WEDC Developing knowledge and capacity in water and sanitation

GUIDE 19

An introduction to water safety plans

This guide describes what water safety plans are, why they are used, and how they can be developed and implemented. It demonstrates how they contribute to ensuring that consumers, suppliers and regulators can have confidence in the quality of water supplies.

The guide is intended for those who have responsibility for the quality of water supplies and are involved in developing, implementing or reviewing water safety plans.

Contents

Water safety plans (WSPs) can be used for water supply schemes of any size, from small community schemes to large utility-managed schemes. Appropriate numbers of water supply staff and community members can contribute to the preparation and implementation of the water safety plans, depending on the size of the scheme and management arrangements.

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Introduction

The delivery of safe drinking water is vital for protecting public health and promoting more secure livelihoods. Very often, however, assessment of water supplies is limited to occasional tests of water quality; insufficient attention is paid to the proactive management of water safety.

Historically, ensuring delivery of safe water has relied on testing water quality at the point of entry to the distribution system, the point of delivery or at the point of use. Monitoring of water quality has usually involved, or been managed by, the service provider, not by the consumer. Such an approach has relied on checking that the water satisfies water quality standards or guidelines that are set for health, technical and aesthetic reasons.

In 2004, the World Health Organisation launched the third edition of *Guidelines for Drinking Water Quality* (GDWQ), with a fourth edition published in 2011. These global guidelines are the principal document in water quality and they outlined a fundamental change in the approach to drinking water quality control.

The GDWQ promote the use of water safety plans (WSPs), which emphasize thorough risk assessment leading to effective risk management, and use simple indicators to monitor process control, with periodic verification through audit of microbial indicators.

The purpose of WSPs

Water safety plans aim to:

- seek to prevent contamination of water from the source to the point of consumption; and
- give consumers greater involvement and control over maintaining water quality.

Microbial indicators

A number of studies in recent years have shown that significant gastro-intestinal disease could be attributed to consumption of water that met standards for coliforms and *E.coli* when tested.

Furthermore, the recognition of the importance of viral and protozoan pathogens in causing waterborne disease has led to a reappraisal of approaches to microbial water quality control, as the bacterial indicator organisms typically used are less reliable in indicating the potential presence of viral and protozoan pathogens. As a result, the water sector is moving away from simple water testing and towards risk assessment and management.

Limitations of the water quality testing approach to assessing water quality

Water quality testing is usually done by the provider, with little communication with, or input by, the consumer.

- A focus on end product testing as an operational tool provides inadequate protection of public health.
- Water quality testing provides results that are 'too little, too late'. By the time contamination is identified, water will have been consumed.
- It is difficult and expensive to collect and analyse sufficient numbers of samples.
- Conditions may vary spatially and temporally. Water sampling only considers quality at a particular time and place.
- The focus is on measuring water quality and not on the means by which it is assured.
- The focus of water quality testing emphasises treatment rather than prevention of contamination and the quality of water at delivery rather than system management.

Water safety plans can be used for new or existing water supply schemes, both for piped urban utility supplies and rural or peri-urban community supplies.

Limitations of WSPs

Water safety plans are only as good as the information available, and how effectively they are planned and implemented. Water safety plans address issues of water quality, but cannot achieve other issues such as water quantity issues or deciding between different water use priorities.

"The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in the water supply from catchment to consumer. In these Guidelines, such approaches are termed water safety plans."
(WHO, 2011:45)

Information required

To form a water safety plan, it is imperative that the water supplier has an understanding of the complete supply system from the catchment to the consumer. This involves a thorough understanding of the source(s) of contamination, the pathway / movement of contamination, along with any barriers, and ultimately to the user (receptor) who may be impacted by any contamination (Figure 1).

Decisions about the extent to which water supply staff and community members should be involved should be made locally.

Developing a WSP

Before developing a WSP it may be important to identify, and reach agreement upon, health-based targets or outcomes. This is particularly important for some communities, where people need to understand the objectives and potential benefits of a WSP before committing themselves to developing and implementing a WSP.

The main stages in developing a WSP are:

- Preparation;
- System assessment;
- Operational monitoring;
- Management and communication;
- Feedback and improvement.

Figure 2 highlights this process control approach to water safety.

Preparation

The preparation stage involves determining what skills are needed and how large the team should be, identifying suitable experienced personnel (including members of the community who could be members of the team), securing adequate support in terms of finances and other resources, and identifying relevant stakeholders. Assembling the team may not be simple, because people may need to rearrange their existing duties to accommodate new responsibilities and adapt to the introduction of new procedures.

System assessment

This requires collecting detailed information about a water supply scheme. Examples of information required include information about the catchment and abstraction point for the water supply, information about pipes and other components (upto the point of use so may include the transport of water from a public standpost to the home), details of any treatment techniques used, and details of relevant water quality standards to be achieved.

This stage also requires identification of hazards, hazardous events, and an assessment of possible risks. **Hazards** may be physical, biological, chemical or radiological agents that could have a negative impact on human health.

Hazardous events refer to possible contamination or interruption of a water supply.

The **risk** associated with each hazard is assessed based on the likelihood or **frequency** of the hazard occurring, and the **severity** or consequence of the occurrence. Risks should then be prioritised. One technique for ranking risks in order of priority is to use a scoring system. For example, scores for frequency could range from 1 (rare) to 5 (almost certain), and scores for severity to public health could range from 1 (insignificant or no impact) to 5 (catastrophic impact). The product of these two scores then determines the risk, which could be from 1 (low risk: rare and with insignificant or no impact) to 25 (very high risk: almost certain and with catastrophic impact).

Risk = frequency × severity

Operational monitoring

Associated with the identification of hazards and assessment of risks, the team should identify **critical control points** (where action can be taken to reduce risk) and control measures (suitable actions that will reduce the risk). For example, a control point could be a borehole fitted with a handpump. For this control point, one possible control measure would be to ensure that there is a sanitary seal around the top of the borehole, to prevent surface water washing contaminants into the water source.

In WSPs, distinction is made between monitoring and verification. **Monitoring** focuses on assuring compliance of physico-chemical and sanitary risk factors to established operational limits. This is likely to be done on a regular basis (weekly or monthly). **Verification** is designed to verify the compliance of the monitoring programme with selected microbiological organisms.

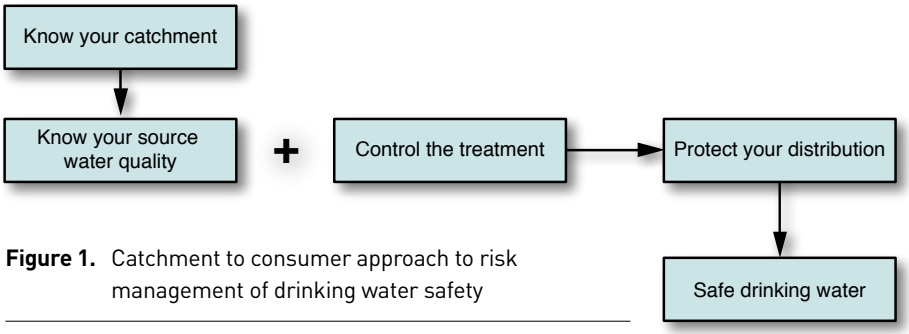


Figure 1. Catchment to consumer approach to risk management of drinking water safety

Control point. A step at which control can be applied to prevent or eliminate a water safety hazard or reduce it to an acceptable level. Some plans contain key control points at which control might be essential to prevent or eliminate a water safety hazard.

Control measure. Any action and activity that can be used to prevent or eliminate a water safety hazard or reduce it to an acceptable level.

(WHO, 2009: 101)

When the control points have been identified and control measures implemented, verification is needed to determine whether the controls are effective in reducing or eliminating risks to ensure that water quality targets are achieved and maintained. The various hazards and risks can then be reassessed.

Management and communication

It is important that management procedures are documented to detail what actions and procedures are needed during normal operational conditions, and what actions should be taken should a hazard event occur and affect the quality or continuity of water supply. The management procedures should be communicated to relevant management and operating staff, to ensure that they follow correct procedures as and when necessary. Following any staff changes, individuals need to be aware of relevant procedures and responsibilities. Procedures should be reviewed periodically, following any emergency, and staff should be informed of any changes introduced.

Supporting programmes may include aspects of training, research and development for water supply staff and consumers or community members.

Programmes may be necessary to educate members of the public about water safety, to improve public relations, to raise the knowledge and skills of staff, to ensure that adequate resources are available, and to make staff and community members aware of quality targets and any changes to these.

Feedback and improvement

The water safety plan team should meet routinely to review the water safety plan, and to share and learn from experiences. The water safety plan should be reviewed to make sure that it remains up-to-date, Reviews should be conducted following any emergency or ‘near-miss’, and when there are changes to the catchment, treatment facilities or distribution system.

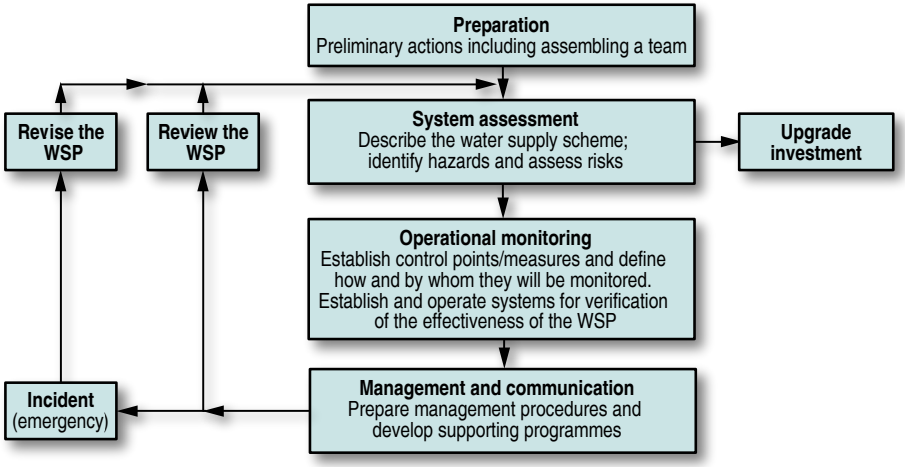


Figure 2. Development and implementation of a water safety plan

Verification

The use of WSPs does not mean that water quality testing is unnecessary. Water quality analysis forms part of the verification process to show that the WSP is functioning as designed and that safe water is being delivered.

Audits of WSPs (to review treatment processes, working practices, etc.) should be carried out periodically.

Water quality sampling and analysis to check for microbial indicators (such as thermotolerant coliforms) is an important part of verification of WSPs, and monitoring of water quality can also show trends, indicating whether the WSP is contributing to improved water quality.

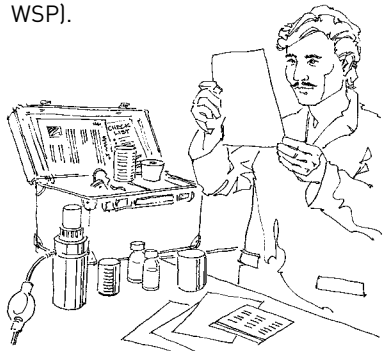
If water safety plans are used, analysis of water samples using laboratory or field test equipment is very useful at various stages – during assessment, as a control measure, and at the verification stage.

Field test equipment can also be very useful for one-off or routine testing of water sources and water supplies.

Risk management

Once the cause of a hazard (contamination) event is identified using sanitary inspections, methods for controlling each risk can be established, which are monitored using *surrogate parameters* (e.g. chlorine residuals, pH, conductivity). Corrective or remedial actions are then established once the guideline value for the parameter is exceeded. The following information needs to be recorded (see table overleaf for an example).

- Hazard event (and identified cause);
- Assessed risk (based on likelihood and severity);
- Control measure (required to prevent hazard);
- Critical limits (best and worst case scenarios);
- Monitoring (method, frequency and body to monitor hazard and associated risk);
- Corrective action (remedial measures required to reduce risk);
- Verification (test of effectiveness of WSP).



Summary

Water safety plans are the most effective tool for ensuring the quality of water supplies. Preparation of a water safety plan may involve several people from the water supply agency and local community to collect information, identify potential hazards that may affect the quality or reliability of supplies, and taking action to minimise the possibility of contamination or interruption of supplies.

Water safety plans can be used for water supply schemes of any size, from small community schemes to large utility-managed schemes. Appropriate numbers of water supply staff and community members can contribute to the preparation and implementation of the water safety plans, depending on the size of the scheme and management arrangements.

Preparation of a water safety plan is part of an ongoing process. The Water Safety Plan will need to be reviewed and revised so that it remains up to date, and takes account of experiences of using the water safety plan and changes to the water supply catchment and system.

Water safety plans have been prepared in several countries and for water supply schemes of different sizes. Existing water safety plans may be useful as examples, but each water supply scheme needs to be considered separately, to take account of local conditions.

Table 1. Example of a water safety plan matrix

Hazard event	Cause	Risk	Control measure	Critical limits		Monitoring			Corrective action
				Target	Action	What	When	Who	
Microbial contamination of a service reservoir from birds	Birds' faeces enter through open inspection hatches	Moderate catastrophic	Inspection covers remain in place	Inspection covers locked in place	Inspection covers not in place or unlocked	Sanitary inspection, and Chlorine residual	Daily	Operating staff	Replace inspection cover and check chlorine residual

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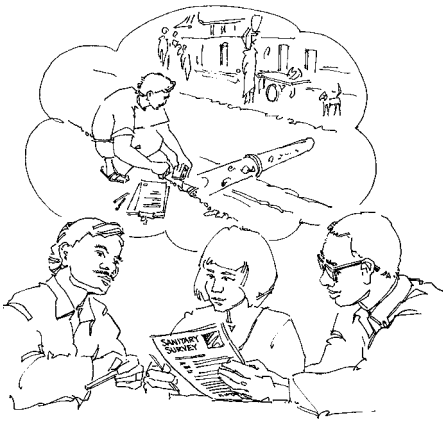

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