is due to go out to water suppliers, the health authorities etc for consultation. So this is not the final version.

Target group

The risk screening methodology is directed at the Public and Private Group Water Schemes (PuGWS and PrGWS). Although it is not stated in the document, it is assumed that a person from the PuGWS or PrGWS is nominated to carry out the screening. The screening is performed to identify the systems with the highest risk (prioritisation) and is regarded as a precursor for the development of a DWSP.

Type of water supply

The handbook focuses on group water schemes which can range from two to several thousand connected households. Private water supplies that typically serve one to a few households are also addressed. There are two sections, one for groundwater or spring water supplies (which are the majority) and one for surface water supplies. Both simple and more complex systems (including advanced treatment like membrane filtration or UV disinfection) are discussed. The system from catchment to water leaving treatment is discussed. Distribution and consumer premises are not part of the screening.

Comments on the design and contents

Design
The screening consists of identifying risks and risk reducing measures in all parts of the water supply system. Each is scored. A positive score indicates an increase of risk and a negative score indicates risk reducing factors or measures. The scores are summarised, and the total score indicates the level of risk for contamination of the drinking water with *Cryptosporidium*.

Contents
The screening doesn't provide a total risk management approach and it only addresses risk of *Cryptosporidium* contamination. It is included in this study since it provides a slightly different approach to risk assessment than other documents:

- it provides a quantification of the severity of risks or effectiveness of risk reduction
- it provides more elaborate descriptions than most WSP documents, providing information for people with less know-how that water supply professionals
- it provides a point of reference to a 'national standard' for water operators that generally only know their own system(s).

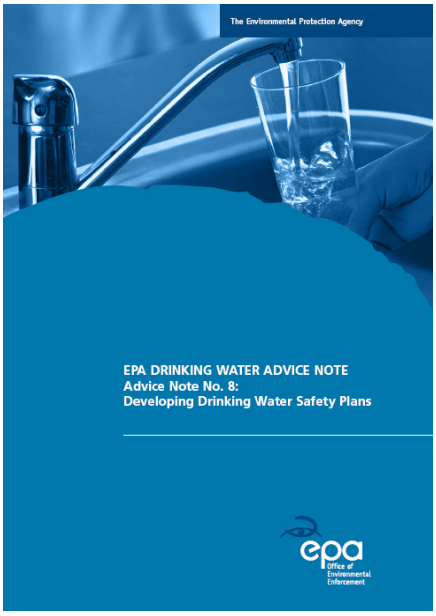
Various risk factors in the catchment from animals, agriculture and discharges in the catchment are addressed and distinctions are made between for example wild deer or cattle in the catchment. Then the infrastructure, management and operation of the catchment, source and treatment are discussed which can lead to increase or decrease of risk. Finally the risk score is weighted according to population. This last step is relevant to prioritise between systems, but for a single system, population would be irrelevant. The final score leads to a classification of low to high risk. This screening should be followed by a proper DWSP development, however many steps of the DWSP have already been taken in the screening.

Scorings table

Assessment criteria	**Comments**
Screening team	OK
System Description	OK
Hazards and risks	Clear understandable descriptions for non water professionals
Control measures	Clear understandable descriptions for non water professionals
Improvement plan	Scoring helps select measures
Monitoring control	OK
Verification (audit)	Audited by WSA
Management	OK
Support and training	Not specifically addressed in the methodology but training courses are provided on an national level by the Water Services Training Group (http://www.wsntg.ie) to water providers for public and private supplies
Periodic review	Not mentioned in Section 10 however Local Authorities are required to report the *Cryptosporidium* Risk Score to the EPA annually as outlined in Section 9 of the Handbook for public and private water supplies
Integrated approach	Engagement of public…essential component of any DWSP approach
Examples included	Clear understandable descriptions for non water professionals
Forms/Templates	Yes
Other observations	

7b: EPA Drinking Water Advice Note

Advice Note No. 8. Version 1: Issued August 2011
Developing Drinking Water Safety Plans
EPA Office of Environmental Enforcement Ireland



Basic data

Audience	Local Authority staff in Ireland
Size of the document	27 pages
Information	Interpretation of WHO WSP for Ireland, extensive risk checklist
Templates	Hazard Identification Worksheets, Risk Assessment and Action Matrix and an Action Plan
Examples	No
Elements	Catchment, source, treatment, distribution, in-house, management
Basis	WSP Manual WHO/IWA 2009
Legal status	Recommended by EPA

Characteristics for application:

Water supply size range (approx. people)	2 to 50,000
System complexity	Simple up to complex
System type	Groundwater/spring and surface water
Technology level	Hydraulic, mechanical, electronic, PC
Required expertise (own or hired)	Water operation professional (knowledge of water operation standards)
Economic setting	Medium developed or higher

Background information on the situation in Ireland

The EPA in Ireland has adopted the WHO water safety plan approach to ensuring drinking water is both safe and secure. Water safety plans are not legally required for either public or private supplies in Ireland to date but the EPA recommends that they are put in place by all water suppliers. However, the EPA are only the supervisory authority for public water supplies which is why they are insisting on them in public water supplies.

The draft Advice Note on water safety plans which includes the risk assessment to be used as part of the WSP has been produced by the EPA. It gives an overview of the steps involved in constructing a water safety plan and an outline of what it should contain in the Irish context.

The Advice Note has not been published yet and is due to go out to water suppliers, the health authorities etc for consultation. So this is not the final version.

Section 10 of the Handbook
Previous to the advise note, the EPA published the *Handbook in implementation for Water Services Authorities for private water supplies Section 10: Drinking Water Safety Plans* in April 2010. It deals in general with WSPs and specifically with Cryptosporidium because of the immediacy of the Crypto risk in the aftermath of the outbreak in Galway. Crypto would be one of the biggest risks in Ireland and hence the EPA wanted to address this first. This document was assessed separately.

Target group
The document is aimed at all local authority staff involved in the production of drinking water and should be read in conjunction with the WHO guidance manual when implementing a Drinking Water Safety Plan.

Type of water supply
The approach applies equally to small and large drinking water supplies. Hazards are described for both groundwater/spring and surface water supplies.

Comments on the design and contents
The Advice Note is intended to give an overview of the steps involved in constructing a water safety plan and an outline of what it should contain in the Irish context. It contains guidance on hazard identification, risk assessment and the preparation of action plans for hazards identified.

Design
A DWSP is developed specifically for each water supply and should be considered as a risk management strategy to ensure the continuous supply of safe water. The water safety plan approach builds on existing good water supply management practices. An emphasis in the plan is placed on risk mitigation above sampling, although targeted operational monitoring is still a key component of the plan.

Contents
The DWSP consists of a number of key elements:

- An assessment of the water supply from source to tap to determine whether the water supply can consistently deliver water of a quality that meets health-based targets.
- Operational monitoring of an appropriate nature and frequency at an appropriate point in the water supply.
- Documentation of management arrangements including details of the supply assessment, validation monitoring and operational monitoring. Description of actions under normal operating and under incident conditions.

In accordance with the WHO guidance the main steps of a water safety plan approach are included in the Advice Note.

1. Assemble a team of experts
2. Document and describe the supply
3. Identify the hazards and hazardous events
4. Perform a Risk Assessment
5. Define and Validate Control measures
6. Re-assess risk to determine current risk
7. Establish improvement/action plan for risks
8. Define Monitoring of the Control Measures and Verify effectiveness of the DWSP
9. Management procedures and Documenting
10. Supporting programmes – develop skills & knowledge
11. Regular review of hazards, risks, controls (e.g. new equipment).

Comments

For a better understanding of both the Advice Note and the attached forms it is also necessary to also familiarize with the basic WHO guidance manual. Also for some of the examples reference is made to the WHO guidance document.

However, the note itself is short, transparent and user-friendly (easy to follow). Special mention is made of the suitability for Group Water Schemes[21] as they exist in Ireland.

The construction of a WSP as described is definitely an integrated approach; the integration both involves water supplier internal stakeholder involvement and external stakeholder involvement. In the assembly of the WSP team the whole water supply chain is included such as external experts from the catchment, public health specialists etc. Also involvement of other groups as agriculture, forestry, industry, residents groups, consumers and regulators is foreseen.

In the description of the water supply, desk studies are combined with site visits and also the level of knowledge and skills required is compared with the level available to identify any gaps and training needs.

First an initial assessment is carried out: hazards and hazardous events, including not readily obvious ones as the occurrence of flooding are identified and assessed in isolation of any existing control measures that are in place. Then a risk assessment is carried out considering both the likelihood of a hazard occurring and the impact or severity should it occur.

Next the situation is reassessed taking into account the effectiveness of the control measures currently in place to determine the current level of risk remaining.

Appendixes guide the water supplier through the various steps involved in the construction of a WSP.

- Appendix 1: List of typical hazardous events associated with each element of the supply. Suitable for groundwater sources, surface water sources and a combination of both.
- Appendix 2: Includes a Risk Matrix where likelihood and severity are scored from 1 to 5. The values for likelihood and severity are multiplied together to give a value for the risk posed, resulting in a maximum score of 25 for each hazardous event. The matrix is different from the WHO example, and seems more appropriate as catastrophic events are less frequently accepted.
- Appendix 3: Provides a template action plan, that details the initial risk assessment, control measures (both validated and already in place and controls planned for the short-term) and the current risk classification for each hazard.

A positive aspect of the Irish approach is the multiple verification activities to ensure that the DWSP is working properly, consisting of compliance monitoring, internal and external audits and verification of consumer satisfaction (e.g. through complaints register).

The DWSP is a working document and forms an integral part of operational practices. The schedule for periodic full reviews is foreseen as well as a review after any significant event.

Scorings table

Assessment criteria	**Comments**
WSP team	OK
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	OK
Monitoring control	OK
Verification (audit)	OK
Management	OK
Support and training	OK
Periodic review	OK

Integrated approach	OK
Examples included	For examples reference is made to WHO documents
Forms/Templates	OK
Other observations	See comments

8: New Zealand.

Various nr 9 documents:

The information for risk management for small supplies in New Zealand is modular and therefore it is necessary to collect the various pieces of information that apply to a specific water supply.

A Framework on How to Prepare and Develop Public Health Risk Management Plans for Drinking-water Supplies

Citation: Ministry of Health. 2005. *A Framework on How to Prepare and Develop Public Health Risk Management Plans for Drinking-water Supplies.* Wellington: Ministry of Health.

Published in June 2005 by the
Ministry of Health
PO Box 5013, Wellington, New Zealand

ISBN 0-478-29627-4 (Book)
ISBN 0-478-29628-2 (Internet)
HP 4141

This document is available on the Ministry of Health's website:
http://www.moh.govt.nz

Basic data

Audience	Water supplier/operator of the water supply
Size of the document	Difficult to say as it is a modular system Chapter 19 50 pages General framework document 12 pages Selected modules on e.g. specific treatment steps X pages
Information	Supporting guides on all elements with check lists
Templates	Yes
Examples	Yes
Elements	Catchment, source, treatment, distribution, storage, in-house installation
Basis	HACCP and NZ Guidelines for drinking water quality management
Legal status	Guidance material

Characteristics for application:

Water supply size range (approx. people)	Anything from individual household supplies to approx. 500 persons
System complexity	Simple to moderate
System type	Groundwater, surface water, rainwater/roof water
Technology level	Low to moderate
Required expertise (own or hired)	Owner of the supply, basic to skilled operator, sometimes training needs are identified
Economic setting	Depends on the setting and complexity of the supply

Background information on the situation in New Zealand

The basis for drinking water safety in New Zealand is provided by The Drinking-water Standards for New Zealand 2005 (DWSNZ). This document describes safe drinking water in terms of maximum acceptable levels of contaminants and describes how to demonstrate that drinking water is safe. The DWSNZ includes a specific section for small water supplies and a specific section for tinkered water supplies. These types of drinking –water supplies are required to carry out and document specific

actions. Individual household supplies and reticulated community supplies that serve less than 5000 person days (e.g. less than 25 persons for 60 days) per year do not have to demonstrate compliance with the DWSNZ, but must still provide safe (potable) drinking water.

- Relevant background document Chapter 19 of the Draft Guidelines for Drinking-water Quality Management for NZ, October 2005. This chapter 19 addresses, small, individual and roof water supplies and provides a set of resources and additional information to assist water suppliers to manage their supplies to ensure safe drinking water and to meet their obligations under the DWSNZ. An option to show compliance with the DWSNZ is to prepare a Public Health Risk Management Plan. This option will be further explained and not the alternative options.
    - 19.2 small water supplies
    - 19.3 individual water supplies
    - 19.4 roof water supplies.
- Another background document is A framework on how to prepare and develop public health risk management plans for drinking water supplies. June 2005. This is a generic document for all types of supplies. It explains the various steps and most importantly it explains which guides are available for various situations. Guides are available for different sources of water, for different treatment steps, for the distribution system as well as some general elements that are applicable for all situations (e.g. staff training and monitoring). This background document allows the end-user to decide on all modules (guides) necessary for their own specific situation.
- Finally there is a small document specifically for small supplies, Small Drinking-water Supplies: Preparing a Public Health Risk Management Plan. June 2005.

Target group
The target group of the documents selected are the owners/operators of small or individual water supplies. As regards the individual and the rainwater supplies these are mostly the owners and users of the supplies and there is no operator with specific skills available. The documents are very suitable for owners of private supplies and individual household supplies.

Type of water supply
All types of supplies are covered and the user of the documents has to identify the various modules for their own specific situation. Groundwater, surface water, rainwater/roofwater are covered. Modules to prepare a risk management plan are available for all types of sources, treatment steps (if any), storage tanks and sizes of supply and distribution methods.

Comments on the design and contents
The system used in New Zealand is modular as explained at the beginning. However, it is not always clear which set of documents to use as there is quite some overlap. We found it best to use chapter 19 of the Draft Guidelines for drinking-water quality management for New Zealand from October 2002 "Small, individual and roof water supplies", because it contains the same material (templates) as the document Small drinking water supplies Preparing a PHRMP from June 2005. In conclusion we recommend Chapter 19 and the Document "A framework on how to prepare and develop PHRMPs for drinking water supplies" to identify any additional detailed guides and checklists if and when required.

<u>Design</u>
Once the various modules have been identified and selected the guides work very well. There are checklists, examples and illustrations in the text. Also much attention is paid to storage of water and safeguarding the quality of drinking water in premises such as back flow prevention and also point of use devices and point of entry devices.
There are separate sections in the main document chapter 19 for small water supplies, individual water supplies and for roof-collected rainwater supplies. In New Zealand more than 10percent of the population are on roof-collected rainwater systems, mostly in areas not served by municipal town supplies.

The PHRMP covers three aspects of a water supply: catchment and intake, treatment and storage and distribution. It helps to identify whether any of the following four barriers to contamination are missing:

- Preventing contaminants entering the source water
- Removing particles from the water (where many of the germs hide)
- Killing germs
- Preventing recontamination after treatment.

The plan covers the questions:

1. what could happen to cause the water quality to deteriorate and become unsafe to drink?
2. which if these issues needs urgent attentions?
3. how to know when water quality is deteriorating to a point where action is needed?
4. how to respond if action is needed?
5. what to do to stop deterioration happening in the future?

Contents

The plan is prepared in three steps:

Step 1 A simple drawing and description of the drinking water supply

Step 2 For each of the three aspects of the water supply a worksheet is prepared answering the questions: what could happen to cause the water quality to deteriorate and become unsafe to drink and which if these issues needs urgent attentions?

Step 3 Focuses on the things that need urgent attention and develop a plan to manage these. It covers both immediate responses and longer-term improvement schedules.

The plan is reviewed annually or after any significant change to the water supply or in response to finding a weakness in the plan.

The information and guidance available for three different types of supplies, small, individual and rainwater are simple and transparent. There are checklists and illustrations in the text as well as information on common contaminants causes, problems and likely sources. Also information is given on how to avoid and treat for contaminants. Attention is also paid to point-of-entry and point-of-use devices. There is also much attention on the impact materials might have on the quality of drinking water.

What is not addressed in the guidance is involvement of other stakeholders e.g. in the catchment area. In this respect the guidance could be improved especially where other users of the area/water have an impact on the quality of the water supply.

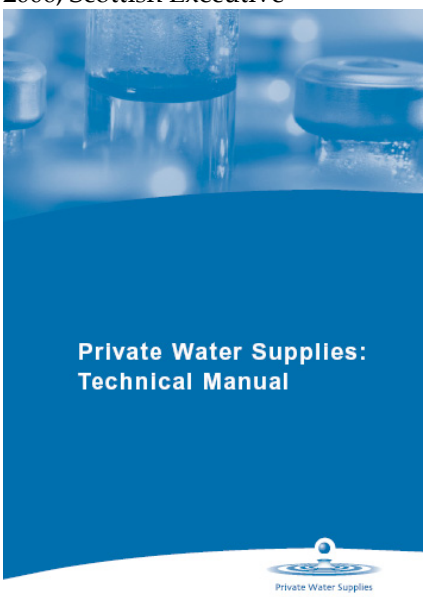
Verification (auditing) and management are mentioned in the generic main documents for all types and sizes of water supplies but are not addressed in the case of individual and rainwater supplies.

Scorings table

Assessment criteria	**Comments**
WSP team	Little attention for WSP team
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	OK
Monitoring control	OK
Verification (audit)	Little attention
Management	Little attention
Support and training	OK
Periodic review	OK
Integrated approach	OK
Examples included	OK
Forms/Templates	OK
Other observations	There is no involvement of stakeholders other than the operator/owner of the water supply.

9: Private Water Supplies:Technical Manual

2006, Scottish Executive



Basic data

Audience	Professionals regulating and maintaining private water supplies
Size of the document	618 pages
Information	Full manual how to operate and manage risks for private supplies, including legislation
Templates	Yes
Examples	Yes, many
Elements	Borehole, well, spring, lake, stream or river
Basis	WHO Drinking Water Guidelines and EU directive
Legal status	Risk assessment is a Legal duty for water supplies of ten or more cubic meters, >50 persons or for supplies for commercial or public activity. Also legal requirement to provide advice to owners and users of all other systems on request.

Characteristics for application:

Water supply size range (approx. people)	Distinction between 1 to 50 and >50 served
System complexity	Single supply to small distribution systems
System type	Groundwater/spring and surface water
Technology level	Hydraulic, mechanical, electronic, PC
Required expertise (own or hired)	Water supply professional
Economic setting	Affluent countries

Background information on the situation in Scotland

Scotland regards any system not supplied by its statutory water undertaker as a private water supply (PWS). A PWS can serve a single or many households and businesses. Drinking water quality standards are laid down in The Private Water Supplies (Scotland) Regulations 2006 ('The 2006 Regulations'). This document is meant to aid professionals who regulate and maintain private water supplies. The 2006 Regulations place local authorities under a duty to complete a risk assessment for Type A supplies

(supplies over 10 m^3 per day or over 50 persons or is a commercial supply) and to provide information and advice to enable owners to complete a risk assessment for Type B supplies (all other private supplies). Grants for improving private water supplies cannot be approved unless a risk assessment has been completed.

Target group
The document is targeted at Environmental Health staff of local authorities who can cover a wide range of issues, including drinking water. They are professionals, but not necessarily water specialists.
It is also targeted at owners and users of supplies. Some local authorities have a lot of PWS and a lot of experience, others authorities, owners and users have less experience. The manual contains a lot of basic information that is also suitable for inexperienced users of the document.

Type of water supply
The manual was written for all private water supplies and the examples all show small supplies. Very small supplies of less than 50 people do not have the duty to a risk assessment (unless they have commercial activities). Most of the supplies are wells, bore holes or springs, but surface water is also addressed.

Comments on the design and contents

Design
The document is a collection of sections covering different aspects of water supply. Most sections start with a summary and then more elaborate text. Section 4 is most relevant for the current study as it addresses risk assessment and risk management. Section 5 provides examples of risk assessment. Other sections mainly provide information to help water suppliers perform their duties.

In Section 4, after the introduction, the risk assessment procedure and materials are collected per type of supply: well, spring, bore hole and surface water. These can be used as separate documents. They contain the steps to undertake, explanation of the hazards ('items'), and forms. As a result, the risk assessment results will have a uniform setup, which makes it easier to complete them.

In general the document has a 'glossy' style with a lot of colors, pictures, text boxes etc. This makes it inviting to read. Due to the amount of information included and the repetition in the risk assessment parts, the document is very thick. This makes it harder find the relevant information and can 'scare' unexperienced people that have to perform the risk assessment without further guidance. The document is divided up into different sections and is also on-line.

Contents
- Section 1: General introduction to the manual.
- Section 2: General introduction to water quality and contaminants. Both microbial and chemical contaminants are explained.
- Section 3: Source selection, protection and monitoring. After the summary, the water cycle is explained after which each type of source is discussed including clear pictures of how infrastructure can be build. Finally monitoring of source water is discussed.
- Section 4: Deals with risk assessment. The procedure requires the risk assessor to go though a number of checklists with 'risk items'. Each item is clearly explained and guidance is provided how to score the likelihood of risk depending on the local circumstances. The severity of the item is already filled in the risk assessment form. Even in-house treatment is addressed in the assessment. Full guidance is provided for wells, springs, boreholes and surface water. This leads to a lot of doubling in the document but allows the users to only use the part relevant for their situation.
- Section 5: Provides examples of risk assessment case studies. Relevant questions of the risk assessment are discussed for these examples. These are very practical and helpful due to the many pictures of examples how to recognize risks.
- Section 6: Provides a basic introduction of water treatment processes and how they should be operated and maintained. This includes simple but also advances techniques such as ozone and UV disinfection. Nice overview of which contaminants are treated by what technique.

- Section 7: Introduces household treatment techniques also on a basic level. Again, nice overview of which contaminants are treated by what technique.
- Section 8: Describes treatment for radon and uranium.
- Section 9: Explains the Scottish legal background and is not relevant for other countries.
- Section 10: Describes how water samples should be taken, stored and transported.
- Section 11: Describes hazard response for private supplies.

Comments

In the introduction it is stated that it is intended for professionals regulating and maintaining private water supplies. The level of information in Sections 2, 3, 6, 7, 8 and 10 is quite basic, providing background information for professionals that are less experienced in water supply, owners and users.

The risk assessment is very much driven by the Scottish situation. It may need adaptation for use in other social, economic and climatic situations. A strong point is that guidance is provided on how to score risks, based on the local situation. This can be very helpful to the risk assessors and results in a balanced scoring across different systems. Some of the important issues are addressed in the document text, but not in the forms. Since the manual is so big, it is likely that these issues are overlooked. Therefore training was given and the manual is divided into sections.

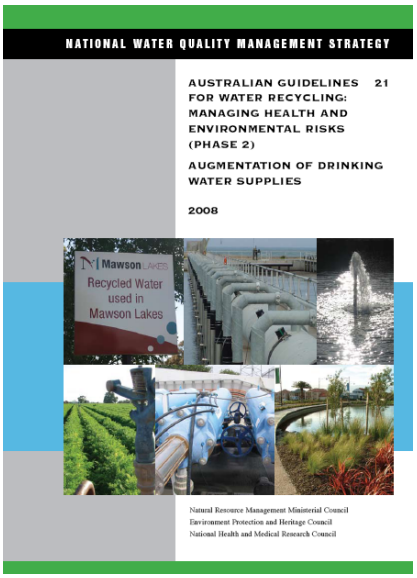
Scorings table

Assessment criteria	**Comments**
WSP team	In text, not in template*
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	In text, not in template*
Monitoring control	OK
Verification (audit)	In text, not in template*
Management	Not addressed
Support and training	In text, not in template*
Periodic review	In text, not in template*
Integrated approach	In text, not in template*
Examples included	OK
Forms/Templates	Yes
Other observations	

* These issues are discussed in the document text but are not clearly addressed in the checklists and templates. Therefore they can be overlooked.

10: Australian Guidelines for water recycling

Australian Guidelines for water recycling: Managing health and environmental risks (phase 2). Augmentation of drinking water supplies, May 2008
National Resource Management Ministerial Council, Environment Protection and Heritage Council, National Health and Medical Research Council. Australia



Basic data

Audience	All experts involved in recycling water for drinking water purposes
Size of the document	100 pages introduction+ 45 pages appendices
Information	Very detailed information on all aspects and risks of recycling
Templates	no
Examples	yes
Elements	Catchment, source, treatment, distribution, in-house
Basis	Australian Guidelines for water recycling, part of Australian Drinking Water Guidelines
Legal status	Guidelines are not mandatory, but encouraged to adopt as it reflects a shared national objective

Characteristics for application:

Water supply size range (approx. people)	Not specified is generic
System complexity	Very complex
System type	Sewage and storm water re-use
Technology level	Very high because of potential risks to human health and the environment
Required expertise (own or hired)	Very high level required
Economic setting	Sufficient resources are needed for the high costs for treatment and highly skilled operators
Prioritisation	Health-based targets whereby risk is reduced to concentrations below those that would produce 10^{-6} DALYs per person per year

Background information on the situation in Australia

The Australian Guidelines for water recycling: managing health ad environmental risks, augmentation of drinking water supplies are part of the Australian Guidelines for Water Recycling that are being introduced in two phases. This document is one module in the second phase of the guidelines. It deals with the use of recycled water to augment drinking water supplies, also referred to as 'potable reuse'. The Guidelines are intended to provide principles and a framework for safe implementation of recycled water schemes. The guidelines are not mandatory and have no formal legal status, their adoption provides a shared national objective. It allows flexibility of response to different circumstances at regional and local levels. All states and territories in Australia are encouraged to adopt the approach described in the guidelines.

Target group
The guidelines are intended to be used by anyone involved in the supply, use and regulation of recycled water schemes, including government and local government agencies, regulatory agencies, health and environment agencies, operators of water and waste water schemes, water suppliers, consultants, industry, private developers, body corporates and property managers. A high technical level of skill is required to be able to understand and use the guidelines.

Type of water supply
The approach applies equally treated sewage and storm water that is directly or indirectly used to augment drinking water supply. The guidelines do not specify the size of the supply but considering the very complex treatment of the water needed it is not likely to be applicable to very small water supplies.

Comments on the design and contents
The guidelines describe and support a broad range of recycling options. They provide a scientific basis for implementing decisions on uses of recycled water in a safe and sustainable manner. Considering the sources (sewage and storm water) used for the augmentation of the water supply there is a high level of exposure of end-users. The high exposure is one of the main drivers for the guidance presented in the document. The relatively high exposure requires correspondingly high levels of control, and a commitment to ongoing management and continuous monitoring to ensure safety. The community needs to be a partner in the development of the scheme as community acceptance and support is vital for successful introduction of drinking water augmentation schemes and effective community engagement is the best way to ensure such support. Without the trust and confidence of the consumer there will be insurmountable barriers to the initiative of recycling.

<u>Design</u>
The measures to control risk start with reducing hazards in source waters (e.g. trade-waste controls) followed by multiple advanced treatment processes. The processes are difficult and challenging and a high level of technology. Two different situations are covered:

- Indirect augmentation which includes the discharge of highly treated recycled water into a receiving body (river, stream, reservoirs, aquifer)
- Direct augmentation using recycled water derived from highly treated sewage or storm water means that recycled water enters the recycling system without going through an intermediary receiving body of water.

<u>Contents</u>
The preventive risk management approach includes hazard analysis and critical control point (HACCP) principles. The guidelines cover the whole supply chain from source to the consumers' tap. Te approach should ensure that recycled water is safety to drink before adding it to either receiving water or to a drinking water supply.

There are in the guidelines:

- specific definitions of safety (especially microbiological quality) based on the use of disability adjusted life years (DALYs)
- health-based performance targets, including required reductions of microbiological and chemical hazards
- use of reference pathogens.

The Guidelines consist of four main sections:

- Principles
  - Protection of public health
  - Community acceptance and support
  - Institutional capacity
  - Multiple barriers
  - Skills and training
  - Management of industrial waste
  - Regulatory surveillance
  - Additional principles
- Health-based targets
  - Tolerable risk (microbiological risk and chemical risk)
- Management of drinking water augmentation (consisting of 12 elements)
  1. Commitment to responsible use and management of recycled water quality
  2. Assessment of the recycled water system
  3. Preventive measures for recycled water management
  4. Operational procedures and process control
  5. Verification of recycled water quality and environmental performance
  6. Management of incident and emergencies
  7. Operator and contractor awareness and training
  8. Community involvement and awareness
  9. Validation, research and development
  10. Documentation and reporting
  11. Evaluation and audit
  12. Review and continual improvement.
- Monitoring
  - General principles
  - Validation monitoring
  - Operational monitoring
  - Verification monitoring
  - Summary of monitoring requirements.

Comments

The guidelines for water recycling present a very complete and detailed approach to drinking water safety. It is a very good overview document with a complete overview of microbiological and chemical hazards that could threaten a water supply. The guidelines have extensive information on issues as DALY's, NOELs(geno) toxicity and addresses substances as pharmaceuticals, personal care products and endocrine disrupting compounds. Also impressive are the sections on preventive measures, corrective actions, operational procedures and process control with many examples for various water treatment processes. Even though the guidelines are not based on eth WHO framework all aspects are more than covered.

The guidelines addresses re-use of non-traditional water sources as sewage and storm water. Even though there might be interest in recycling of storm water in the EU, there is at the moment little support for (direct or indirect) recycling of sewage for drinking water purposes. Because of the high risk of exposure using these sources the level of skill required is extremely high and multiple advanced treatment processes are needed. Both factors will considerably increase the cost of such a water supply. It is therefore for very likely that recycling of sewage or storm water will be used for small water supplies.

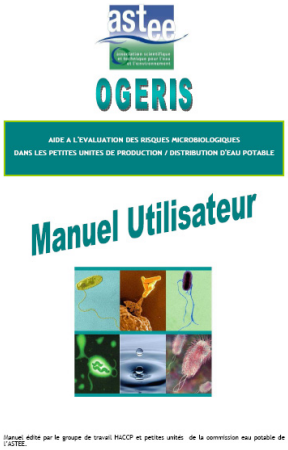
The guidelines are very good and a valuable source of information. They deserve a mention in the best practices guidance document; however, it is doubtful whether they will ever be used in small water supply systems.

Scorings table

Assessment criteria	Comments
WSP team	OK
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	OK
Monitoring control	OK
Verification (audit)	OK
Management	OK
Support and training	OK
Periodic review	OK
Integrated approach	OK
Examples included	OK
Forms/Templates	Templates are not included

11: Ogeris, aide a lévaluation des riques microbiologiques dans les petite unites de production/distribution d'eau potable

Software tool, paper version and Manual. Prepared by ASTEE, 2009
(In French, the material was assessed with limited knowledge of French)



Basic data

Audience	Operators of small supplies
Size of the document	35 p manual, 40 forms, software tool
Information	Checklists for risk assessments
Templates	Yes, paper or software
Examples	No
Elements	Source, treatment, storage, pumping, distribution
Basis	HACCP ISO 22000 and WSP
Legal status	Strongly Recommended

Characteristics for application:

Water supply size range (approx. people)	<5000
System complexity	Simple to complex
System type	Groundwater\spring and surface water
Technology level	Hydraulic, mechanical, electrical, automated
Required expertise (own or hired)	Trained water professional
Economic setting	Affluent

Background information on the situation in France
A risk based approach is strongly recommended in France. There are a large number of small systems that are often owned or operated by large water supply companies.

Target group
The tool seems to aim at water treatment professionals that have knowledge about drinking water supply techniques and understand water safety issues.

Type of water supply
Templates are provided for both groundwater and surface water supplies. Treatment templates include both traditional and advanced techniques. It is specifically aimed at small supplies serving less than 5000 people.

Comments on the design and contents

Design

The documents are written in the native language of the risk assessors: French. Three documents are discussed here:

- Paper checklists
- Ogeris software
- Ogeris manual

There are 19 paper checklists for different types and parts of the water supply. Each template is approximately 2 pages. The questions can often be answered with 'yes' or 'no'. It seems that the checklist does not result in a prioritization of risk, or a conclusion about the level of risk at the site.

The software tool is freely available and was developed in Microsoft Excel. It leads through the same questions as the paper checklist. However, additional information can be added such as water quality data. Finally a report can be generated that contains an overview of the information, but also an scoring of risk. Based on the score, recommendations for improvement are given.

The manual merely describes how to use the software technically.

Contents

The risk assessment is approached purely technologically. With the checklists it draws attention to the important risks and risk management options. It provides no further information to 'teach' the risk assessor. Although some method of scoring is applied it is not clear how this works.

Scorings table

Assessment criteria	**Comments**
WSP team	Not addressed
System Description	OK
Hazards and risks	OK
Control measures	OK
Improvement plan	Some mention, not explicit
Monitoring control	OK
Verification (audit)	The format allows for easy auditing
Management	Not addressed
Support and training	Not addressed
Periodic review	Not clearly addressed
Integrated approach	Not addressed
Examples included	No
Forms/Templates	Is mainly templates
Other observations	In French, native language of the operators/risk managers

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