Guidelines for drinking-water quality

Small water supplies

World Health Organization

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Foreword

These Guidelines, specifically tailored to small water supplies, build on over 60 years of guidance by the World Health Organization (WHO) on drinking-water quality. This guidance has formed an authoritative basis for the setting of national regulations and standards for water safety in support of public health.

Safe drinking-water is a human right. States have the responsibility to progressively improve drinking-water service delivery, paying particular attention to vulnerable communities. Through Sustainable Development Goal 6 – to ensure availability and sustainable management of water and sanitation for all by 2030 – the world reaffirmed its commitment to ensure safe drinking-water in all settings.

Settings served by small supplies, however, pose particular challenges. Small supplies are more prone to breakdown and contamination in both developed and developing countries, with root causes linked to inadequate training, support, resourcing and oversight. As a result, a substantially smaller proportion of the population served by small supplies (including in rural areas) benefit from safely managed drinking-water as compared to large supplies. Those served by small supplies are more at risk of consuming water containing pathogens and harmful chemical contaminants, which increases their risk of waterborne illness. In many cases, surveillance of small supplies is inadequate and water safety risks are not identified. Even when they are identified, corrective actions may not be taken, requiring consumers desiring safe water to treat water at home, which is an additional task on top of others such as water haulage. Those most impacted are the marginalized and otherwise disadvantaged, including women and people living with disabilities. The ever-increasing impacts of climate change on water quantity and quality create additional urgency to act.

The problem is solvable. Many countries have developed innovative programmes to identify vulnerable communities through monitoring; address small supplies in regulations; and strengthen small water supply service delivery, including by targeting local operators with advice and technical support and thereby contributing to the professionalization of services. These highly beneficial actions recommended by WHO can be – and have been – implemented successfully. Some countries have proven that with political will, increased investment and community engagement, it is possible to radically scale up access to safe drinking-water through small supplies.

These Guidelines, which update the guidance provided in WHO's 1997 *Guidelines for drinking-water quality. Volume 3: surveillance and control of community supplies* (or *Surveillance and control of community supplies*), underscore that it is unacceptable for water supplies to be managed by those without adequate training or support. They recognize the wide variety of supply types and management models that fall under the label of "small water supplies", and they provide tailored guidance for several management models rather than focusing on community managed supplies only. These Guidelines consolidate decades of practical experience in realizing the central goal of safe, sustainable and more professionalized service delivery. These experiences include lessons learned through the implementation of *Surveillance and control of community supplies*. For the first time, these Guidelines fully integrate the concept of water safety planning, with specific tailoring to a small supply context. Understanding the limitations of end-product testing, water safety planning allows small water suppliers to focus on proactively managing risks in a stepwise manner. New tools to support risk management and surveillance include sanitary inspection packages for a suite of water delivery scenarios, each with revamped illustrations, supporting technical fact sheets and management advice.

These Guidelines have been designed to be practical and accessible. They offer clear guidance to support the progressive improvement of a broad range of small water supplies to achieve long-term objectives. By following the guidance in this document, governments can better address small water supplies in policies, regulations and supporting programmes to improve drinking-water safety for the many who rely on these supplies.

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Acronyms and abbreviations

CFU	colony forming unit
E. coli	*Escherichia coli*
GDWQ	*Guidelines for drinking-water quality*
GLAAS	UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water
HWT	household water treatment
ISO	International Organization for Standardization
JMP	World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply, Sanitation and Hygiene
MSD	minimum safe distance
NTU	nephelometric turbidity unit
P/A	presence–absence
SI	sanitary inspection
3Ts	taxes, tariffs and transfers
WASH	water, sanitation and hygiene
WHO	World Health Organization
WSP	water safety plan

Executive summary

Need for these Guidelines

Providing access to safe and adequate drinking-water services is one of the most effective means to promote health and reduce poverty, and small water supplies have an essential role to play in meeting this need. For a significant proportion of the global population, drinking-water comes from small supplies that range from individual household wells to piped supplies serving entire communities. More than 40% of the global population lives in rural areas, which are commonly served by small supplies. People living in small towns, peri-urban areas and urban areas may also rely on small water supplies. Small supplies are more likely to experience deficiencies related to water safety, which can result in water-related illness as well as adverse social and economic impacts. Improving the safe management and performance of small water supplies therefore represents an important opportunity to make significant contributions to public health and well-being, address inequalities and improve livelihoods.

Ensuring the safety of drinking-water delivered through small water supplies requires explicit consideration in policies and regulations.

Although small water supplies are diverse, they tend to experience a common set of operational, managerial, technical and resourcing challenges that can affect their ability to sustainably deliver safe drinking-water. For many water supplies, these challenges are exacerbated by the impacts of climate change on water quality and quantity. Small water supplies therefore require explicit policy and regulatory consideration and associated support. These Guidelines have been developed to address the needs and opportunities associated with small supplies to facilitate progressive improvement towards safe and sustainable drinking-water services for all.

Target audience

These Guidelines aim to help governments and practitioners improve the safety of drinking-water delivered through small supplies. The guidance is intended primarily for decision-makers at national and subnational levels with responsibility for developing and implementing drinking-water quality regulatory frameworks and associated programmes for risk management and surveillance. Other stakeholders involved in water service provision will also benefit from the guidance in this document, including nongovernmental organizations and community-based organizations that support the operations and management of small drinking-water supplies. The guidance is also important for small water suppliers, although most recommendations are directed at the institutions that regulate and support them.

Links to other WHO publications

These Guidelines are based on the principal recommendation in the World Health Organization's (WHO's) *Guidelines for drinking-water quality* (GDWQ) – that is, the framework for safe drinking-water (see Fig. E1) – and they provide guidance on applying that recommendation to small water supplies in particular. The framework for safe drinking-water comprises three elements, namely:

Fig. E1 • WHO's framework for safe drinking-water, adapted from the GDWQ

- developing regulations and standards that include **health-based targets** (e.g. water quality targets);
- undertaking **water safety planning**, which is a comprehensive and proactive risk assessment and risk management approach that includes all steps in the water supply chain (from catchment to consumer); and
- carrying out independent **surveillance** to ensure risk management practices are effective and health-based targets are being met.

This publication, *Guidelines for drinking-water quality: small water supplies* (or *GDWQ: small water supplies*), is complemented by WHO's 2024 *Sanitary inspection packages – a supporting tool for the Guidelines for drinking-water quality: small water supplies* (or *Sanitary inspection packages*). Sanitary inspection (SI) is a simple, on-site evaluation that is traditionally performed using a checklist to identify risk factors that may lead to contamination of a water supply, and it is an important tool to support risk management (including water safety planning) and surveillance activities.

Together, *GDWQ: small water supplies* and *Sanitary inspection packages* update and supersede WHO's 1997 *Guidelines for drinking-water quality. Volume 3: surveillance and control of community supplies*.

Key changes reflected in *GDWQ: small water supplies* include:[1]

- a greater focus on preventive risk management, namely by addressing water safety plans (WSPs);
- tailored guidance for a broader range of small water supplies, including supplies managed by households, communities and professional entities; and
- guidance targeting decision-makers.

Small water supplies covered

Globally, a wide variety of supplies fall under the label of "small water supplies". These supplies may serve one household or a number of premises (e.g. households, businesses, schools and health care facilities) in rural areas, small towns, peri-urban areas or urban areas. They may be non-piped supplies (e.g. dug wells, springs, rainwater collection systems or other point sources), or piped supplies that deliver water to communal access points and private household connections. They may or may not involve water treatment, and they may be used year-round or seasonally. They may be managed by individual households, groups of households (a community), community-based organizations, private operators, local governments, public or private water utilities, or a combination of actors.

Collectively, small water supplies represent a wide range of sizes, technologies, skill sets, resources and support needs. To allow context-appropriate recommendations, these Guidelines have established a reference typology of small water supplies based on management model. Management model refers to the set of arrangements for the operation, maintenance and administration of a water supply, and it can be broadly indicative of the relative numbers of consumers served and/or levels of water supplier expertise, available resources and external support needs. Specifically, these Guidelines have defined three points on a broad spectrum of possible management models to support practical and risk-based guidance. These are:

- **household managed supplies**;
- **community managed supplies**, ranging from limited to more advanced management; and
- **professionally managed supplies**, including management by private operators, public utilities, local government and other formalized entities responsible for supplying drinking-water.

1 For a summary of key changes made to SI tools, refer to Annex 2 of *Sanitary inspection packages*.

Users of these Guidelines will need to consider the various arrangements in their own contexts and decide how they relate to this reference typology and the associated guidance throughout the document.

Guiding principles

Fig. E2 presents 10 cross-cutting principles that are foundational to improving drinking-water safety in the context of small supplies. Concrete actions to apply these principles are presented in the next section.

Fig. E2 • Overview of principles foundational to the recommendations in these Guidelines

Prioritize public health	Engage water suppliers
Take a risk-based approach	Practise supportive regulation
Progressively improve	Approach WASH[a] holistically
Adapt for context	Provide equitable services
Strengthen systems	Build climate resilience

a Water, sanitation and hygiene

Recommended actions

The Guidelines' six recommendations to achieve safe services from small water supplies are given below, along with a summary of practical implementation guidance for each recommendation.

Chapter 2 • Assessing the enabling environment

Recommendation 1

Assess enabling environment conditions that affect small water supply service delivery to inform system strengthening.

Implementation actions

- **Review service levels and trends** → Trends in service level are a key indicator of the effectiveness of the enabling environment that supports small water supply service delivery. Basic service parameters to be reviewed include accessibility (or coverage), quantity, quality, continuity and affordability.
- **Review governance arrangements** → Successful drinking-water service delivery (including for small water supplies) relies on a clear vision for the sector that is set out in policy; a supporting legal framework for achieving that vision; formal regulatory mechanisms to ensure that policies and legislation are applied and enforced; and effective institutions with mandates, responsibilities and interactions between different institutions clearly defined.
- **Review financing** → To identify and address any imbalance between what is required and what is available to finance small water supply service delivery, it is important to review life-cycle costs, current sources of finance and strategies to reduce finance gaps.
- **Review capacity and human resources** → Individual and institutional capacities should be developed to build a strong, diverse and gender-balanced workforce.
- **Review monitoring frameworks and practices** → Monitoring frameworks and practices should account for small water supplies specifically (e.g. through dedicated metrics); be fully integrated into national and subnational systems and processes; and reflect the needs of target data users.
- **Develop a strategic plan to strengthen the enabling environment** → A comprehensive review of the enabling environment for small water supplies should inform outreach, advocacy and short- to longer-term action to progressively improve service delivery. Linking the assessment to formal processes of sectoral review and strategy development can help secure the necessary political support.

Chapter 3 • Health-based regulations

Recommendation 2

Establish regulations for small water supplies that promote risk management practice and define priority monitoring parameters and frequencies on the basis of risk.

Recommendation 3

Adopt regulatory approaches that promote a shift towards professionalized operation and management of small water supplies.

Implementation actions

- **Engage and support small water suppliers** → Small water suppliers should be engaged to ensure their knowledge and perspectives are considered. Regulatory requirements applied to small supplies should be balanced by programmes, measures and tools that enable and incentivize compliance. For small water supplies exempted from regulatory requirements, support is still needed to help ensure that safe water is delivered through these supplies.

- **Promote catchment-to-consumer risk management** → Regulations should promote or require water safety planning by water suppliers, who have primary responsibility for drinking-water quality control, as well as source water protection by relevant authorities.

- **Define priority water quality parameters** → Regulations should establish a set of priority parameters (water quality targets) for monitoring small water supplies that reflect public health risks and resource availability, and that are periodically reviewed and revised as needed for progressive improvement. Monitoring to ensure microbial water quality is the highest priority, followed by monitoring of priority chemical contaminants. Where resources are particularly constrained, free chlorine residual monitoring of chlorinated supplies (ideally combined with testing for turbidity and pH) will provide an indication of microbial water quality between *Escherichia coli* (*E. coli*) monitoring events.

- **Set protective and realistic parameter limits** → The aim should be to produce water where *E. coli* is not detectable in a 100 mL sample, although microbial grading schemes can be useful to distinguish between lower- and higher-risk sites to support prioritization where microbial targets are difficult to achieve. For chemical water quality, various regulatory approaches (e.g. interim limits, exemptions, derogations and locally determined safe limits) can serve to protect public health while navigating practical limitations in achieving the GDWQ guideline values where water treatment is inadequate (or absent).

Chapter 3 continued • Health-based regulations

Recommendation 2

Establish regulations for small water supplies that promote risk management practice and define priority monitoring parameters and frequencies on the basis of risk.

Recommendation 3

Adopt regulatory approaches that promote a shift towards professionalized operation and management of small water supplies.

Implementation actions continued

- **Establish monitoring frequencies and locations** → Regulatory monitoring programmes should consider technical conditions (such as parameter concentration, point of introduction, stability and seasonal variability); size and vulnerability of populations served; logistics (e.g. site accessibility); and availability of resources (human, financial, technical) to undertake monitoring. Deviations from national or subnational monitoring requirements should be permitted as appropriate on the basis of local risk assessments.

- **Specify analytical requirements (including for field test kits)** → Regulations should allow the use of field test kits when performance has been validated. Field test kits offer an alternative to analysis in formal laboratory settings, and they often have the advantage of being simpler to use and less expensive than laboratory testing methods.

- **Establish reporting requirements and incident protocols** → Regulations should establish what, when, how and between whom information should be shared during normal operations and incidents (e.g. water quality parameter exceedances). Requirements for public reporting will contribute to transparency and may incentivize improvement action.

- **Define a risk-based surveillance programme** → Regulations should establish surveillance requirements that include WSP auditing and/or SIs; direct testing of water quality; and reviewing the results of compliance monitoring that is conducted by water suppliers. If enforcement of drinking-water regulations lies with another body, clear institutional arrangements should be defined to support timely action based on surveillance findings.

- **Establish suitable additional regulations** → Other regulatory requirements and/or associated frameworks (e.g. technical standards and codes of practice) to consider include treatment technology targets; performance targets for household water treatment; requirements for operator training and skills; and material safety standards.

Chapter 4 • Water safety planning

Recommendation
4

Promote and support WSPs, which should be implemented by water suppliers to most effectively manage risks from catchment to consumer.

Implementation actions

- **Understand the distinctions between risk management approaches** → It is important to understand the relationship and distinctions between SIs and WSPs as risk assessment and risk management approaches and tools.
- **Establish risk management requirements** → Where populations served are greater or more vulnerable (e.g. in health care facilities), and where water supplier capacity is more advanced, regulations should promote or require WSPs. Where populations served are particularly low or it is not feasible for the water supplier to develop and maintain a WSP, routine SIs and associated management action can be applied as an interim (or, in some cases, alternative) approach.
- **Consider a staged approach to risk management requirements** → Small water suppliers may require more time to comply with regulatory requirements for risk management practice as compared to larger suppliers.
- **Provide water suppliers training and guidance in risk management** → Small water suppliers require ongoing technical assistance to effectively and sustainably practise risk management, including training in WSP and SI approaches and tools, as well as guidance and support to address risks.
- **Provide water suppliers practical tools to support risk management** → Essential support for small water suppliers includes risk management guidance materials and tools that are tailored for different types of water supplies. Useful resources include guidance notes, infographics with pictorial representations of risks and locally relevant forms and templates.
- **Establish sustainable financing for risk management programmes** → Risk management programme support and oversight by national and subnational authorities require dedicated budget allocations. In addition, it is important to establish mechanisms that allow small water suppliers to access funding for improvement needs that require more substantial financial investment.
- **Link to other WASH initiatives** → Water safety planning should be approached as part of holistic WASH programming due to its strong linkages to sanitation and hygiene, and to climate-resilient and equitable WASH services.

Chapter 5 • Surveillance

Recommendation 5

Practise risk-based surveillance, including verifying risk management practice by water suppliers and applying limited resources to address priority public health concerns.

Implementation actions

- **Define minimum frequencies for surveillance activities** → The surveillance agency should visit small water supplies periodically to perform SIs and/or WSP audits, and generally to conduct water quality testing. Specified frequencies should consider risk as well as available resources and other practical considerations, including the number and locations of water supplies and the number of trained surveillance personnel.
- **Progressively expand surveillance activities** → Where surveillance agencies are unable to fully implement surveillance programmes, strategic judgments must be made about how to carry out limited surveillance activity for the greatest public health benefit (e.g. prioritizing sites according to risk, monitoring a subset of priority parameters or focusing on SIs and WSP audits). Alternative water quality testing options (including field test kits) can also be considered.
- **Invest in training and tools for surveillance staff** → Surveillance staff play an important role in providing technical assistance to small water suppliers, and they require comprehensive training and well designed tools and templates to support their work.
- **Establish sustainable financing for surveillance** → Surveillance costs can be relatively high for small water supplies owing to the number of supplies and their geographical spread, and these costs must be adequately financed to support safe and sustainable drinking-water service delivery. Costs associated with the management, collation and review of surveillance data to inform programming must also be covered.
- **Jointly analyse risk management scores and water quality** → Combined analysis of risk management scores (from SIs or WSP audits) and microbial water quality data is important to verify the continuous safety of a water supply, particularly in the case of small water supplies, where infrequent testing may miss contamination events and analytical results alone may create a false sense of security.
- **Share surveillance findings promptly and clearly** → The practice of sharing surveillance findings with water suppliers before leaving the site creates an opportunity for discussion that can strengthen a water supplier's technical understanding, contribute to prompt corrective action where needed and help to build relationships and rapport. Findings should also be shared with authorities to ensure corrective actions are undertaken by the water suppliers as needed and to inform programming.
- **Strengthen surveillance-driven remedial action** → Linking surveillance findings to specific recommendations for improvement action (where needed) can be especially important where small water suppliers' technical knowledge and access to external expertise are limited. Systems for following up recommendations for remedial actions should be formalized and records should be kept.
- **Address parameter exceedances** → When water quality testing reveals non-compliance with regulations, investigative and possibly corrective action should be taken to ensure the protection of public health, with priority given to *E. coli* exceedances. It is important that findings of non-compliance are addressed with a view to supporting progressive improvement rather than only enforcing standards, especially in the case of lower-capacity supplies.

Chapter 6 • Improving data use

Recommendation
6

Strengthen systems of data sharing and use to inform decision-making and action at all levels.

Implementation actions

- **Assess factors that contribute to effective data use** → It is valuable to assess systems and practices that support the use of data to inform decisions and action to improve small water supplies, including consideration of what decisions need to be made, by whom, what data are required to make those decisions, and what tools are in place to aid reporting and use of data.

- **Progressively strengthen data use** → The highest priority use of water supply data is to address any immediate threats to user health, in particular preventing waterborne disease. After these needs are met as the top priority, a stepwise approach can be taken to support the use of additional data to inform planning and improvement action.

- **Harmonize data collection and management** → Harmonization of data collection tools and approaches (including SI and WSP audit forms) is critical to avoid fragmentation of data sets and help ensure that data can be readily compared nationally and subnationally. Shared data platforms should be considered where multiple stakeholders are collecting and using related data.

- **Prepare timely and fit-for-purpose reports** → To support evidence-based prioritization and decision-making at national and subnational levels, data from across sites and regions should be collated, interpreted and presented in reports that are fit for purpose and delivered at optimal times. This encourages the review and use of data by target data users.

- **Systematize data use in decision-making processes** → Consistent use of data requires that clear processes and platforms for data collation and review are embedded in all relevant planning and funding cycles. Decision-making processes that should involve a systematic review of available data include those related to site improvements, training programmes, funding allocations, strategic planning and operator licensing renewal.

Sanitary inspection and water quality testing being carried out at a public tapstand and dug well. See Fig. A4.2 for additional small water supplies covered by sanitary inspection tools.

1 Introduction and key concepts

This chapter provides a brief introduction to these Guidelines.

Questions addressed include:

- What is the purpose and scope of this guidance, and for whom is it intended?
- How are small water supplies characterized within this document?
- Why do small water supplies require explicit regulatory consideration?
- What principles should be applied to achieve safe drinking-water services in the context of small water supplies?

1 Introduction and key concepts

Providing access to safe and adequate drinking-water services is one of the most effective means to promote health and reduce poverty, and small water supplies have an essential role to play in meeting this need. For a significant proportion of the global population, drinking-water comes from small supplies that range from individual household wells to piped supplies serving entire communities. More than 40% of the global population lives in rural areas *(1)*, which are commonly served by small supplies. People living in small towns, peri-urban areas and urban areas may also rely on small water supplies. Small supplies are more likely to experience deficiencies related to water safety, which can result in water-related illness as well as adverse social and economic impacts *(2–5)*. Improving the safe management and performance of small water supplies therefore represents an important opportunity to make significant contributions to public health and well-being, address inequalities and improve livelihoods.

Although small water supplies are diverse, they tend to experience a common set of operational, managerial, technical and resourcing challenges that can affect their ability to sustainably deliver safe drinking-water. For many water supplies, these challenges are exacerbated by the impacts of climate change on water quality and quantity. Small water supplies therefore require explicit policy and regulatory consideration and associated support. These Guidelines have been developed to address the needs and opportunities associated with small supplies to facilitate progressive improvement towards safe and sustainable drinking-water services for all.

Ensuring the safety of drinking-water delivered through small water supplies requires explicit consideration in policies and regulations.

This first chapter sets out the purpose, target audience, scope and structure of these Guidelines (section 1.1). It also further characterizes small water supplies and establishes a reference typology of small supplies that is used throughout these Guidelines (section 1.2). Finally, it presents a set of guiding principles for the progressive improvement of small supplies that underpin the recommendations made throughout this document (section 1.3).

The development methodology for these Guidelines is detailed in Annex 1. A checklist of key recommendations and implementation guidance presented throughout these Guidelines is presented in Annex 2.

1.1 Purpose, target audience, scope and structure

▶ Purpose and linkages to other WHO publications

This publication, *Guidelines for drinking-water quality: small water supplies* (or *GDWQ: small water supplies*), aims to help governments and practitioners improve the safety of drinking-water delivered through small supplies. These Guidelines are based on the principal recommendation in the World Health Organization's (WHO's) *Guidelines for drinking-water quality* (GDWQ) *(6)* – that is, the framework for safe drinking-water – and they provide guidance on applying that recommendation to small water supplies in particular. The framework for safe drinking-water comprises three elements, namely establishing health-based targets that reflect the highest priority risks for inclusion in drinking-water quality regulations and standards; proactively managing risks to water supplies through water safety planning; and carrying out independent surveillance to ensure water safety planning is effective and health-based targets are being met (see Fig. 1.1).

Fig. 1.1 • WHO's framework for safe drinking-water

Source: adapted from the GDWQ *(6)*.

Detailed information on microbial, chemical, radiological and acceptability aspects of drinking-water is presented in WHO's GDWQ *(6)*. This companion publication to the GDWQ offers complementary guidance for small water supplies specifically.

Topics addressed by these Guidelines include:

- strengthening the enabling environment for small water supply service delivery;
- addressing different types of small supplies within regulations;
- varying risk management approaches according to water supplier capacity and population served;
- establishing water quality monitoring requirements that reflect priority risks and resource availability;
- targeting surveillance activity to best protect public health; and
- using information on small supplies to inform decision-making and drive improvement.

The recommendations throughout these Guidelines are supported by practical implementation considerations, including advice on progressive achievement, as well as good-practice examples from countries and areas around the world (see Annex 3).

This publication is complemented by WHO's 2024 *Sanitary inspection packages – a supporting tool for the Guidelines for drinking-water quality: small water supplies* (or *Sanitary inspection packages*) *(7)*, which provides sanitary inspection (SI) resources that can be used to support risk management and surveillance activities (see Chapters 4 and 5). See Annex 4 for additional information on SI packages.

Together, *GDWQ: small water supplies* and *Sanitary inspection packages* update and supersede WHO's 1997 *Guidelines for drinking-water quality. Volume 3: surveillance and control of community supplies* (or *Surveillance and control of community supplies*) *(8)*. Key changes reflected in *GDWQ: small water supplies* include:[1]

- a greater focus on preventive risk management, namely by addressing water safety plans (WSPs);
- guidance tailored for a broader range of small water supplies, including supplies managed by households, communities and professional entities; and
- guidance targeting decision-makers.

▶ Target audience

The guidance in this document is intended primarily for decision-makers at national and subnational levels with responsibility for developing and implementing drinking-water quality regulatory frameworks and associated programmes for risk management and surveillance of small water supplies. Target audience groups may come from various sectors (e.g. health, water supply, environment or rural development) and have roles in one or more key tasks, including:

- establishing, reviewing and revising drinking-water quality regulations, standards and policies;
- strategic planning and investment for improved drinking-water safety;
- providing technical assistance to small water suppliers, including for proactive risk management (e.g. water safety planning);
- verifying drinking-water safety through independent surveillance; and
- collating and analysing data to inform improvements at both operational and policy levels.

1 For a summary of key changes made to SI tools, refer to Annex 2 of *Sanitary inspection packages (7)*.

Other stakeholders involved in water service provision will also benefit from the guidance in this document, including nongovernmental organizations and community-based organizations that support the operation, management and oversight of small drinking-water supplies.

The guidance is also important for small water suppliers, although most recommendations are directed at the institutions that regulate and support them. (The Selected further reading section includes resources that are intended for use directly by water suppliers to support water safety planning.)

▶ Scope

These Guidelines address a broad range of small water supplies, which are further characterized in section 1.2. Although household managed supplies (e.g. private wells) are commonly exempted from regulations, they are addressed in these Guidelines to ensure that these water users (who may include those from the lowest socioeconomic levels) are considered and supported.

These Guidelines primarily address drinking-water quality; that is, safety and acceptability. However, they also acknowledge the critical importance of the overall adequacy of water supply, which considers not only quality but also accessibility, quantity, continuity and affordability (see section 2.3.1). Further, they address the broader interrelationships between water, sanitation and hygiene (WASH), and promote integrated WASH approaches and solutions.

These Guidelines support the achievement of safe and sustainable service delivery from existing water supplies, as well as from water supplies yet to be constructed to ensure due consideration of water safety from the outset.

▶ Structure

These Guidelines have been structured according to the three elements of WHO's framework for safe drinking-water, namely health-based regulations (Chapter 3), water safety planning (Chapter 4) and surveillance (Chapter 5 and elements of Chapter 6). Guidance is also included on assessing the enabling environment to inform planning and system strengthening (Chapter 2) and improving the sharing and use of all data available on small water supplies (Chapter 6). The content and structure of these Guidelines are summarized in Fig. 1.2.

Fig. 1.2 • Overview of the content and structure of these Guidelines

Chapter 1 – **Introduction and key concepts**
Setting out the purpose and scope of the Guidelines, a typology of small water supplies and cross-cutting principles underpinning recommendations

Chapter 2 – **Assessing the enabling environment**
Reviewing the enabling environment for safe and sustainable service delivery from small water supplies to inform strategic planning and system strengthening

Chapter 3 – **Health-based regulations**
Developing or revising drinking-water regulations and standards (including prioritized health-based targets) to best support the improved management and safety of small water supplies

Chapter 4 – **Water safety planning**
Promoting and supporting risk management practice by operators of small water supplies through water safety planning

Chapter 5 – **Surveillance**
Establishing independent surveillance programmes for small water supplies that will optimize the use of limited resources to best protect public health

Chapter 6 – **Improving data use**
Strengthening systems of data sharing and use to inform decision-making and action at all levels to improve small water supplies

1.2 A typology of small water supplies

The way small water supplies are defined differs by country. Legal, policy and regulatory instruments commonly refer to such criteria as population served, number of service connections, volume of water supplied, technology type, management model and geographical location. Globally, a wide range of supplies fall under the label of "small water supplies". These supplies may serve one household or a number of premises (e.g. households, businesses, schools and health care facilities) in rural areas, small towns, peri-urban areas or urban areas. They may be non-piped supplies (e.g. dug wells, springs, rainwater collection systems or other point sources), or piped supplies that deliver water to communal access points and private household connections. They may or may not involve water treatment, and they may be used year-round or seasonally. They may be managed by individual households, groups of households (a community), community-based organizations, private operators, local governments, public or private water utilities or a combination of actors. Refer to Fig. A4.2 in Annex 4 for examples of typical small water supplies.

This reference typology has been established to allow tailored recommendations throughout these Guidelines rather than a one-size-fits-all approach.

Small water supplies collectively represent a wide variety of sizes, technologies, skill sets, resources and support needs. Accordingly, many of the recommendations in these Guidelines vary by type of small supply, especially the recommendations related to water quality monitoring (see Chapter 3), water safety planning (Chapter 4) and surveillance (Chapter 5). To allow context-appropriate recommendations, these Guidelines have established a reference typology of small water supplies based on management model (see Table 1.1). Management model refers to the set of arrangements for the operation, maintenance and administration of a water supply, and it can be broadly indicative of the relative numbers of consumers served and/or levels of water supplier expertise, available resources and external support needs. Specifically, these Guidelines have defined three points on a broad spectrum of possible management models to support practical and risk-based guidance. These reference points, shown in Table 1.1, are not intended to characterize the full range of possible management arrangements. Users of these Guidelines will need to consider the various arrangements in their own contexts and decide how they relate to Table 1.1 and the tailored guidance throughout this document.

Table 1.1 • Three reference points on the small water supply management model continuum

Reference points on a management model continuum	Characteristics of the reference management models
Household managed[a]	Households manage their own water supplies, e.g. private wells and rainwater harvesting.
Community managed[b]	A water user committee or other community organization is responsible for the day-to-day operation, maintenance and management of the water supply. At one end of the community management spectrum, those responsible may have had limited training opportunities, receive little or no remuneration (i.e. be volunteers) and provide support on a part-time basis only due to other responsibilities. Water user fees, if collected, may not cover even basic operations and maintenance costs. These supplies may be operated without legal recognition and associated support (technical and financial) and accountability structures. This scenario is often referred to as unsupported, or basic, community management. Further along the community management spectrum, paid staff may be engaged by communities or local authorities, the management entity may be registered by the local authority, certain functions may be outsourced to private operators, and associations may be formed that offer member support services, e.g. maintenance or repairs by qualified technicians, financial management and water quality monitoring and reporting. (For highly sophisticated community management models, refer to the professionally managed category.)
Professionally managed[c]	Supplies are operated, maintained and managed by trained and supervised staff who receive compensation to perform these duties and work to agreed service standards. Operating costs are typically covered or offset by tariffs and/or local taxes. There is typically legal recognition of these management entities and accountability mechanisms are in place. This group may include direct provision of water supply services by local government (e.g. municipalities or communes), private operators, public utilities and other formalized entities responsible for supplying drinking-water.

a Self-supply associated with a business (e.g. a restaurant or hotel) is not considered part of this reference group due to differing regulatory implications of supplying water to the public.

b There is a broad spectrum of community-based management models, ranging from limited to advanced. Within these Guidelines, this reference point is intended to generally represent lower- to mid-level community management. More sophisticated community management models may be considered professionally managed for regulatory and support purposes as appropriate (i.e. the next reference point on the continuum).

c Levels of sophistication and performance will often vary between the different professionalized service providers listed in this table. For example, direct service provision by local government has been associated with lower performance levels in some cases *(9)*. However, these systems are positioned within the "professionally managed" group within these Guidelines to indicate that these water suppliers should be held to a higher regulatory standard. Resources and support should be provided for further professionalization of these suppliers as needed.

The following are examples of water supplies that may not neatly align with the categories and characterizations presented in Table 1.1, requiring Guidelines users to determine which management model reference point best applies.

- **Schools and health care facilities:** Water supplies for schools, health centres and other facilities serving vulnerable populations should be prioritized and held to the highest feasible standards. Where these facilities are served by an external entity such as a water utility, water supplies should generally be considered professionally managed. Where these facilities are served by on-site water supplies, the community management model may best apply, depending on contextual factors. (Chapters 3, 4 and 5 present special considerations for these facilities.)
- **Self-supply schemes as part of businesses:** Self-supply schemes that provide drinking-water (or use water for food preparation) as part of commercial endeavours (e.g. a guest house or restaurant) should generally be held to more stringent regulatory standards than the recommendations in these Guidelines for household managed supplies. Depending on the scale of operation and other contextual factors, community or professional management will likely be more appropriate categories.
- **Water vending:** Water vending may be undertaken by formal bodies, such as water utilities or licensed operators, or by informal suppliers. For formalized vendors, particularly those serving larger populations, it may be appropriate for these suppliers to be categorized as professionally managed. For informal vendors serving smaller populations, grouping with community managed supplies may be more suitable, depending on context.

1.3 Guiding principles to achieve safe services from small water supplies

Box 1.1 presents 10 cross-cutting principles that are foundational to improving drinking-water safety in the context of small supplies. Concrete actions to apply these principles are presented throughout these Guidelines.

Box 1.1 ▸ Principles foundational to the recommendations in these Guidelines

1. Prioritize public health → The protection of public health for all who rely on small drinking-water supplies should be prioritized.

2. Take a risk-based approach → A risk-based approach should be taken to identify and address the highest priority concerns to achieve the greatest public health benefit with the resources available. This includes supporting proactive risk management by drinking-water suppliers, establishing monitoring requirements based on risk, and ensuring that programmes to improve small supplies are designed to address the key risks identified.

3. Progressively improve → An incremental approach can be taken to improve small water supplies, recognizing that it may take time to overcome challenges and achieve overall water quality objectives. As capacities and resources are gained over time, more ambitious goals should be established. Improvement should be steady, with meaningful steps continuously taken to achieve safe and sustainable drinking-water service delivery from small supplies.

4. Adapt for context → Small water supply technologies, management models, capacities, baseline conditions and available resources vary considerably both within and between countries. Accordingly, there are no one-size-fits-all solutions, and due consideration of context is important to ensure that regulatory and support approaches are realistic and effective.

5. Strengthen systems → Safe and sustainable drinking-water service provision requires a strong enabling environment, including supporting policy and legal frameworks; regulation and monitoring that support planning and action; and the coordination of these processes by strong national institutions with a clear delineation of mandates and sufficient human and financial resources.

6. Engage water suppliers → Meaningful engagement of small water suppliers is essential to successful drinking-water quality regulation, water safety planning and surveillance. This engagement supports awareness-raising and capacity development and ensures water suppliers' knowledge and perspectives are taken into account.

7. Practise supportive regulation → Regulatory approaches that provide practical support for overcoming performance barriers are more likely to result in better health outcomes than focusing on enforcement only. While enforcement has an important role to play in operationalizing regulations and incentivizing performance, a balanced and support-oriented approach is important for small water suppliers with limited capacity and resources.

8. Approach WASH holistically → Water, sanitation and hygiene are strongly interrelated, especially for small supplies, for which the same government entity may manage or oversee various WASH programmes. Approaching WASH holistically will therefore create synergies and efficiencies in support of common public health goals.

9. Provide equitable services → Addressing small water supplies will support equitable service delivery given the disparities in access for those who rely on small supplies. Further, vulnerable and marginalized populations should be explicitly considered to ensure equitable participation in, and benefit from, initiatives to improve small supplies.

10. Build climate resilience → With increased frequency and intensity of climate-related events, the impacts of climate variability and change on water quality and quantity require priority attention in regulations, risk management programmes and surveillance.

2 Assessing the enabling environment

This chapter covers the assessment of the enabling environment for small water supply service delivery to inform strategic planning and system strengthening.

Questions addressed include:

- Do current drinking-water coverage and service levels suggest a need to strengthen the systems that support small water supplies?
- Do policy, legislative and regulatory frameworks adequately address the needs of small water supplies, including clear institutional arrangements?
- Are there human and financial resource gaps to be filled, including through greater political attention and support for small water supplies?
- Are monitoring frameworks and practices effectively serving small water supplies?

2 Assessing the enabling environment

This chapter covers the assessment of the enabling environment for small water supply service delivery to inform strategic planning and system strengthening.

2.1 Guidelines recommendation

Recommendation 1

Assess enabling environment conditions that affect small water supply service delivery to inform system strengthening.

The national (and subnational) system that facilitates and supports safe, equitable and sustainable drinking-water services from small supplies should be reviewed to identify areas for immediate and longer-term improvement. Although this system – or enabling environment – applies to the broader water supply sector, it should contain elements that are specific to small water supplies. An assessment of the enabling environment should review key sector building blocks and explore the overall adequacy of small water supply service delivery (as a key indicator of system effectiveness). Sector building blocks may be defined in various ways, but they should generally include consideration of governance, financing, capacities and monitoring. A review of the enabling environment involves asking questions on the extent to which each building block is fulfilling its required function. Issues identified that can be readily addressed should be acted on immediately, while other issues may need to be progressively addressed through strategic planning.

System strengthening will generally require governance and policy decisions, as well as financing. It is therefore important to secure political support to optimize the impact of such an assessment, and to link the assessment to formal processes of sectoral review and strategy development (e.g. related to sustainability, development and supporting marginalized populations). The joint sector review process, for example, may provide a suitable platform for sharing assessment findings and securing commitment from senior officials and political leaders to implement change.

2.2 Rationale

There is widespread recognition that safe and sustainable drinking-water service delivery is determined not only by the state of infrastructure, but also by the broader enabling environment *(9–11)*. Although this enabling environment (or system) may be defined in various ways, core building blocks include policy, legal and regulatory frameworks that support planning and action; the coordination of processes by strong national institutions with clear delineation of mandates; sufficient human and financial resources; and effective monitoring frameworks and practices.

Evidence indicates that while most countries have the requisite building blocks in place, operationalization is limited in practice, especially in rural settings, which tend to rely on small water supplies *(12)*. In many countries, the drinking-water sector is divided between urban areas (where water is largely delivered by utilities and subject to more formalized institutional, financial and regulatory arrangements) and rural areas, with the latter typically covering a wide range of small supplies, management arrangements and levels of formality. The relative complexity of the small water supply context, combined with the lower political priority sometimes given to these supplies, may contribute to greater service delivery gaps and vulnerabilities. Reviewing the status of the various system building blocks, particularly with respect to small supplies, and the linkages between them will support decision-makers in identifying priority needs to effectively target strengthening efforts.

The guidance on improving regulations (including water safety planning requirements), surveillance and data use in the chapters that follow should be approached as part of overall system strengthening and should be informed by a comprehensive assessment of existing conditions and needs.

2.3 Implementation guidance

This section presents guidance to support the practical implementation of the recommendation in this chapter, including the sector building blocks that should be reviewed for opportunities to strengthen the enabling environment.

2.3.1 Review service levels and trends

It is important to review trends in the levels of service provided by small drinking-water supplies as a key indicator of the effectiveness of the existing system that supports service delivery. To assess the adequacy of services provided, the following basic service parameters should be reviewed. For more information on these parameters, including indicators and approaches for measurement, refer to section 5.3 of the GDWQ *(6)*.

- **Accessibility (coverage):** Evaluation of access (or coverage) may consider type of supply, a minimum quantity of water supplied, and a maximum tolerable distance or round-trip travel time to a source, including queuing. From a public health standpoint, the proportion of the population with sustained, reliable access to safe drinking-water is the most important single indicator of the overall success of a drinking-water supply programme.

- **Quantity:** The quantity of water available to consumers has important health implications, as quantity must be sufficient to maintain adequate hydration, use for food preparation and support hygiene practices. The quantity of water collected and used by households is primarily a function of access level; that is, distance to the water supply or the total round-trip travel time required.
- **Quality:** Drinking-water must be safe; that is, free of pathogenic microorganisms and chemical and radiological hazards at levels that threaten health. It must also be of an acceptable colour, odour and taste.
- **Continuity:** Interruptions to drinking-water supplies, e.g. from intermittent or insufficient sources, is a major determinant of the quantity and quality of drinking-water available to consumers.
- **Affordability:** Drinking-water must be affordable to everyone, even the poorest.

Although this document primarily addresses drinking-water quality, all basic service parameters have water quality implications and are essential to the protection of public health. For example, where sufficient quantities of drinking-water are not reliably available, acceptable and affordable, consumers may turn to alternative water sources that may be of poorer quality and present greater health risks. Further, water supplies that are not accessible on premises and available when needed may become contaminated during collection, transport or storage.

Assessing existing conditions related to the adequacy of services provided by small water supplies can reveal priority challenges and support needs, provide an evidence base to secure political and financial commitments, and provide a baseline for measuring improvement over time. Various national and local data sources can be reviewed, including data from any existing small water supply registries or inventories, drinking-water quality monitoring data, SI results, WSP audit findings, information on consumer perceptions, data from health agencies and census information. Data may also be available from projects or scientific studies in select areas; from other regulatory authorities (e.g. economic or environmental regulators); or from local community groups or special interest groups. Also, data gathered through international monitoring mechanisms may help to clarify existing conditions.[2]

2 For example, monitoring of drinking-water (including in rural areas) undertaken through the WHO and United Nations Children's Fund Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP). The latest JMP data (including data on sanitation and hygiene) can be accessed at washdata.org/data (accessed 27 September 2023) and allow customized reports to be created that can inform decision-making processes.

If information is scarce, targeted assessments can be undertaken to fill data gaps. This is particularly relevant with respect to data on water quality in rural areas and for populations using non-piped supplies, where data from drinking-water regulatory authorities are frequently limited *(13)*. These assessments may be one-off, such as a rapid assessment of drinking-water quality. Alternatively, water quality testing can be integrated into national household surveys that are routinely undertaken, allowing for cost efficiencies and more regular collection of water quality data to gauge change over time, while ideally also strengthening capacities of drinking-water regulatory authorities to collect and publish this information.

Data gaps should not deter action.

In any case, data gaps should not deter action. Improvement can begin with the information at hand, with additional data needs prioritized and addressed incrementally over time. Refer to section 2.3.5 and Chapter 6 for guidance on reviewing and improving national systems related to the collection, management and use of information on small water supplies. Refer to Chapter 5 for guidance on surveillance programme strengthening to more systematically and sustainably address gaps in collecting and sharing data related to drinking-water quality, sanitary conditions and risk management practices.

See Cases A3.1 and A3.2 for country examples related to reviewing the performance of small water supplies and integrating water quality testing into household surveys, respectively.

2.3.2 Review governance arrangements

Successful drinking-water service delivery requires strong governance. This includes a clear vision for the sector that is set out in policy; a supporting legal framework for achieving that vision; and formal regulatory mechanisms to ensure that policies and legislation are applied and enforced. Strong governance also requires effective institutions, with the mandates, responsibilities and interactions between different institutions and actors clearly defined in policy and legislation *(4)*.

A review of governance instruments and structures with a view to strengthening the enabling environment should consider several key aspects, including the following.

- **Policy and legislation:** Do sector policies and legislation adequately address and support drinking-water service delivery from small supplies? Is there sufficient clarity around legal ownership for all small water supply management models (including household, community and professionally managed supplies)? Are schemes for approving and registering small water suppliers clearly defined and appropriate? Do they reflect practical considerations such as operator competencies and capacities? Are mandates and responsibilities clearly defined for the various institutions and actors involved in small supply service provision at all administrative levels, including the critical roles of regulatory authorities, service providers and water users?

- **Institutional arrangements:** Are the institutional arrangements and interactions between actors distinct and complementary, with no gaps, ambiguities, overlaps in key functions or conflicts of interest?
- **Regulatory frameworks:** Is there a regulatory entity for small supplies that is independent of the institution(s) responsible for service provision? Does the regulatory framework define accountability mechanisms for small water suppliers to fulfil their roles in service delivery (e.g. through enforcement of minimum requirements with proportionate rewards and penalties)? Are enforcement procedures clear and transparent so as to effectively promote and incentivize regulatory compliance? Do regulations consider different types of water supplies (e.g. piped versus non-piped or different management models) and support progressive improvement of service levels? Are there programmes to support small water suppliers to progressively meet regulatory requirements, particularly for those with the least capacity and resources?
- **Coordination mechanisms:** Do coordination mechanisms and platforms exist (e.g. shared databases, working groups or joint sector review processes) to facilitate information sharing, collaboration and joint decision-making between relevant institutions, including those representing water, health, environment, financing and rural development? Does adequate coordination also take place between different levels of government (national and subnational, including local)? Do coordination mechanisms include organizations responsible for water resource allocations (for drinking-water as well as agriculture, etc.) and environmental protection for an integrated water resource management approach? Is there adequate coordination with nongovernment organizations, civil society groups and development partners, if relevant? (Chapter 6 provides guidance on systems and processes to support data sharing and use by various stakeholders.)
- **Health care facilities and schools:** Is drinking-water service delivery in health care facilities and schools, and other facilities with vulnerable populations served by small supplies, adequately covered by policies and regulations?
- **Climate resilience:** Do policy and regulatory frameworks consider climate-related risks and mitigation and adaptation measures to strengthen the resilience of small drinking-water supplies to climate variability and change?

See Cases A3.3 and A3.4 for country examples of strengthening regulatory frameworks, institutional arrangements and coordination mechanisms in the context of small water supplies.

2.3.3 Review financing

It is important to review arrangements for financing drinking-water service delivery through small supplies. There is often a large financial gap between what is required and what is available to support safe and sustainable drinking-water service delivery, particularly in the case of small supplies *(12)*. For small supplies, financial challenges tend to be exacerbated by small economies of scale; lower potential for revenue generation (e.g. owing to smaller populations served); higher costs of providing technical assistance and oversight; and possibly a lower policy priority as compared to larger utilities.

Effective policies, strategies and plans are needed for the sustainable financing of small water supply service provision so that these supplies can consistently provide safe drinking-water. Financial plans should be reviewed to ensure that they reflect the needs and interests of small water supplies and that these supplies are sufficiently financed. This requires a review of the life-cycle costs of service delivery, current sources of finance and strategies to reduce finance gaps. Each of these review topics is further addressed in this section.

Accurately determining all direct and indirect costs of service provision and leveraging available (or potential) funding sources to cover these costs requires specialist knowledge and supporting resources and tools. Refer to the Selected further reading section for resources related to strengthening the enabling environment, including financing resources.

▶ Life-cycle costs

The central costing question to be considered during a financing review is what are the life-cycle costs of service delivery from small water supplies (see Box 2.1), including all direct and indirect expenditure?

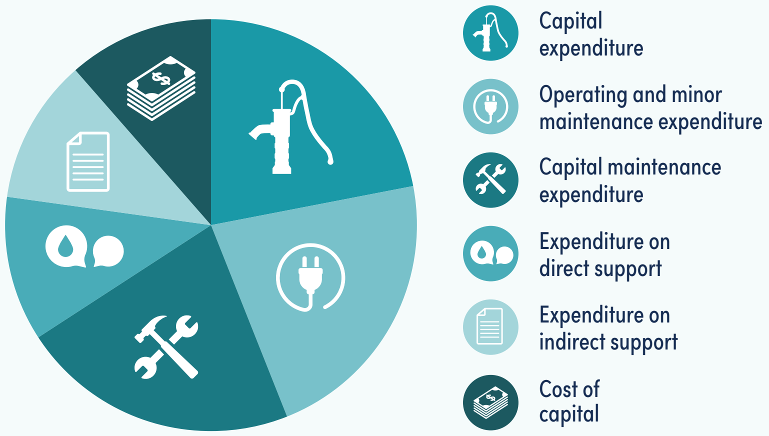
It is important to consider not only the costs incurred by small supplies, but also the costs incurred by the institutions tasked with providing support and oversight to small water suppliers (e.g. for planning and policy-making, WSP training, technical support and surveillance). These costs include, but are not limited to, staffing, fixed assets (e.g. office and laboratory space), mobilization, training materials and water quality testing. The costs of providing technical support to small water suppliers are often relatively high owing to the sheer number of small supplies and their wide geographical spread and remoteness (compared to larger utilities serving more concentrated populations).

Box 2.1 ▸ Life-cycle costs of drinking-water service delivery

Life-cycle costs are shown in Fig. 2.1 and include:

- **capital expenditure:** construction and installation of infrastructure;
- **operating and minor maintenance expenditure:** recurrent expenditure on staff, energy and materials needed for routine operations and maintenance;
- **capital maintenance expenditure:** renewal and rehabilitation costs;
- **expenditure on direct support:** ongoing support to water suppliers, e.g. the costs of surveillance, technical advice and training;
- **expenditure on indirect support:** costs of government planning, policy-making and regulation; and
- **cost of capital:** cost of servicing capital, e.g. loan repayments.

Fig. 2.1 • The six categories of life-cycle costs



Source: adapted from *Costing and financing of small-scale water supply and sanitation services* (14).

▸ Current sources of finance

Sources of finance should be reviewed, along with existing mechanisms and processes for distributing funds. Such an analysis may reveal opportunities to better channel existing resources to the areas that need them most. When reviewing finance sources, it is important to consider tariffs, taxes and transfers – often referred to as the 3Ts – as well as repayable finance.

- **Tariffs:** What is the financial viability of small water supplies, including tariff design and cost recovery? Do small supplies typically operate at a loss, cover a significant share of operations and maintenance costs, or generate profits that can be reinvested in capital maintenance?

- **Taxes:** What is the availability of financing for small supplies from public budgets, for both initial capital infrastructure investment and for ongoing subsidies to support operations, maintenance and management?
- **Transfers:** How much financing for small supplies comes from transfers from development partners (i.e. aid expenditure) and/or regional or national investment banks (e.g. grants)?
- **Repayable finance:** What is the availability and use of private capital for small supplies, in the form of bank loans or other commercial lending?

▶ Reducing finance gaps

When weighing the costs of small supply service delivery against finance sources, often an imbalance – or a financial gap – is found. It is important to review strategies to reduce this gap by lowering costs and increasing efficiencies, increasing the sources of finance and attracting repayable finance. Questions to consider include the following.

- **Reducing costs and increasing efficiencies:** Are there opportunities to promote low-cost technologies for small supplies? Are there opportunities to reduce water losses and increase the efficiency of operations? Are programmes in place to improve energy efficiency for small supplies (that promote solar power and other forms of renewable energy)?
- **Increasing each of the 3Ts:** Are there opportunities to increase tariff revenues for small supplies? Could more professionalized, higher-quality service lead to greater user satisfaction and increased willingness to pay? Is there scope to improve tariff structures and collection practices? Is there potential to increase public finance for small supplies? Are there strategies in place to channel transfers to small supplies?
- **Attracting repayable finance:** Are there strategies in place to attract repayable finance for small supplies, including smaller-scale financing options (e.g. microfinance)?

See Case A3.5 for a country example of financing small water supply service delivery.

2.3.4 Review capacity and human resources

Various stakeholders at national and subnational levels contribute to the delivery of safe drinking-water from small supplies. Primary stakeholders include, but are not limited to, water suppliers, regulatory authorities and water users, as well as those responsible for broader public health protection, policy-making and resource allocation. Beyond these primary actors, there are various others who support the safety of small water supplies, such as catchment management authorities, landowners and those involved in water supply installations (e.g. pump retailers, plumbers and construction entities). Successful programmes for drinking-water service delivery require sufficient human resources with the education, training and motivation to fulfil these roles. This includes water suppliers with sufficient capacity to support professionalized service delivery (see Chapter 3).

A long-term human resource plan should be developed that addresses capacity-building for institutions and individuals to establish and sustain a strong, diverse and gender-balanced workforce. This plan should be informed by a review of human resource needs and opportunities, including the following.

- What are the human resources required to support (directly and indirectly) the various aspects of drinking-water service delivery, including regulation?
- What competencies are necessary to successfully carry out these roles?
- What programmes exist for stakeholder training and education? Do they involve periodic refresher opportunities? Are they meeting objectives for building and sustaining capacity?
- What programmes and incentives exist to attract and retain qualified staff?
- Are opportunities for peer-to-peer learning being leveraged?
- Are the expertise and resources of academic institutions, nongovernment organizations, civil society groups and development agencies being harnessed to support capacity development?

Chapters 4 and 5 present additional considerations on capacity development needs related to water safety planning and surveillance, respectively.

See Case A3.6 for a country example of capacity development programmes for small water supply operators.

2.3.5 Review monitoring frameworks and practices

Evidence-informed decision-making requires the existence and use of monitoring frameworks to collect, manage, report, share and use data. Effective monitoring frameworks allow the measurement of performance against regulations and targets; the identification of bottlenecks and areas requiring priority attention; and an evidence-based approach to policy and investment decisions. Monitoring frameworks are also important to understand what level of services are being delivered to whom (see section 2.3.1).

A review of existing monitoring frameworks and practices should consider several questions, including the following.

- Do monitoring frameworks account for small water supplies specifically (e.g. through dedicated metrics)?
- Is monitoring of small water supplies fully integrated into national and subnational systems and processes?
- Are monitoring outputs relevant, useful and available to decision-makers at all levels, from water suppliers to policy-makers? Are resource (human and financial) efficiencies targeted by avoiding the collection of unnecessary or unusable data?
- Do monitoring frameworks and metrics support data disaggregation, particularly for vulnerable and marginalized groups?
- Are stakeholder arrangements clear and do they contribute to an atmosphere of collaboration, trust and mutual support among the various actors involved in data collection, communication and use (e.g. consumers, surveillance agencies, water suppliers and planning and finance authorities)?

Refer to Chapter 6 for guidance on the effective sharing and use of monitoring information by various stakeholders at different administrative levels to support evidence-based decision-making, including how to assess and progressively strengthen systems of data use. Refer to Chapter 5 for guidance on the reporting and use of surveillance data to drive remedial action and improvement by small water suppliers.

See Case A3.7 for a country example related to adapting monitoring frameworks to small water supply conditions, as well as the sharing and use of monitoring data.

2.3.6 Develop a strategic plan to strengthen the enabling environment

The information and insights gained through a comprehensive review of the enabling environment for small water supplies should be used for outreach and advocacy to senior government officials and political leaders to garner political support and secure the human and financial resources needed to improve the delivery of safe, equitable and sustainable services from small water supplies. As noted in section 2.1, linking the assessment to formal processes of sectoral review and strategy development can help to secure the necessary support.

Some of the issues identified through the enabling environment review process may require considerable financial resources and time to address, including within the context of sector reform and planning efforts. As a minimum, senior government decision-makers (e.g. those who can influence target setting, policy-making, regulation and financing) should be informed of the review and should be encouraged to take actions to strengthen the systems and institutions that support small water supplies. Some of this reform may be a longer-term process that could benefit from a strategic plan, whereas other issues could be acted on immediately to initiate a process of progressive improvement.

The remaining chapters in this document provide practical guidance on improving select elements of the enabling environment for small water supplies, namely drinking-water quality regulatory frameworks and practices that include water safety planning and surveillance (Chapters 3, 4 and 5) and data use (Chapter 6). Strengthening these frameworks and practices should be considered in strategic planning efforts.

See Case A3.8 for a country example of strategic planning to strengthen the enabling environment for drinking-water service provision in rural areas.

3 Health-based regulations

This chapter addresses the development or revision of national or subnational drinking-water quality regulations and standards to best support the improved management and safety of small water supplies.

Questions addressed include:

- How can regulatory approaches support and incentivize improved performance by small water suppliers?
- How should regulations address proactive risk management by small water suppliers?
- What are the priority water quality parameters and appropriate monitoring frequencies for small water supplies?
- How should regulations define risk-based surveillance programmes for small water supplies that will best protect public health?

3 Health-based regulations

This chapter addresses the development or revision of national or subnational drinking-water quality regulations and standards to best support the improved management and safety of small water supplies.[3] Health-based targets, which are measurable objectives for water quality and safety, are a key component of drinking-water regulations *(6)*. The health-based targets addressed in these Guidelines are water quality targets (i.e. priority parameters and safe limits), specified water treatment technologies and performance targets for household water treatment (HWT) technologies.

This chapter addresses select regulatory aspects for which guidance tailored to small water supplies is warranted. For more comprehensive guidance on the development or revision of regulations that applies to all types and sizes of water supplies, refer to *Developing drinking-water quality regulations and standards (15)*.

3.1 Guidelines recommendations

Recommendation 2

Establish regulations for small water supplies that promote risk management practice and define priority monitoring parameters and frequencies on the basis of risk.

Recommendation 3

Adopt regulatory approaches that promote a shift towards professionalized operation and management of small water supplies.

Governments should develop drinking-water regulations for small water supplies that are risk based, which means they should:

- promote or require proactive, context-appropriate risk management practice by water suppliers;
- clarify the highest priority water quality parameters for targeted monitoring programmes (i.e. the parameters that reflect the greatest risks);
- establish protective and realistic parameter limits;
- establish minimum monitoring frequencies according to water supply typology; and
- allow deviations from national or subnational monitoring requirements (parameters, frequencies or locations) on the basis of local risk assessments.

3 Other types of drinking-water regulation (e.g. economic regulation) are beyond the scope of these Guidelines. The regulation of drinking-water quality and safety to support public health protection is the focus of this chapter.

To protect all consumers, regulatory approaches should facilitate progressive improvement of all small water supplies, including supplies serving populations that that tend to be left out and left behind. Realistic requirements should be established to address the highest priority public health risks, with a view towards introducing more ambitious requirements over time as needed to achieve overall water quality objectives. The inclusion of a review clause in regulations is useful to provide a formal mechanism to ensure that regulations are reviewed regularly (e.g. every 5 to 10 years, depending on the local context) to allow relevant requirements to become increasingly robust as needed and as resources and capacities for compliance are strengthened. Various factors that should trigger a review of regulations are provided in Chapter 3 of *Developing drinking-water quality regulations and standards (15)*.

As part of progressive improvement, governments should support professionalized management of small water supplies to support safe and sustainable drinking-water services. Professionalization refers to water supplies that are operated, maintained and/or managed by well trained and qualified individuals working within clear legal and accountability frameworks *(16)*. Professionalized service providers are subject to monitoring and evaluation against performance indicators, and to affordable pricing structures that contribute to cost recovery. A supportive regulatory environment for professionalization may, for example, involve regular performance monitoring and reporting to government, reliable public financing and the application of sanctions when terms are violated. It may also establish minimum operator training and certification requirements, and it may allow contracts for maintenance and support services that clearly allocate roles between service providers, water users and authorities. Professionalized supplies should be subject to higher regulatory standards, as indicated in the differentiated guidance throughout this document.

3.2 Rationale

Effective regulation of small water supplies requires a practical, risk-based approach that considers resource realities and targets progressive improvement. There is limited value in establishing requirements that cannot practically be achieved. This creates an environment in which non-compliance becomes the status quo and regulations lose their power to drive and sustain improvement. Addressing the highest priority public health risks will help ensure maximum impact from the use of limited resources. Regulations that accommodate a variety of contexts and conditions and define a path for progressive improvement as capacities and resources are gained will deliver the best outcomes.

The professionalization of operators, including those managing small water supplies, has been recognized as an important strategy for raising service standards, maximizing operational efficiencies and increasing abilities to respond to environmental threats and climate-induced risks *(4, 6, 9)*. There is also a body of evidence to demonstrate that professionalization, often driven by the consolidation or aggregation of service areas, can result in improved outcomes and more sustainable services *(9, 17, 18)*. Progress in professionalization of maintenance services is also showing promise for small community managed supplies, with data indicating significantly improved service levels, functionality rates and time to repair *(19, 20)*. Ensuring that operators have adequate ongoing training and support (technical and financial) and the right regulatory incentives and accountability measures to fulfil their roles are important elements of professionalization.

See Cases A3.9 and A3.10 for country examples illustrating different approaches to professionalizing small water supply service delivery and benefits realized.

3.3 Implementation guidance

This section presents guidance to support the practical implementation of the Guidelines recommendations, including what should be set out within regulations to drive proactive risk management, appropriate monitoring and progressive improvement. The essential regulatory support needs of small water suppliers are also addressed.

3.3.1 Engage and support small water suppliers

Meaningful engagement of small water suppliers is essential to the successful regulation of these supplies. Water suppliers best understand their needs and constraints, and they are much more likely to participate in regulatory approaches that they have influenced and that reflect their unique circumstances. Where regulatory enforcement is more limited, as may be the case for small supplies, it is particularly important to secure water supplier buy-in to compel compliance.

In light of the challenges faced by small water suppliers, regulatory requirements should be balanced with programmes and tools that will enable understanding and compliance. Recurrent training opportunities for water suppliers, information campaigns, practical tools, access to technical advice and, if needed, financial assistance will be essential to achieving regulatory standards for many small supplies. (Chapters 4 and 5 provide guidance on capacity development and supporting tools related to water safety planning and surveillance, respectively.)

It is also helpful to put measures in place to incentivize regulatory compliance. Incentives to encourage good practice and performance may include economic incentives, which may be offered through subsidies or grants. Public recognition and awards for good performance may also encourage water suppliers to meet and exceed regulatory standards. Requirements to publicly report drinking-water quality monitoring results (see section 3.3.7) can also motivate water suppliers. Authorities also must be able to compel compliance through regulatory measures, such as penalties or sanctions, including fines or suspension of licences. Although penalties and sanctions may sometimes be required, a supportive approach for small water supplies that incentivizes good practice is recommended.

For small water supplies that are exempted from regulatory requirements, such as household managed supplies in many contexts, support is still needed to encourage and enable the achievement of health-based targets (including water quality targets) to protect the health of these water users. See Box 3.1.

Box 3.1 ▸ Support for household managed supplies

Household managed supplies (e.g. private family wells or boreholes, spring sources and rainwater harvesting systems) are often exempted from regulatory requirements owing to issues related to the technical and financial burdens implied for households, as well as the resource implications for oversight and enforcement. A high level of self-reliance is therefore required. However, households commonly have limited technical expertise, access to information, access to testing facilities, and/or financial means to test and manage water supplies (including water treatment). Support should therefore be provided to help ensure that safe water is delivered through these supplies. Support may include information campaigns and easy-to-use tools to guide self-checking and remedial action by households. Information campaigns should address, for example:

- impacts of unsafe water on health;
- priority water safety risks (including those related to climate change) and how they should be proactively managed;
- where to access supporting tools, such as SI forms or other checklists to identify priority risk factors;
- safe and effective household water supply, storage and treatment options that are available locally;
- optimal household water supply management practices, including operations and maintenance;
- water quality targets and monitoring recommendations (or requirements);
- how to access water quality testing equipment or services and how to interpret findings; and
- who to contact for further information or assistance (technical or financial).

Support programmes should take care to consider households with low literacy levels, means to access information and resource availability to make improvements.

See Cases A3.11 and A3.12 for country examples of meaningful engagement of small water suppliers in regulatory processes; Case A3.13 for an example of regulator guidance and support for household managed supplies; and Case A3.14 for an example of incentive-based regulation to strengthen water supplier performance.

3.3.2 Promote catchment-to-consumer risk management

The proactive management of threats to water safety is best practice in any context, including for small water supplies, for which treatment and monitoring will often be more limited and where waterborne disease outbreaks may be more likely to occur. Therefore, regulations should promote or require water safety planning by water suppliers, as well as source protection by relevant authorities in close cooperation with communities.

▶ Risk management by water suppliers

See Chapter 4 for more guidance on water safety planning.

National regulations should require or promote the implementation of WSPs by water suppliers, who have primary responsibility for drinking-water quality control. Water safety planning is a comprehensive approach to proactively manage risks to water quality and quantity from the catchment to the consumer to prevent problems from occurring, and it is fundamental to ensuring the continuous safety of drinking-water supplies *(6)*. WSPs are covered in detail in Chapter 4, including guidance related to capacity development and other support that small water suppliers need to effectively and sustainably implement them. Chapter 4 also addresses the role of SIs, which are simple on-site evaluations to identify and address key threats to a drinking-water supply. The information in Chapter 4 will support decision-makers in defining risk management requirements within regulations.

▶ Source protection by relevant authorities

Although the scope of water safety planning includes source protection, small water suppliers often have limited ability to influence or control catchment-level activities that may contaminate source waters, for example agriculture or industry. Therefore, preventive regulation of activities within drinking-water catchments (for both surface water and groundwater sources) is an important complement to risk management by water suppliers. Interagency coordination and collaboration is important to ensure source water protection, especially if catchment management measures cannot be incorporated directly into drinking-water regulations. It may also be appropriate to make legal provisions for water suppliers to initiate legal action as needed to protect water sources from polluting activities. This is especially important where there are not yet effective government programmes in place to control pollution.

Preventive regulation of source water catchments may include these (and other) protection measures *(21, 22)*:

- establishing protection zones around water abstraction points, including restricting access to catchments;
- establishing an abstraction licensing programme that requires and/or funds protection measures (with scope to deny abstraction from high-risk sources if alternatives are available);
- restricting potentially polluting activities, e.g. agriculture and industry, and possibly offering incentives for cooperation;
- requiring adherence to codes of good practice, e.g. for agriculture and industry;
- specifying requirements for siting and/or managing sanitation facilities; and
- establishing climate change assessment, mitigation and resilience measures to understand and manage climate-related impacts on source water quality and quantity.

Successful protection measures will reflect the unique needs and concerns of the local setting and engage affected stakeholders in the identification of appropriate measures. However, even when stakeholders are engaged in the design of such measures, implementation may be challenging. There may be capacity barriers, such as a lack of technical knowledge on how to protect source waters, which can be overcome through guidance and support. There may also be strong financial disincentives, such as direct costs and lost revenue (e.g. when an income-generating activity is banned, impacting livelihoods). In the case of small water supplies, tension between competing interests may exist within a community – even between neighbours – compounding sensitivities. To minimize conflicts, address vulnerabilities and help enable compliance, the development of regulatory measures to protect source waters should be complemented by mechanisms to assist affected stakeholders. Incentive-based programmes and cooperative agreements can help manage adverse impacts on livelihoods, build capacity and increase compliance with regulations.

Further guidance on the protection of drinking-water sources, including effective policy and regulatory measures and special considerations for small supplies, is available in *Protecting groundwater for health (21)* and *Protecting surface water for health (22)*. These publications include practical guidance on coordination mechanisms for effective design and implementation of protection measures.

See Case A3.15 for a country example of catchment protection measures and associated cooperative agreements between water suppliers and farmers.

3.3.3 Define priority water quality parameters

The GDWQ *(6)* present information on more than 200 drinking-water quality parameters covering microbial, chemical, radiological and acceptability aspects. It is not feasible nor desirable to include all these parameters in national or subnational regulations, as not all will be likely to occur in local drinking-water supplies at concentrations of concern. Further, monitoring an extensive list of regulatory parameters requires considerable resources that could be used in a more targeted and efficient way to improve public health outcomes. Prioritization of parameters is therefore especially important in the case of small water supplies, where challenges related to human and financial resources, analytical capacity and equipment, and logistics (e.g. site accessibility and proximity to testing facilities) affect monitoring feasibility.

This section presents guiding principles for parameter prioritization, as well as a core set of priority parameters to initially consider for inclusion in drinking-water regulations.

See Case A3.16 for a country example of a risk-based approach to prioritizing parameters for regulatory inclusion that considers resource limitations.

▶ Guiding principles

Parameters included in regulations should protect health while reflecting resource limitations (technical, financial and human) *(15)*. Accordingly, the list of regulatory parameters and associated safe limits (i.e. water quality targets) applied to small supplies should be tailored to the local context. Regulations should:

- prioritize microbial safety;
- consider priority chemical contaminants where these occur at concentrations of concern;
- consider acceptability parameters that may cause users to reject the water and turn to other sources that are potentially less safe; and
- be periodically reviewed and revised to reflect new information and drive progressive improvement.

Countries should progressively consider the inclusion of additional regulatory parameters beyond the priority set presented in this section based on risks and capacities. For guidance on prioritizing additional parameters, including radiological and additional chemical parameters, see *Developing drinking-water quality regulations and standards (15)*.

▶ Microbial parameters

Control of microbial contaminants is the highest priority. Infectious diseases caused by pathogenic bacteria, viruses, protozoa and helminths are the most common and widespread health risks associated with drinking-water.

Waterborne disease can result from even a single exposure to microbial contaminants in drinking-water. For this reason, ensuring that drinking-water is free of microbial hazards should be the highest priority for regulations *(6)*. The recommended approach to verify microbial safety is based on testing of indicator organisms. The preferred indicator organism is *Escherichia coli* (*E. coli*), although thermotolerant coliforms provide a less reliable but acceptable alternative. See Box 3.2 for further information on indicator organisms.

Box 3.2 ▶ *E. coli* and other faecal indicators

The greatest public health threat from microorganisms in water is consumption of drinking-water that is contaminated by human or animal faeces. Accordingly – and also considering issues relating to complexity, sensitivity of detection, cost and timeliness of obtaining results – microbial analysis is usually limited to testing for microorganisms that indicate recent faecal contamination, referred to as "faecal indicator organisms".

Although there is no ideal single faecal indicator organism, the bacterium *E. coli* is considered the most suitable indicator of faecal contamination in drinking-water supplies. Another acceptable (but less reliable) indicator of faecal contamination is thermotolerant coliforms, as in most circumstances, populations of thermotolerant coliforms are composed predominantly of *E. coli*. Total coliforms or heterotrophic bacteria are not a suitable measure of recent faecal contamination and have limited sanitary significance, although they are useful for other monitoring purposes (e.g. to confirm the integrity of distribution networks). Further information on *E. coli* as a faecal indicator and other microbial indicators can be found in sections 7.4 and 11.6 of the GDWQ *(6)*.

E. coli is most commonly measured by cultivating samples in specific growth media and incubating overnight. However, research to reduce the time required to quantify *E. coli* in water and to identify other, more rapid indicators of faecal contamination is ongoing. The suitability of alternative indicators should be considered in light of the criteria for faecal indicators listed in section 7.4 of the GDWQ.

As a complement to *E. coli* testing, certain parameters have implications for microbial water quality and are often included in regulations. These are turbidity and, if drinking-water is chlorinated, free chlorine residual concentration and pH. Table 3.1 presents the relationship between these parameters and microbial water quality. Ideally, these parameters should be measured wherever samples are tested for *E. coli*. Where resources are highly constrained, free chlorine residual monitoring should be prioritized (ideally combined with testing for turbidity and pH to confirm that conditions are optimal for effective chlorination) to provide an indication of microbial water quality between *E. coli* monitoring events.

The parameters shown in Table 3.1 can be considered a core set of priority parameters to be included in regulations in order to verify microbial safety. For each of the parameters included in Table 3.1, section 3.3.5 presents guideline (or target) values as well as recommended frequencies and locations for compliance monitoring programmes. While many of the parameters in Table 3.1 are also important for routine operational monitoring, the guidance in this chapter focuses on compliance monitoring. (See Box 3.3 for an explanation of the term compliance monitoring and how it differs from operational monitoring.)

Box 3.3 ▸ Compliance monitoring versus operational monitoring

Chapter 3 addresses **compliance monitoring**; that is, monitoring activity that is specified within regulations. Compliance monitoring should be routinely carried out by the surveillance agency and/or the water supplier to demonstrate compliance with regulations, including verifying that the drinking-water supplied to users is safe. Compliance monitoring is distinct from **operational monitoring**, which is carried out by the water supplier at various points along the water supply chain (e.g. raw water, filtered water) to ensure that control measures are operating as intended and to inform operational decisions (e.g. chemical dosing rates). Operational monitoring is a critical complement to compliance monitoring. Results from operational monitoring are generally for the water supplier's own use, whereas compliance monitoring results should be shared with the regulator. Operational monitoring is a key element of water safety planning and is further addressed in Chapter 4.

Sources: adapted from *Developing drinking-water quality regulations and standards (15)* and *Water safety plan manual (23)*.

Table 3.1 • Priority parameters related to microbial safety

Critical parameters related to microbial safety (all supplies)		
Parameter[a]	**Significance for microbial water quality**	**Occurrence in drinking-water**
E. coli (or alternatively thermotolerant coliforms)	*E. coli* is excreted in large numbers in the faeces of humans and other warm-blooded animals. While most strains are non-pathogenic, certain strains can cause acute diarrhoea. *E. coli* is an important indicator of the presence of recent faecal contamination and associated pathogens (see Box 3.2).	Higher *E. coli* concentrations are expected in surface water and shallower groundwater sources (including those under the influence of surface water). Lower concentrations are typically found in deeper groundwater sources that are protected.
Free chlorine residual (if chlorinated)	Free chlorine residual provides an indication of microbial safety in terms of the efficacy of disinfection. Maintaining a residual throughout storage and distribution provides some protection against low-level microbial recontamination and growth, including as a result of user practices.	Added as a water treatment chemical for disinfection purposes.
Turbidity	Turbidity is caused by suspended or dissolved organic and inorganic materials. Where water treatment is applied, turbidity provides an indication of the effectiveness of particle removal processes and/or of conditions for effective disinfection (as high turbidity can interfere with disinfection processes, including chlorination). It also provides an indication of changes in source water quality and distribution network integrity, which can indicate vulnerability to microbial contamination.[b] (Acceptability issues are discussed at the end of this section.)	Higher turbidity levels are expected in surface water and shallower groundwater sources (including those under the influence of surface water), and turbidity levels tend to fluctuate with rainfall and snowmelt (e.g. seasonally). Lower levels of turbidity are typically found in deeper groundwater sources that are protected.
pH (if chlorinated)	pH is an important parameter in determining chlorination efficacy.	pH is naturally influenced by source water characteristics (including geology), and may be optimized by the addition of treatment chemicals. Contact with certain materials (e.g. cement-based storage tanks and pipes) may alter the pH.

a See Tables 3.4 and 3.5 for guideline or target values.

b See *Water quality and health – review of turbidity (24)*.

Sources: adapted from WHO documents *Developing drinking-water quality regulations and standards (15)* and the GDWQ *(6)*.

▶ Chemical parameters

Priority chemicals are those for which there has been widespread exposure through drinking-water and for which there are concerns for health. These are arsenic, fluoride, lead, manganese and nitrate.

In contrast to the acute and immediate nature of waterborne disease from microbial hazards, the great majority of chemical contaminants in drinking-water only exert an effect after a long period of exposure (i.e. years) *(6)*.[4] Further, for most chemicals, there is no direct evidence that they have a significant impact on public health as a consequence of exposure through drinking-water. Therefore, most chemicals are a lower priority for monitoring in resource-limited settings, such as small water supplies. However, there are some chemicals that warrant special consideration for inclusion in regulations, where they are relevant. Arsenic, fluoride, lead, manganese and nitrate are the most important chemicals to consider in regulations due to confirmed or potential health effects and widespread exposure through drinking-water. See Table 3.2 for further information on these priority chemical parameters. For each of the parameters included in Table 3.2, section 3.3.5 presents guideline values as well as recommended compliance monitoring frequencies and locations.

Inclusion of a parameter in Table 3.2 does not indicate that the parameter is a high priority for regulatory inclusion everywhere. For example, arsenic and fluoride will not be relevant for all countries, regions or source waters. Regulatory inclusion of the chemical parameters listed in Table 3.2 should be based on findings from an assessment of occurrence in drinking-water supplies in the national (or subnational) context. Where there is evidence of non-occurrence or where detected levels are below concentrations of public health concern, reduced monitoring may be appropriate. See section 3.3.5 for guidance on adjusting monitoring frequencies for priority chemicals to reflect stable trends below concentrations of concern.

4 Exceptions may include large-scale accidental contamination of a drinking-water supply. However, the majority of these incidents would cause the water to be rejected by users owing to unacceptable taste, odour and appearance.

Table 3.2 • Priority chemical parameters

Priority chemicals (where applicable)[a]		
Parameter[b]	**Health significance[c]**	**Occurrence in drinking-water**
Arsenic	Arsenic can affect multiple body systems, with the first symptoms of long-term exposure to elevated levels in drinking-water usually observed in the skin (pigmentation changes and skin thickening on palms of hands and soles of feet). Long-term exposure to arsenic in drinking-water can cause various cancers in humans.	Widespread natural occurrence in deposits in the earth. Consequently, distribution in groundwater occurs in many places globally. May also occur from human activity, e.g. industry.
Fluoride	Elevated concentrations of fluoride, including in drinking-water, can cause adverse effects on teeth and bones, causing a skeletal malformation called skeletal fluorosis at very high concentrations.	Widespread natural occurrence in deposits in the earth. Consequently, distribution in groundwater occurs in many places globally. May also occur from human activity, e.g. industry.
Lead	Lead can affect multiple body systems, with infants and children particularly vulnerable to the neurological effects of lead.	Lead is found primarily as a consequence of the use of lead-containing materials in water supplies, including service pipes, plumbing in homes and other buildings, and components in borehole and well parts. The presence of lead in source waters is unusual but may occur as a result of human activity, e.g. mining, or as a result of natural occurrence.
Manganese	Elevated concentrations of manganese can cause neurological effects. Several epidemiological studies have identified an association between these effects and increased exposure through drinking-water, with infants and children considered to have a greater sensitivity to manganese toxicity than adults. Also gives rise to objectionable discolouration, including staining of laundry and fittings.	Naturally occurring in many surface water and groundwater sources as a result of soil and rock weathering (dissolving manganese-containing minerals). May be released from deposits under acidic or reducing conditions that are found in groundwater and in some lakes and reservoirs. Also occurs as a result of human activities, e.g. industry.

Table 3.2 continued • Priority chemical parameters

Priority chemicals (where applicable)[a]		
Parameter[b]	**Health significance[c]**	**Occurrence in drinking-water**
Nitrate	High nitrate and nitrite concentrations in drinking-water can give rise to blue-baby syndrome in bottle-fed infants, particularly where there is endemic diarrhoea in infants (e.g. from poor microbial quality of drinking-water).	Nitrate may be naturally occurring, although its presence in drinking-water is more often associated with agricultural activities (e.g. excessive use of fertilizers), or it may come from poorly sited and maintained latrines and septic tanks. Nitrate occurs widely throughout the world in both groundwater and surface water, and it presents a particular problem in shallow wells. Elevated concentrations of nitrite may occur in groundwater supplies under reducing conditions, or in piped supplies where there are high concentrations of free ammonia entering the distribution system (which can lead to nitrification). Nitrite is usually not present in significant concentrations except for these situations.

a A risk assessment should be conducted to determine if these parameters are likely to occur at concentrations of concern and, therefore, should be prioritized for compliance monitoring. This risk assessment should be revisited following any significant changes in circumstance that could affect the parameter's presence or concentration.

b See Tables 3.6 to 3.9 for guideline values.

c See the GDWQ *(6)* for more comprehensive information on health effects.

Sources: adapted from WHO documents *Developing drinking-water quality regulations and standards (15)* and the GDWQ *(6)*.

As resources permit, additional chemicals that have been prioritized through a risk assessment should be included in regulations. For instance, consideration could be given to other chemicals for which:

- there is widespread occurrence in water supplies; and
- there is a reasonable chance of consumers being exposed to the chemical at concentrations of concern; that is, above or close to the GDWQ guideline values.

▶ Acceptability parameters

Acceptability parameters should also be considered in regulations to help ensure that consumers do not reject the water and turn to potentially unsafe sources due to issues affecting taste, odour or appearance. Generally, acceptability parameters either have no direct health effects, or concentrations of health concern are significantly higher than those that affect acceptability. Therefore, it is not normally necessary to directly regulate or monitor such substances (e.g. iron), particularly where resources for monitoring are limited. Instead, these parameters can be addressed through a general regulatory requirement that the drinking-water supplied must be acceptable to most consumers. However, some acceptability parameters also have important implications for microbial and chemical water quality and should therefore be considered for regulatory (and operational) monitoring. For example, turbidity and (in chlorinated systems) pH have important implications for microbial water quality, as described in Table 3.1. For more information on acceptability parameters, see Chapter 10 of the GDWQ *(6)*.

3.3.4 Set protective and realistic parameter limits

For microbial water quality, the aim should always be to produce water in which *E. coli* is not detectable in a 100 mL sample. However, achieving this can often be a challenge for small water supplies, and risk categories (or grading schemes) can help to distinguish between lower- and higher-risk sites to support prioritization and resource allocation. This is further discussed in section 5.3.5.

Determining the appropriate numeric limits for the various chemical parameters included in regulations requires careful consideration in the context of small water supplies. In many cases, it will be appropriate to adopt the GDWQ guideline values as the limits for those parameters. In other cases, existing treatment methods (or lack thereof) may be incapable of sufficiently reducing concentrations to the GDWQ guideline values, or the cost of achieving a GDWQ guideline value may outweigh the likely health benefits in the local context. In such cases, alternative approaches may need to be considered to ensure that the limits set in regulations are both protective of health and realistic. There are various options available to regulatory authorities to protect public health while navigating practical limitations, including the following.

- **Establishing interim limits:** An interim (or transitional) limit can be set for a chemical parameter that is less stringent than the ultimate target (e.g. the GDWQ guideline value). This approach should involve setting a suitable time frame for improvements that will allow achievement of the more stringent limit in due course.
- **Specifying exceptions and exemptions:** Certain areas or types of supplies may be exempted from a particular component of the regulations. Exceptions and exemptions may be temporary, permanent or phased and may be granted on the basis of a lack of significance or insufficient resources to address a problem (e.g. resources to treat the water).

- **Allowing derogations:** Regulations may also allow case-specific derogations (or the time-bound relaxation of a regulatory requirement) to temporarily authorize a water supply to exceed a parameter limit where it may take time to implement remedial measures. Derogations can be considered where public health risks from exceedances are minor. They may also be important where there are no alternative water sources available. (Derogations are further discussed in section 5.3.8 in the context of surveillance findings that are non-compliant with regulations.)
- **Determining safe limits locally:** The assumptions made in deriving the GDWQ guideline values are generally conservative. Therefore, use of context-specific data may provide a scientific basis for regulatory authorities to establish parameter limits that are higher than the GDWQ guideline value. Alternatively, a local risk assessment can be undertaken to determine safe limits.

For guidance on how to establish locally determined safe limits, and for examples of how these regulatory approaches (interim limits, exemptions, derogations and locally determined safe limits) have been applied in various countries, refer to *Developing drinking-water quality regulations and standards (15)*. See also Case A3.17 for a country example of interim regulatory limits applied to account for treatment capacity limitations among small water suppliers. Where less stringent regulatory measures are temporarily applied (e.g. an interim measure or a derogation), they should be periodically reviewed and revised with a view to progressively building capacities so that the measure is no longer needed.

Where it is considered a priority to monitor radionuclides in drinking-water (e.g. where there are high levels of natural radionuclides in the underlying rocks and soil of groundwater supplies), the options for setting limits relating to chemical parameters may be considered. A screening approach for monitoring radionuclides should be applied as a first step, as described in the GDWQ *(6)*. The screening values (and guidance levels for specific radionuclides) can be adapted to the national context. See Box 9.3 in the GDWQ and section 1.5.10 in *Management of radioactivity in drinking-water (25)* for further guidance on adapting WHO radionuclide-related values.

3.3.5 Establish monitoring frequencies and locations

The first part of this section presents guiding principles to be considered when developing context-appropriate programmes for compliance monitoring (as defined in Box 3.3) for small drinking-water supplies. In the second part of this section, specific recommendations for minimum monitoring frequencies and locations are presented in Tables 3.4 to 3.9.

▶ Guiding principles

Regulations should specify water quality testing frequencies and locations for all parameters that have been prioritized for compliance monitoring based on risk. Monitoring has human and financial resource implications that must be considered, and requirements need to be balanced with other initiatives that ensure drinking-water safety, such as water safety planning (see Chapter 4).

Deviations from national or subnational monitoring requirements should be permitted as appropriate on the basis of local risk assessments. Monitoring requirements should also reflect due consideration of target users of the monitoring information and their specific data needs to help ensure that all data collected are used effectively. (See Chapter 6 for guidance on improving the use of information on small water supplies.) Monitoring requirements can be progressively increased as needed and as resources permit through periodic review and revision of regulations.

Appropriate compliance monitoring frequencies and locations will vary by parameter according to conditions summarized in Table 3.3. These technical conditions should be considered alongside logistical considerations (e.g. site accessibility and sample holding times) and the availability of trained personnel, transport, testing equipment and facilities, and funds to undertake monitoring and associated activities (e.g. equipment maintenance, quality assurance and quality control). It is also important to consider which entity will be responsible for conducting the monitoring when establishing requirements. Where compliance monitoring is primarily carried out by the water supplier (who in turn reports findings to the regulator), for example for professionally managed piped supplies, more frequent monitoring may be feasible. Where compliance monitoring is undertaken solely by the surveillance agency, for example for some basic community managed supplies or household managed supplies, less frequent monitoring requirements may be necessary due to feasibility considerations. Water quality monitoring should be carried out in conjunction with SIs to better assess the overall safety of a drinking-water supply. Where water quality testing cannot be performed, SIs can still provide valuable information to assess the safety of the drinking-water supply and support safe management (see Chapter 5).

Table 3.3 • Considerations for determining compliance monitoring frequencies and locations

How often to monitor?	
What is the size of the population served?	Water supplies serving more consumers may warrant more frequent monitoring due to the potential for exposing larger populations to unsafe water.
Is the parameter likely to be present at concentrations of concern?	The frequency of monitoring should reflect the risk that a parameter will be present at a concentration of concern. Where a local risk assessment indicates that a parameter (prioritized for monitoring at a national or subnational level) is not expected to be present at a concentration of concern, only very occasional monitoring may be needed, and possibly no monitoring at all once successive sampling events have validated the low likelihood of occurrence.
How stable is the parameter?	Water quality parameters that can change rapidly should be tested at greater frequency than parameters that are more stable. For example, microbial indicators and chemical disinfectants (e.g. chlorine) should be tested more frequently than inorganic chemicals found in groundwater, such as arsenic or fluoride.
Are there seasonal variations?	The timing and frequency of monitoring should account for seasonal variations (including as a result of changes in climate), particularly for surface water and groundwater under the influence of surface water. For example, turbidity and microbial loading may be greater during the rainy season or periods of snowmelt, and nitrate concentrations may be higher during the season(s) of fertilizer application. Monitoring should be carried out when parameters are most likely to be present at concentrations of concern.

Table 3.3 continued • Considerations for determining compliance monitoring frequencies and locations

Where to monitor?	
Where is the parameter introduced and is it likely to change within the water supply?	When defining sampling locations, it is important to consider the point at which the parameter is likely to be introduced to the water supply, as well as the likelihood that its concentration or properties will change downstream. For example, in treated piped water supplies, arsenic may be sampled at the point of exit from the water treatment plant. Monitoring downstream of this point is unnecessary given that arsenic is introduced at the source and concentrations should not change following treatment. Conversely, compliance monitoring of free chlorine residual should be conducted at the point of delivery and/or point of use in piped supplies, given that the concentration of chlorine will decrease during distribution, transport and storage.
Where should sampling points be established?	For piped supplies, sampling locations should provide an indication of water quality across the pipe network while also allowing comparison of water quality over time at select points. The use of designated sampling locations will allow comparison over time and can help ensure easy and reliable access to sampling sites. Representative sampling points should be established throughout the network and visited on a rotational basis as needed for optimal network coverage. Provision can be made for high-priority locations to be visited during each sampling event. Random sampling locations can be visited in addition to designated locations. For non-piped supplies, samples should be taken from the point of collection and/or point of use, if different. (See guidance related to user practices below.)
Where are the known areas for water quality issues?	Areas prone to water quality issues should also be prioritized. For example, within piped supplies, samples should be collected from distal points of the pipe network and/or areas with low or intermittent flow, poor pipe condition or pressure problems.
Where are the vulnerable populations?	Samples should be collected from areas serving more vulnerable populations, e.g. schools, health care or aged care facilities, and populations with lower socioeconomic characteristics, including informal settlement areas.
Are user practices likely to introduce contamination?	Water quality degradation between the point of collection (or point of delivery) and the point of use should be considered, including through transport, handling, household treatment and storage. For this reason, regulations may stipulate sampling from the point of collection and at the point of use. However, where resources are limited and the degradation from user practices is well established, regulations may take a pragmatic approach and stipulate sampling from the point of collection only. It is important to encourage safe handling, storage and treatment practices by households, including through the application of SIs.

Source: adapted from *Developing drinking-water quality regulations and standards* (15).

For further guidance on monitoring frequencies and locations, refer to *Developing drinking-water quality regulations and standards* *(15)* and *Water safety in distribution systems* *(26)*.

See Cases A3.18 and A3.19 for country examples of monitoring requirements that vary according to population served by the water supply, or that can vary according to findings from local risk assessments, respectively.

▶ Minimum recommendations for compliance monitoring

Tables 3.4 to 3.9 present key considerations and minimum monitoring recommendations.[5] This guidance should be considered by those responsible for establishing requirements for compliance monitoring within drinking-water regulations and standards. In addition to the compliance monitoring requirements that are stipulated in regulations, operational monitoring should be carried out by water suppliers, generally at greater frequencies than those indicated in Tables 3.4 to 3.9. (Chapter 4 addresses operational monitoring by water suppliers as part of water safety planning.)

The guidance in Tables 3.4 to 3.9 is presented according to management model (i.e. household managed, community managed or professionally managed), technology type (i.e. piped or non-piped supplies, and with or without water treatment), and other key considerations such as management capacity and source water type. A general characterization of these management models is presented in section 1.2, along with guidance on determining the most appropriate classifications for special circumstances (e.g. water supplies serving vulnerable groups such as schools and health care facilities, as well as vended water). See Box 3.4 for additional considerations related to the monitoring guidance in Tables 3.4 to 3.9.

5 The recommendations in Tables 3.4 to 3.9 draw on the guiding principles presented in the first part of section 3.3.5 and the guidance in section 3.3.3. The recommendations are based on guidance in the GDWQ *(6)*, *Surveillance and control of community supplies* *(8)* and *Developing drinking-water quality regulations and standards* *(15)*, as well as extensive expert and practitioner inputs (see Annex 1).

Box 3.4 ▸ Considerations related to the monitoring guidance in Tables 3.4 to 3.9

For **household managed supplies**, the primary purpose of compliance monitoring will generally be to inform policy and programming (including prioritizing corrective action), rather than for regulatory enforcement of standards for individual household supplies. As regular visits to each individual supply will likely be impractical, testing may be carried out on a rotational basis. Testing should be conducted in sufficient numbers to establish trends (including seasonal variability) that will inform decision-making. Supplies to be visited can be prioritized based on a risk assessment and/or be statistically selected. The outcomes from this activity can also be used to identify supply types that are more likely to be contaminated to inform targeted monitoring. Where national drinking-water quality household surveys are conducted (e.g. as part of Multiple Indicator Cluster Surveys), monitoring data from this activity can also inform policy and programming (see Chapter 2).

Recognizing the broad spectrum of **community and professionally managed supplies** that exist, a monitoring frequency range is provided in Tables 3.4 to 3.9. For supplies with lower management capacity and resources, the lower frequency should be considered. For supplies with higher capacity and resources, more frequent monitoring should be considered. If resources do not allow testing at the recommended frequency, sites should be visited on a rotational basis in sufficient numbers to establish trends and inform planning and programming, e.g. every 3–5 years at a minimum when there are significant numbers of community managed pointed sources.

Where resources are particularly limited for chemical water quality monitoring, consideration may be given to applying a cross-sectional survey approach to inform decision-making. In such cases, due consideration should be given to a parameter's likely variability in water sources, which can result in contaminant levels differing significantly between closely located water points (e.g. as can be the case for arsenic).

Table 3.4 • *E. coli* monitoring: considerations, locations and minimum frequencies according to water supply type

E. coli (or alternatively, thermotolerant coliforms)		
Guideline value	Not detectable in any 100 mL sample (see section 7.4 of the GDWQ *(6)*)	
Guideline value considerations	Consider an appropriate grading scheme for non-complying water quality test results which links to prioritizing action for progressive improvement. See section 5.3.5 for guidance.	
Minimum monitoring frequency[a]		
Household managed	**Community managed**	**Professionally managed**
Once initially.[b] Thereafter, periodically at a suitable frequency.	*Less management capacity*: 1–2 times per year, capturing seasonal variability. *More management capacity:* once per month to once per 3 months.	Once per month.
Frequency considerations		
E. coli should be routinely monitored in all water supplies if possible. If microbial testing cannot be carried out at the recommended frequency, consider testing on a rotational basis in line with guidance in Box 3.4. Also, see Table 3.5 for guidance on complementary monitoring strategies to provide an indication of water quality between microbial monitoring events. More frequent monitoring of surface water and shallow groundwater sources (including those under the influence of surface water) may be required as compared to deeper groundwater sources, given their greater vulnerability to microbial contamination, e.g. from surface run-off following rain. More frequent monitoring is also required in situations such as known or suspected outbreaks of waterborne disease, extreme weather events and natural disasters.		
Minimum sample number (per sampling event)		
Household managed	**Community managed**	**Professionally managed**
One sample from the monitoring location indicated.	*For non-piped supplies:* one sample from the monitoring location indicated. *For piped supplies:* see professionally managed.	*<5000 population:* one sample from the monitoring locations indicated. *>5000 population:* one sample per 5000 population from the monitoring locations indicated.

Table 3.4 continued • *E. coli* monitoring: considerations, locations and minimum frequencies according to water supply type

***E. coli* (or alternatively, thermotolerant coliforms)**		
Monitoring locations[c]		
Household managed	**Community managed**	**Professionally managed**
Point of collection.	*For non-piped supplies:* point of collection. *For piped supplies:* see professionally managed.	Point(s) of delivery,[d] which may include: – consumer water meters or taps – tapstands – water kiosks – water carters. Additional locations may include: – point of exit from treatment plant or entry point to the distribution network (e.g. if water treatment is not in place); – point of exit from network water storages; and – other accessible points throughout the distribution network for representation throughout the network.
Monitoring location considerations		
Point of collection refers to the outlet of the abstraction device (e.g. outlet of a hand pump or a user tap where a private well is piped to premises). Consider designated monitoring locations that account for denser population zones, vulnerable populations (e.g. schools, health care facilities, informal settlement areas) and known higher-risk zones (e.g. extremities and low-use areas of the network). For piped supplies, sampling from designated monitoring locations may be conducted on a rotational basis for optimal network coverage. Flexibility may be needed to accommodate scenarios in which multiple water sources are used seasonally (e.g. changes between piped and non-piped sources of water used at different times of the year).		

a See Box 3.4 for more guidance on monitoring frequencies, including guidance related to the range of monitoring frequencies presented, and on testing sites on a rotational basis as needed.

b Once initially may include monitoring before commissioning of new supplies, or an initial sample for supplies that are already in operation but were not tested before commissioning.

c If the point of use is different from the point of collection (or point of delivery), see Table 3.3 for considerations related to additional sampling at the point of use (to understand the impact of user practices).

d Where there are multiple points of delivery within the one system, these should be tested on a rotational basis.

Table 3.5 • Turbidity, free chlorine residual and pH monitoring: considerations, locations and minimum frequencies according to water supply type

Turbidity **Free chlorine residual and pH (if chlorinated)**	
Target values	**Turbidity:** <1 NTU (nephelometric turbidity unit) for effective disinfection[a] (see section 10.2 of the GDWQ *(6)*) **Free chlorine residual**: ≥0.2 mg/L (see section 7.3.2 of the GDWQ) **pH:** 6.5–8.5 (noting that the optimum pH varies depending on the context; see section 10.2 of the GDWQ)
Target value considerations	**Turbidity:** High turbidity in drinking-water can harbour microbial pathogens and reduce the efficacy of disinfection (e.g. chlorination, ultraviolet light disinfection). From a health perspective, if <1 NTU for effective disinfection is not achievable, the aim should be to keep turbidity below 5 NTU. In these cases, higher disinfection doses and/or contact times will be required to ensure that adequate disinfection is achieved. Above 5 NTU, disinfection should still be practised. Consider the aesthetic impact in addition to the health impacts. Turbidity levels >4 NTU can be visible (i.e. give a cloudy appearance to the water), which may result in user rejection of the drinking-water for aesthetic reasons. Users may then search for more acceptable but potentially less safe water. For more information, see *Water quality and health – review of turbidity (24)*. **Free chlorine residual:** To ensure effective disinfection, sufficient contact time between free chlorine and the drinking-water must be ensured (e.g. 0.5 mg/L for at least 30 minutes at pH less than 8). Other factors also impact chlorine effectiveness, including turbidity and water temperature. Contact times and/or disinfection doses should be adjusted as necessary to ensure adequate disinfection. Before disinfection, it is important to remove as much organic matter as possible (including keeping turbidities <1 NTU). This will not only improve disinfection efficacy (e.g. lower doses and/or contact times will be required), but also minimize formation of disinfection by-products. To provide a degree of protection against low levels of microbial contamination during distribution and storage, including as a result of user practices, a minimum free chlorine residual of 0.2 mg/L is recommended at the point of delivery for piped supplies with household connections, or at the point of use for non-piped supplies.[b] User acceptability should also be considered when determining the optimal free chlorine residual concentration. For points of delivery that require transportation by water users (e.g. tapstand or water kiosk), the free chlorine residual concentration should be higher (e.g. at least 0.5 mg/L) at the delivery point to allow for chlorine decay during user transport, and subsequent storage and handling at the household level. User acceptability should also be considered when determining the optimal free chlorine residual concentration. **pH:** For effective chlorination, the pH of drinking-water should be less than 8. However, to balance other considerations, including corrosion control, the optimum pH for a water supply is generally considered to be between pH 6.5 and 8.5.

Table 3.5 continued • Turbidity, free chlorine residual and pH monitoring: considerations, locations and minimum frequencies according to water supply type

Turbidity
Free chlorine residual and pH (if chlorinated)

Minimum monitoring frequency

As per *E. coli* (see Table 3.4).

Frequency considerations

Testing of turbidity and, where chlorination is practised, free chlorine residual and pH should be conducted in parallel to microbial testing.

For chlorinated systems where microbial testing cannot be carried out at the recommended frequency, free chlorine residual testing should still be carried out (ideally combined with testing for turbidity and pH to understand if conditions are optimal for effective chlorination) to provide an indication of water quality between microbial monitoring events.

More frequent monitoring may be required as the situation demands (e.g. following an outbreak of waterborne disease or extreme weather events).

Minimum sample number (per sampling event)

As per *E. coli* (see Table 3.4).

Monitoring locations

As per *E. coli* (see Table 3.4).

[a] For optimal disinfection, larger, well run, higher-capacity water supplies with filtration should aim to achieve turbidities of <0.5 NTU at all times, with average turbidities of ≤0.2 NTU.

[b] During outbreaks of waterborne disease, or when faecal contamination of a drinking-water supply is detected, the concentration of free chlorine should be increased to at least 0.5 mg/L throughout the system as a minimum immediate response.

Table 3.6 • **Arsenic and fluoride monitoring: considerations, locations and minimum frequencies according to water supply type**

Arsenic and fluoride (where prioritized)[a]		
Guideline values	**Arsenic:** 0.01 mg/L (provisional; see Chapter 12 of the GDWQ *(6)*) **Fluoride:** 1.5 mg/L (see Chapter 12 of the GDWQ)	
Guideline value considerations	The guideline value for arsenic is provisional, and is based on the difficulties with removing arsenic to lower levels using conventional water treatment.	
Minimum monitoring frequency		
Household managed	**Community managed[b]**	**Professionally managed[b]**
Once initially.[c] Thereafter as the situation demands (see frequency considerations).	1–2 times per year, capturing seasonal variability. After a stable 3-year trend has been established that is consistently below the guideline value, this can be reduced, and should be increased as the situation demands (see frequency considerations).	2–4 times per year, capturing seasonal variability. After a stable 3-year trend has been established that is consistently below the guideline value, this can be reduced, and should be increased as the situation demands (see frequency considerations).
Frequency considerations		
If elevated levels of arsenic or fluoride are detected, more frequent monitoring may be required. Situations that may demand more frequent monitoring include the presence of polluting activities (e.g. mining or industry), changes in catchment land use and changes in environmental conditions. More frequent monitoring of groundwater may be required compared to surface water, as groundwater sources are typically more vulnerable to arsenic and fluoride contamination. Shallower bores may be prone to greater variation than deeper bores. If possible, sampling events should alternate between the wet and dry seasons to capture seasonal variability.		
Minimum sample number (per sampling event)		
Household managed	**Community managed**	**Professionally managed**
One sample from the monitoring location indicated.	One sample from the monitoring locations indicated.	

Table 3.6 continued • Arsenic and fluoride monitoring: considerations, locations and minimum frequencies according to water supply type

Arsenic and fluoride (where prioritized)[a]

Monitoring locations

Household managed	Community managed	Professionally managed
Point of collection.	*No water treatment plant:* point of collection. *With water treatment plant*: point of exit from treatment plant.	

Monitoring location considerations

Point of collection refers to the outlet of the abstraction device (e.g. outlet of hand pump or a user tap where a private well is piped to premises).

a A risk assessment should be conducted to determine if this parameter is likely to occur at concentrations of concern and, therefore, should be prioritized for compliance monitoring (see Table 3.2). Geostatistical modelling can help identify potential areas of concern (for example, see https://www.gapmaps.info), although it is not a substitute for water quality testing.

b See Box 3.4 for more guidance on monitoring frequencies, including guidance related to the range of monitoring frequencies presented, and on testing sites on a rotational basis as needed.

c Once initially may include monitoring before commissioning of new supplies, or an initial sample for supplies that are already in operation but were not tested before commissioning.

Table 3.7 • Lead monitoring: considerations, locations and minimum frequencies according to water supply type

Lead (where prioritized)[a]		
Guideline value	0.01 mg/L (provisional; see Chapter 12 of the GDWQ *(6)*)	
Guideline value considerations	The guideline value for lead is provisional, and is based on the difficulty of removing lead to lower levels using conventional water treatment when lead-containing materials are in contact with drinking-water.[b]	
Minimum monitoring frequency		
Household managed	**Community managed**[c]	**Professionally managed**[c]
Once initially.[d] Thereafter as the situation demands (see frequency considerations).	*For non-piped supplies:* once every 2–3 years. *For piped supplies:* 1–2 times per year from the monitoring locations indicated.	Once per month to once per year from the monitoring locations indicated.
Frequency considerations		
If elevated levels of lead are detected, more frequent monitoring may be required. Situations that may demand more frequent monitoring include the presence of polluting activities (e.g. mining or industry); changes in catchment land use; changes in water quality characteristics that may affect lead release or corrosion (e.g. related to pH; presence of iron or manganese oxides, which may be evidenced by discolouration of the water); and changes in water abstraction or plumbing materials/fittings. For piped supplies, additional lead monitoring should ideally be conducted after events that may affect lead release in the distribution network, including changes in water treatment processes and water sources. When elevated lead is detected in drinking-water, a systematic investigation including additional sampling and analysis is usually needed to better understand exposure (including whether other properties or hand pumps are affected) and the contamination source, and to inform corrective actions. This could include taking a flushed sample from the tap or hand pump outlet where the elevated lead concentration was detected to better understand exposure from that site and to guide prioritization for more resource-intensive corrective action.		
Minimum sample number (per sampling event)		
Household managed	**Community managed**	**Professionally managed**
One to two samples from the monitoring locations indicated.		

Table 3.7 continued • Lead monitoring: considerations, locations and minimum frequencies according to water supply type

Lead (where prioritized)[a]

Sample number considerations

The sampling protocol to adopt, including sampling numbers (e.g. first draw requires one sample; random daytime sampling requires one sample; 30 minutes stagnation requires two samples) should depend on regulatory requirements and the objective of the analysis, recognizing that lead concentrations in water can be influenced by the sampling protocol.

Monitoring locations

Household managed	Community managed	Professionally managed
Point of collection.	*For non-piped supplies:* point of collection. *For piped supplies:* point of delivery (e.g. tapstand, kiosk, consumer tap).[e]	

Monitoring location considerations

Point of collection refers to the outlet of the abstraction device (e.g. outlet of hand pump or a user tap where a private well is piped to premises).

Consideration should be given to facilities serving vulnerable groups (childcare centres, schools, etc.) or areas/supply types suspected of being at greatest risk of contamination (e.g. premises with lead service pipes or in low-use areas). More extensive areas or systems may need to be subdivided into zones for sampling purposes (e.g. divided based on geography, supply type or water quality).

As lead concentrations in drinking-water can vary significantly, the sampling protocol to adopt should depend on regulatory requirements and objectives of the analysis.

a A risk assessment should be conducted to determine if this parameter is likely to occur at concentrations of concern and, therefore, should be prioritized for compliance monitoring (see Table 3.2).

b In water supplies where lead does not originate from the source water, the most effective means of controlling lead levels is through the use of certified lead-free or low-lead materials and the proper installation of parts for new construction and repairs. Standards limiting the amount of lead that is permitted in products and materials used in drinking-water supplies should be included in regulations (see section 3.3.9), and water quality monitoring should be carried out to verify that compliant materials are being used. Where lead-containing materials have already been installed, the principal remedy is the removal of these materials. Given this takes time and resources, other practical measures to reduce lead concentrations in drinking-water should be implemented in the interim, including the use of corrosion inhibitors, flushing and point-of-use water treatment. For more information on developing monitoring strategies and corrective actions, see *Lead in drinking-water: health risks, monitoring and corrective actions* (27).

c See Box 3.4 for more guidance on monitoring frequencies, including guidance related to the range of monitoring frequencies presented, and on testing sites on a rotational basis as needed.

d Once initially may include monitoring before commissioning of new supplies, or an initial sample for supplies that are already in operation but were not tested before commissioning.

e Where there are multiple points of delivery within the one system, these should be inspected on a rotational basis.

Table 3.8 • Manganese monitoring: considerations, locations and minimum frequencies according to water supply type

Manganese (where prioritized)[a]	
Guideline value	0.08 mg/L (provisional; see Chapter 12 of the GDWQ *(6)*)
Guideline value considerations	The guideline value for manganese is provisional because of the use of a high composite uncertainty factor (i.e. 1000) to calculate the guideline value. When manganese levels are approaching or exceed the guideline value, see Chapter 12 of the GDWQ for guidance on actions to consider. Consider the aesthetic impact in addition to the health impacts. Concentrations >0.02 mg/L can cause discoloured water and staining of plumbing fixtures and laundry. Where manganese treatment is in place, aesthetic issues may indicate that treatment is not optimized or that the distribution system is not appropriately managed.

Minimum monitoring frequency

Household managed	Community managed[b]	Professionally managed[b]
Once initially.[c] Thereafter as the situation demands (see frequency considerations).	1–2 times per year, capturing seasonal variability. After a stable 3-year trend has been established that is consistently below the guideline value, this can be reduced, and should be increased as the situation demands (see frequency considerations).	2–4 times per year, capturing seasonal variability. After a stable 3-year trend has been established that is consistently below the guideline value, this can be reduced, and should be increased as the situation demands (see frequency considerations).

Frequency considerations

If elevated levels of manganese are detected, more frequent monitoring may be required.

Situations that may demand more frequent monitoring include the presence of polluting activities (e.g. mining or industry), changes in catchment land use, discolouration of water, and reports of staining or release of deposits.

Surface water (or groundwater under the influence of surface water) may need to be monitored more frequently than deeper groundwater sources because surface water is typically more prone to high and variable concentrations of manganese. In general, manganese concentrations are stable between seasons in groundwater but may vary between wells near to each other.

For surface water and shallow groundwater sources, sampling events should ideally alternate between the wet and dry seasons to capture seasonal variability.

Table 3.8 continued • **Manganese monitoring: considerations, locations and minimum frequencies according to water supply type**

Manganese (where prioritized)[a]		
Minimum sample number (per sampling event)		
Household managed	**Community managed**	**Professionally managed**
One sample from the monitoring location indicated.	One sample from the monitoring locations indicated.	
Monitoring locations		
Household managed	**Community managed**	**Professionally managed**
Point of collection.	*No water treatment plant:* point of collection. *With water treatment plant:* point of exit from the treatment plant.	
Monitoring location considerations		
Point of collection refers to the outlet of the abstraction device (e.g. outlet of a hand pump or a user tap where a private well is piped to premises). For piped supplies where there are dirty water problems, this could indicate that treatment for manganese removal is not optimized or that the distribution system is not appropriately managed. Where resources permit, monitoring within the distribution network and point of delivery (e.g. tapstand, consumer tap) may also be considered since manganese can accumulate within the distribution system and be released at the point of collection (which may not always result in dirty water problems).		

a A risk assessment should be conducted to determine if this parameter is likely to occur at concentrations of concern and, therefore, should be prioritized for compliance monitoring (see Table 3.2).

b See Box 3.4 for more guidance on monitoring frequencies, including guidance related to the range of monitoring frequencies presented, and on testing sites on a rotational basis as needed.

c Once initially may include monitoring before commissioning of new supplies, or an initial sample for supplies that are already in operation but were not tested before commissioning.

Table 3.9 • Nitrate monitoring: considerations, locations and minimum frequencies according to water supply type

Nitrate (where prioritized)[a]		
Guideline value	50 mg/L as nitrate ion (NO_3^-; see Chapter 12 of the GDWQ *(6)*)	
Guideline value considerations	When nitrate levels are approaching or exceed the guideline value, see Chapter 12 of the GDWQ for guidance on actions to consider.[b]	
Minimum monitoring frequency		
Household managed	Community managed[c]	Professionally managed[c]
Once initially.[d] Thereafter as the situation demands (see frequency considerations).	1–2 times per year, capturing seasonal variability. After a stable 3-year trend has been established that is consistently below the guideline value, this can be reduced, and should be increased as the situation demands (see frequency considerations).	2–4 times per year, capturing seasonal variability. After a stable 3-year trend has been established that is consistently below the guideline value, this can be reduced, and should be increased as the situation demands (see frequency considerations).
Frequency considerations		
If elevated levels of nitrate are detected, more frequent monitoring may be required. Situations that may warrant more frequent monitoring include the presence of polluting activities (e.g. agriculture, human settlement and waste management, including in the event of known failures), changes in catchment land use, drought and over-abstraction locally. Monitoring programmes should consider both groundwater and surface water sources. In particular, shallow wells located in agricultural areas or near sanitation facilities may require more frequent monitoring. More frequent monitoring of surface water supplies where elevated levels of nitrate are detected may also be required, since nitrate levels in surface water can change quickly. Piped supplies in areas where there are higher levels of naturally occurring ammonia may also require more frequent monitoring. In contrast, nitrate levels in groundwater not heavily influenced by surface water usually change very slowly, so less frequent monitoring of these supplies may be required. Seasonal variability in relation to human activities should be captured (e.g. monitoring at times of the year when fertilizer application is known to occur).		

Table 3.9 continued • **Nitrate monitoring: considerations, locations and minimum frequencies according to water supply type**

Nitrate (where prioritized)[a]		
Minimum sample number (per sampling event)		
Household managed	**Community managed**	**Professionally managed**
One sample from the monitoring location indicated.	One sample from the monitoring locations indicated.	
Monitoring locations		
Household managed	**Community managed**	**Professionally managed**
Point of collection.	*No water treatment plant:* point of collection. *With water treatment plant:* point of exit from the treatment plant.	
Monitoring location considerations		
Point of collection refers to the outlet of the abstraction device (e.g. outlet of a hand pump or a user tap where a private well is piped to premises).		

a A risk assessment should be conducted to determine if this parameter is likely to occur at concentrations of concern and, therefore, should be prioritized for compliance monitoring (see Table 3.2).

b Where nitrite is deemed to be a concern (see Table 3.2), the combined nitrate/nitrite guideline value should be considered (see the GDWQ *(6)*).

c See Box 3.4 for more guidance on monitoring frequencies, including guidance related to the range of monitoring frequencies presented, and on testing sites on a rotational basis as needed.

d Once initially may include monitoring before commissioning of new supplies, or an initial sample for supplies that are already in operation but were not tested before commissioning.

3.3.6 Specify analytical requirements (including for field test kits)

To ensure the accuracy of water quality monitoring results, regulations should specify analytical requirements. These may include testing methods, sampling methods, requirements for laboratory certification or accreditation, quality assurance and quality control procedures, and required training and skills of analysts and sample collectors. For general guidance on analytical requirements to consider for regulations, refer to *Developing drinking-water quality regulations and standards (15)*.

It is important to consider field testing when specifying analytical requirements. Some parameters must be tested in the field immediately upon collection due to their instability (e.g. pH and free chlorine residual). For other parameters, including *E. coli*, it may not always be feasible to transport samples from remote locations to centralized laboratories for analysis within allowable time frames or to maintain samples at the required temperature during transport. In such cases, field test kits offer an alternative to analysis in formal laboratory settings, and they allow those carrying out the testing (e.g. surveillance staff) to share and discuss results with water suppliers during site visits (see section 5.3.6). Field test kits also often have the advantages of being simpler to use and less expensive compared to testing in a laboratory, which are important considerations for small water suppliers. Many types of low-cost, easy-to-use field test kits are available to measure the priority parameters recommended in section 3.3.3. When properly validated and used, field test kits can be an important tool for reliable, comparatively rapid and cost-effective water quality testing *(6, 28)*.

Regulations should allow the use of field test kits that have been validated for performance against reference or standard methods, especially where laboratory testing is considered infeasible. Where capacity to validate the performance of field test kits against national reference laboratories is lacking, authorities can refer to findings from independent assessments of field test kit performance, including assessments undertaken by WHO against a certified reference method.[6] Quality assurance procedures are important, as is regular calibration of field test kits (where relevant). Ongoing training and refresher programmes are also needed to ensure that staff remain competent in using the equipment. Sufficient resources and robust systems for the timely resupply of consumables are also needed. As access to centralized laboratories from remote settings is expanded over time, regulations can progressively encourage formal laboratory testing for maximum accuracy, for example for chemical parameters that exhibit field stability.

6 For information on WHO's evaluation of portable testing kits, see https://washdata.org/monitoring/drinking-water/portable-testing-kits (accessed 28 September 2023).

Refer to *A guide to selecting water quality field test kits (28)* for more information on field test kits, including different types of field test kits, use cases and priority selection criteria.

See Cases A3.20 and A3.21 for country examples of drinking-water quality guidelines and standards that allow the use of field test kits; and see Case A3.22 for an example of regulatory guidance on field test kit use tailored to the skill sets of small water supply operators.

3.3.7 Establish reporting requirements and incident protocols

Regulations should establish what, when, how and between whom information should be shared during normal operations. Clear regulatory requirements for data sharing and reporting will help ensure that information collected is routinely examined by relevant authorities to assess trends and inform decision-making. Additionally, data should be shared with water users, who have a right to information about their water supplies. Public reporting will help to create transparency and may incentivize improvement action. Regulations may specify the format for data sharing to different stakeholders to ensure data are presented in forms that are accessible and useful to the target audiences.

Regulations should also establish incident response and reporting protocols to protect public health in the event of a water quality parameter exceedance or other incident. Regulations should require that water suppliers take prompt action to manage risks to consumers; specify the agency or agencies to whom the water supplier should report the incident; and establish time frames for such reporting that reflect the urgency of the necessary incident response. The lead agency or agencies responsible for coordinating the response and associated communication should be specified. For example, the decision to issue a boil water notice should be made by the health authority, or by the regulatory agency (if different) in consultation with the health authority. Communication strategies should be developed in consultation with the water supplier for timely and inclusive dissemination of information to users when needed, with due consideration of communication limitations that may apply in remote settings. (See section 5.3.8 for further guidance on rapid communication with water users.)

Developing drinking-water quality regulations and standards (15) provides more guidance on reporting requirements and incident protocols, and section 5.3.8 provides further guidance on steps to take when a parameter limit is exceeded. Also, Chapter 6 provides more guidance on data reporting and use to support decision-making and improvement action.

See Case A3.23 for a country example of regulatory requirements for data sharing in the context of small water supplies.

3.3.8 Define a risk-based surveillance programme

Regulations should establish drinking-water quality surveillance requirements that consider water safety along the whole drinking-water supply chain, from the catchment to the consumer. Surveillance includes verification of proactive risk management practice by water suppliers through WSP auditing and/or through SIs, direct testing of water quality and reviewing the results of compliance monitoring conducted by water suppliers. Surveillance programmes should reflect risk-based decisions on applying limited resources to achieve the greatest public health gains from surveillance activities. Requirements for surveillance data reporting should also be addressed in regulations (see section 3.3.7). Surveillance is covered in detail in Chapter 5, including capacity development and other support that surveillance staff need to fulfil their duties. The information in Chapter 5 will support decisions in defining a risk-based surveillance programme that reflects available resources and drives continuous improvement.

See Chapter 5 for more guidance on surveillance.

Regulations (and/or associated legislation) should define the powers and responsibilities of the surveillance agency, which should be separate from the water supplier to ensure independent oversight. If the surveillance agency has limited capacity or resources to carry out surveillance activities, it should be able to delegate powers to approved entities and appoint qualified persons to act on its behalf (e.g. to carry out water quality testing services or WSP auditing). Regulations and supporting guidelines can specify skill sets and responsibilities for WSP auditors and establish an approval mechanism for their appointment. The surveillance agency's remit should cover the full range of regulated small water supplies. Where resources permit, the surveillance agency should also provide support for water supplies that are exempt from regulatory requirements, including household supplies (see Box 3.1). The surveillance agency should ideally have the authority to enforce regulatory requirements related to drinking-water quality and safety. Where the power to enforce drinking-water regulations lies with another body (e.g. a separate regulatory body), clear institutional arrangements should be defined to facilitate timely action by the enforcement authority based on surveillance findings. (See Chapter 2 regarding considerations related to governance instruments and structures, including policies, legal and regulatory frameworks, and institutional arrangements.)

See Case A3.24 for a country example of governance instruments that set out surveillance roles and responsibilities.

3.3.9 Establish suitable additional regulations

For small water supplies to provide safe services that are protective of health, they should adhere to other relevant regulations and associated frameworks (e.g. technical standards and codes of practice), which may be referenced in drinking-water quality regulations. Such technical regulations may include, but are not limited to, specified treatment technology targets, operator training and skills, material safety standards and construction standards. Performance targets for HWT may also be considered. These topics are briefly discussed in this section. In establishing such requirements, particularly for small water supplies, it is important to consider human and financial resource realities and consider progressively establishing more ambitious requirements over time as capacities increase.

▶ Treatment technology targets

Regulations may include specified technology targets for water treatment (where applied) to help ensure that supplies deliver safe drinking-water. Such targets specify permissible treatment devices or processes for given situations, such as coagulation, flocculation, filtration and disinfection to remove or inactivate pathogens from surface water sources. Specified technology targets can be especially useful where resources and ability to conduct site-specific assessments to design optimal treatment technologies may be limited, which may be more common among small water suppliers. It is important that technology targets included in regulations are reviewed as needed to ensure that they reflect prevailing scientific knowledge.

The suitability of treatment technologies will depend on such factors as water source, priority contaminants, target water quality, efficacy and cost of treatment methods, and operational requirements. Physical requirements such as power, consumables and spare parts should also be considered, as well as the ability of technologies to adapt to changing climatic conditions, including natural disasters. To support the selection of specified treatment technology targets, decision-makers can refer to available performance data for various treatment processes. For example, see Table 7.7 in the GDWQ *(6)* for an overview of microbial treatment capabilities of common water treatment plant processes. The performance information shown in Table 7.7 of the GDWQ is typically presented as a range, thus providing a general indication of microbial reductions that can be achieved. It is important to ensure that treatment process are operated optimally and that multiple barriers are put in place (including in the catchment, distribution system and point of use) to account for variability in treatment performance. It is also important to consider other sources of information on treatment efficacy. For example, the publication *Compendium of drinking-water systems and technologies from source to consumer (29)* provides foundational knowledge to support informed decision-making with regards to the selection of context-appropriate drinking-water systems and technologies for various source water types and characteristics. If more context-specific data are available (e.g. for source water types and catchments), these should be prioritized for consideration.

See Cases A3.25 and A3.26 for country examples of specified technology targets applied to small water supplies.

▶ Performance targets for household treatment

HWT may also require regulatory consideration. In some contexts, HWT is necessary to ensure water safety at the point of consumption. If appropriate, regulations should set out HWT performance targets for the reduction of priority contaminants in drinking-water. Microbial treatment performance is of primary importance, and capacity to treat priority chemicals (e.g. arsenic, fluoride, lead) will also be an important consideration in some areas. WHO has established performance targets for the removal of enteric pathogens that pose health risks *(30)*.[7] In addition, Table 7.8 in the GDWQ *(6)* includes information on microbial treatment capabilities for various HWT technologies, and the *Compendium of drinking-water systems and technologies from source to consumer (29)* includes more details on HWT interventions.

Table 7.8 of the GDWQ provides an overview of microbial treatment capabilities of common HWT technologies. As with Table 7.7 in the GDWQ, the performance information is presented as a range of values. Therefore, it provides only a general indication of treatment performance. For a given HWT technology, there may be significant performance differences between manufacturers and models. Therefore, regulations should ideally require that all HWT products available to consumers are tested and certified based on their performance, with appropriate product labelling to allow consumers to make informed decisions about which products to purchase. Where capacities for HWT performance evaluation do not yet exist nationally, authorities can refer to findings from independent product assessments, including the WHO International Scheme to Evaluate Household Water Treatment Technologies.[7] In such cases, countries are encouraged to fast-track certification of HWT products that have been found to meet WHO's performance requirements and to build capacity to conduct complementary validation testing, including for locally manufactured HWT products for which assessment data are not available.

7 For a summary of products evaluated that meet WHO performance criteria and list of all products evaluated, see https://www.who.int/tools/international-scheme-to-evaluate-household-water-treatment-technologies/products-evaluated (accessed 28 September 2023).

See Case A3.27 for a country example of HWT standards and an associated product certification scheme.

▶ Operator training and skills[8]

Requirements for the training, skills and/or certification of operators should be included in regulations and associated frameworks. Knowledgeable and capable operators are fundamental to the performance and professionalization of small water supplies. These requirements (and accompanying programmes) should cover both an initial level of training and demonstrated competence, as well as requirements for continued capacity development. It may not be feasible to require the same level of operator education and qualification for small water suppliers as compared to large suppliers, but minimum training and skill levels should be defined, along with more ambitious targets for progressive achievement in due course.

See Case A3.28 for a country example of a national certification scheme to ensure competency among operators of small water supplies.

▶ Material safety standards[9]

Regulations should require that products and materials used in water supplies comply with standards governing the composition of these products and materials. These standards should be both protective and achievable. Where product testing and certification systems and capacities do not yet exist nationally, regulations should require use of products and materials approved through other national or international certification schemes.

Drinking-water is exposed to various material surfaces before consumption, and these surfaces may leach high concentrations of hazardous chemicals, promote microbial growth or impart unacceptable tastes and odours. These surfaces may be encountered during abstraction, treatment, distribution and storage of drinking-water. They may include components of boreholes, hand pumps, treatment technologies, pipes and fittings, communal taps, storage tanks and collection containers. Tanker trucks and water carts will also be important considerations in some cases. Establishing material safety requirements helps minimize contamination of drinking-water supplies from use of such materials.

8 Although this section focuses on operator training and skills, regulations or associated frameworks should also consider training or certification programmes for other stakeholders involved in provision of safe water supply, including plumbers and water quality laboratory staff.

9 This section focuses on managing contamination from materials in contact with drinking-water. Chemical additives used in water treatment may also give rise to contaminants in the final water, and this is best controlled through chemical additive quality standards, provision of guidance on their use, and optimization of operations (e.g. through WSPs, see Chapter 4). Refer to section 8.5.4 of the GDWQ *(6)* for more information on chemical additives and materials in contact with water.

At the same time, it is important to consider the cost implications of applying material standards and to balance public health protection with feasibility and affordability. It is also important to consider that full compliance with standards may not be readily achievable for many supplies, including supplies that already include non-compliant components. For such cases, it is important to allow for incremental improvement, whereby all new components are required to comply with standards and existing components can be replaced to achieve compliance over time (e.g. according to upgrade schedules). As it will generally take time and resources to replace non-compliant components of water supplies, interim operational measures should be promoted as appropriate. For example, for lead, iron and other metals, it is important to ensure adequate corrosion control within distribution networks.

Regulatory requirements related to material safety should be balanced by appropriate supporting programmes. For example, awareness-raising is needed among water suppliers and those who design and build water supplies on the importance of using safe materials, where to access information on approved products, and/or requirements for product labelling. For contaminants that can be introduced by household plumbing, such as lead, it is also important to raise awareness among plumbers and consumers. Training for surveillance staff may also be needed to support the enforcement of material safety requirements.

See Cases A3.29 and A3.30 for examples of material safety standards applied to protect the quality of drinking-water supplies, including considerations related to the operationalization and enforcement of such standards.

▶ Other technical standards

It may also be appropriate for regulations to specify additional technical requirements to support drinking-water safety, including technical standards and codes of practice related to drinking-water source selection and the design and construction of water supplies (including plumbing).

4 Water safety planning

This chapter addresses risk management practice by those who operate and manage small water supplies.

Questions addressed include:

- For which small water supplies should regulations require WSPs?
- What role do SIs play in supporting risk management by small water suppliers?
- What technical and financial support is needed for successful risk management by small water suppliers?
- How do WSPs link to other WASH initiatives, including efforts to improve sanitation, hygiene, equity and climate resilience?

4 Water safety planning

This chapter addresses risk management practice by those who operate and manage small water supplies. The information in this chapter is intended for those responsible for establishing risk management requirements within regulations (see section 3.3.2) and for developing associated supporting programmes and tools. The guidance is also important for water suppliers, although most recommendations are directed at the institutions that regulate and support them.

4.1 Guidelines recommendation

Recommendation 4

Promote and support WSPs, which should be implemented by water suppliers to most effectively manage risks from catchment to consumer.

Proactively managing risks along the water supply chain is necessary to ensure water safety for all types and sizes of water supplies (see Box 4.1). This can be achieved through the implementation of WSPs by water suppliers, who have primary responsibility for drinking-water quality control. Governments should require or promote WSPs within drinking-water regulations and provide the support needed for water suppliers to undertake water safety planning.

SIs support water safety planning. If WSP implementation is not yet considered feasible, SIs can be undertaken by water suppliers as an interim risk management approach until WSP capacity is further developed. For household managed supplies, householders can be encouraged and supported to carry out SIs as a simplified alternative to WSPs that is more suitable for their context.

Boxes 4.2 and 4.3 give an overview of WSPs and SIs, including their linkages. Section 4.3 offers further guidance on where WSPs or SIs may be most suitable, and on the supporting programmes required for their successful implementation in the context of small water supplies.

For more guidance on developing or revising WSP regulations, policies and programmes, refer to *Think big, start small, scale up: a roadmap to support country-level implementation of water safety plans* (31).

Box 4.1 ▸ Principles of proactive risk management by water suppliers

- **Water supplier leadership:** Implemented directly by those who are responsible for operating and managing the water supply.
- **Prevention:** Identifying and addressing risks to prevent problems from occurring.
- **Multiple-barrier protection:** Minimizing contamination through source water protection, effective treatment (where applied) and safe distribution, storage and handling practices.
- **Progressive improvement:** Making stepwise and risk-based improvements to water safety that can be initiated with any level of available resources and continuously strengthened over time.
- **Ongoing monitoring:** Undertaking ongoing operations, maintenance and monitoring to keep water supplies safe.

Box 4.2 ▸ Water safety plans

Water safety planning is a comprehensive, proactive and ongoing risk management approach that includes all steps in the water supply chain – from catchment to consumer *(6)*. Recommended by WHO since 2004 as the most effective means to consistently ensure the safety of drinking-water, WSPs have been widely implemented globally *(6, 32, 33)*. The steps involved in a WSP for small water supplies are listed below *(34, 35)*.

1. **Engage the community and assemble a WSP team.** Establish a WSP team, led by the water supplier, to develop, implement and maintain the WSP over the long term.
2. **Describe the water supply.** Describe and map the water supply from catchment to consumer in sufficient detail to identify threats to water safety.
3. **Identify and assess hazards, hazardous events, existing control measures and risks.** At each step in the water supply chain, identify threats to water safety for all water user groups, consider the effectiveness of measures already in place to prevent problems from occurring, and assess risk levels to prioritize improvement action.
4. **Develop and implement an incremental improvement plan**. Prepare an incremental improvement plan to address priority risks, considering small improvements that can be actioned in the short term as well as improvements requiring greater time and resources.
5. **Monitor control measures and verify the effectiveness of the WSP.** Plan and carry out operational monitoring to confirm that the water supply continues to operate as it should, and undertake verification activities to confirm that the WSP is working to protect drinking-water safety and public health.
6. **Carry out operations and plan for emergencies.** Embed the WSP into day-to-day operations and maintenance tasks (e.g. through the development of standard operating procedures) and prepare emergency response plans (e.g. for droughts, floods and contamination events).
7. **Review and improve all aspects of WSP implementation.** Periodically (e.g. annually) review and revise the WSP to ensure it is kept up to date and relevant, revisiting all other steps in a continuous cycle of WSP upkeep and improvement.

Detailed guidance on completing the steps above is provided in *A field guide to improving small drinking-water supplies (34)* and *Water safety planning for small community water supplies (35)*. The Selected further reading section lists more resources on WSPs, including in the context of small water supplies.

Box 4.3 ▸ Sanitary inspections

An SI is a simple on-site evaluation, traditionally performed using a checklist (see Fig. 4.1), to determine if priority risk factors are present that can lead to contamination of the water supply. Risk factors may relate to the physical structure of water supply components, how the supply is operated and maintained, and environmental factors that could compromise water safety (see Fig. 4.2). After being identified through an SI, risks should be managed through remedial actions and ongoing operations and management activities to keep water supplies safe. SIs are a well established and widely applied practice *(8)*.

SIs are a useful activity to support a more comprehensive WSP; that is, to aid in hazard identification and monitoring. When SIs are routinely carried out and combined with planning and action for improvement, ongoing maintenance and monitoring, they can also serve as a simplified risk management approach where a WSP is not feasible (e.g. for an individual household supply), or as an interim approach while WSP capacity is strengthened.

Fig. 4.1 • Excerpt from the SI form checklist for rainwater collection and storage

Sanitary inspection questions		NA	No	Yes	If Yes, what corrective action is needed?
1	**Are there any visible contaminants on the roof or in the guttering channels?** Contaminants on the roof or in the guttering channels (e.g. from animal faces, corroded or damaged roof or gutter materials, leaves, moss) could contaminate the water. This could also cause blockages and an overflow, which could result in water loss.	❑	❑	❑	
2	**Do the roof or guttering channels have an inadequate slope for drainage?** Stagnant water could contaminate the water supply if the roof or guttering channels do not have a downward slope for water to fully drain into the storage tank. *Note* – ponding of water on the roof or in the guttering channels may indicate an inadequate drainage slope.	❑	❑	❑	
3	**Is there any vegetation or structures above the roof?** Contaminants (e.g. from animal faeces) could enter the water supply if there is overhanging vegetation, balconies or wires above the roof. Fallen leaves could also block gutters and cause an overflow, which could result in water loss.	❑	❑	❑	

Source: *Sanitary inspection packages (7)*.

Box 4.3 continued ▸ Sanitary inspections

Fig. 4.2 • Excerpt from the SI form risk factor illustration for rainwater collection and storage

Source: *Sanitary inspection packages (7).*

SI packages have been developed for common small water supply technologies. Each package includes three components.

1. **SI form:** A checklist of yes/no questions (see Fig. 4.1) and a supporting illustration (see Fig. 4.2) to help identify common risk factors and encourage planning for remedial action.
2. **Technical fact sheet:** Basic technical information on the water supply components to support completion of SI forms.
3. **Management advice sheet:** Guidance on the ongoing operations, maintenance and monitoring needed to keep the water supply safe, and on remedial actions to consider when risk factors are identified.

Refer to Annex 4 for more information on SI packages, including a list of small supply technologies and scenarios for which SI packages are available. The complete SI packages are published in the supporting publication *Sanitary inspection packages (7)*. The individual SI packages are also available online in PDF and editable formats (see Annex 4). Refer to Chapter 5 for guidance on the use of SIs as part of surveillance.

4.2 Rationale

Small water supplies stand to benefit considerably from proactive risk management. Water quality monitoring to verify water safety is commonly infrequent for small supplies, and it may not be feasible to test all priority parameters. Also, consumers have generally already been exposed to contaminated water by the time it is detected through monitoring. When contamination is detected, it may not be clear what has gone wrong and what corrective action is needed. Also, managing risks to source water quality is particularly important where water treatment is limited or absent, as is the case for many small supplies. Managing risks associated with water user practices is also important, as evidence shows widespread water quality degradation between the point of collection and the point of use for various types of small supplies (e.g. through unsafe collection, storage and handling practices) *(36)*.

The potential benefits of well implemented WSPs (for small and large water supplies alike) include:

- better understanding of the water supply, especially the risks that may affect water quality and health;
- more robust planning and practice related to day-to-day operations and management;
- targeted resource allocation through the development of risk-based incremental improvement plans that identify actions that can be readily implemented and those requiring more substantial investment;
- improved water quality;
- reduced prevalence of waterborne diseases;
- greater cooperation among those who share responsibility for, interest in and knowledge of the water supply;
- improved risk awareness and behaviour change among water users (e.g. source protection and hygiene practices);
- increased integration of various WASH initiatives within a single framework, including aspects of sanitation and hygiene; and
- contributions to climate change resilience and social inclusion through a participatory process and the systematic consideration of climate and equity risks.

Refer to the Selected further reading section for more information on WSPs, including documentation of benefits. Also, see Cases A3.31 and A3.32 for country and regional examples of small water supply improvements linked to WSPs.

4.3 Implementation guidance

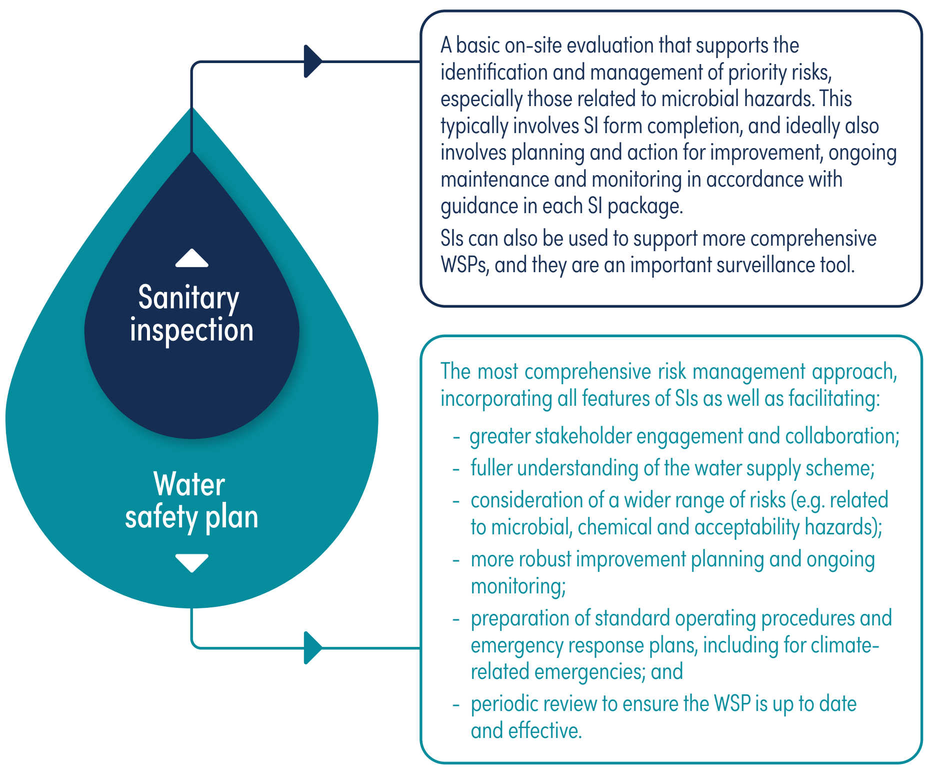
This section presents guidance to support the practical implementation of the recommendation in this chapter, including actions to create an enabling environment for effective and sustained WSP and SI programmes. Decision-makers should consider the guidance in this section when establishing regulatory requirements for risk management approaches (see section 3.3.2).

4.3.1 Understand the distinctions between risk management approaches

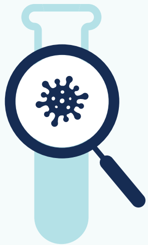
WSPs and SIs have important roles to play in proactive risk management for small drinking-water supplies. However, they are not equivalent. Fig. 4.3 provides an overview of the commonalities and distinctions between WSPs and SIs as risk management approaches and tools.

Water quality testing is an important component of, and complement to, WSPs and SIs, as explained in Box 4.4.

Fig. 4.3 • The relationship and distinctions between WSPs and SIs as risk management approaches



Box 4.4 ▸ The role of water quality monitoring in WSPs and SIs



Whether WSPs or SIs are conducted, compliance monitoring should be carried out periodically to confirm that the water meets regulatory standards. This compliance monitoring can be carried out by the water supplier or by the surveillance authority. Refer to Chapter 3 for guidance on compliance monitoring parameters, frequencies and locations.

In addition to this, water quality testing should be carried out by the water supplier in accordance with defined operational monitoring schedules to inform operational decisions. Operational monitoring is one of the most important water safety planning activities and is central to proactive risk management. It is usually carried out through simple observations and tests (e.g. observing structural integrity or monitoring chlorine residual, turbidity and pH) in order to rapidly confirm that control measures continue to work as they should.

Refer to Box 3.3 for more information on operational monitoring versus compliance monitoring.

In addition to routine operational monitoring and compliance monitoring, investigative monitoring may also be carried out to inform a WSP risk assessment.

4.3.2 Establish risk management requirements

Drinking-water regulations should ideally require those responsible for the operation and management of water supplies to routinely assess and manage risks to water quality and quantity (see section 3.3.2). For such regulatory requirements to contribute effectively to water safety, they must be workable for the various stakeholders involved. It is therefore important to consider which risk management expectations are achievable, not only for water suppliers but also for the government staff responsible for building capacity and providing the ongoing support and oversight necessary for sustained implementation. The more comprehensive the risk management approach, the more external support is required for training and oversight (including WSP auditing; see Chapter 5). In all cases, water suppliers require technical assistance and supporting tools, as discussed in section 4.3.4.

Regulations may specify different risk management requirements for different types of water supplies. Where populations served are greater and water supplier capacity is more advanced (e.g. for professionally managed supplies), WSPs should be promoted or required. Where populations served are particularly low or it is not feasible to expect those responsible for the water supply to develop and maintain a WSP (e.g. for household managed supplies), routine SIs and associated management action can be promoted or required as an alternative to WSPs. SIs can also be promoted or required as an interim measure, or stopgap, while WSP capacity is further developed.

Fig. 4.4 presents a conceptual diagram of contexts in which WSPs or SIs may be most suitable. The overlap in Fig. 4.4 reflects the inexact nature of this delineation and the broad range of capacity and professionalism that exists among community managed supplies.

Table 4.1 presents minimum risk management recommendations for the management models presented in Table 1.1, including recommended SI frequency where applicable. Box 4.5 presents special considerations for facilities serving vulnerable populations, such as schools and health care facilities.

See Case A3.33 for an example of risk management requirements that vary according to water supply size.

Fig. 4.4 • Conceptual diagram of contexts for different risk management approaches

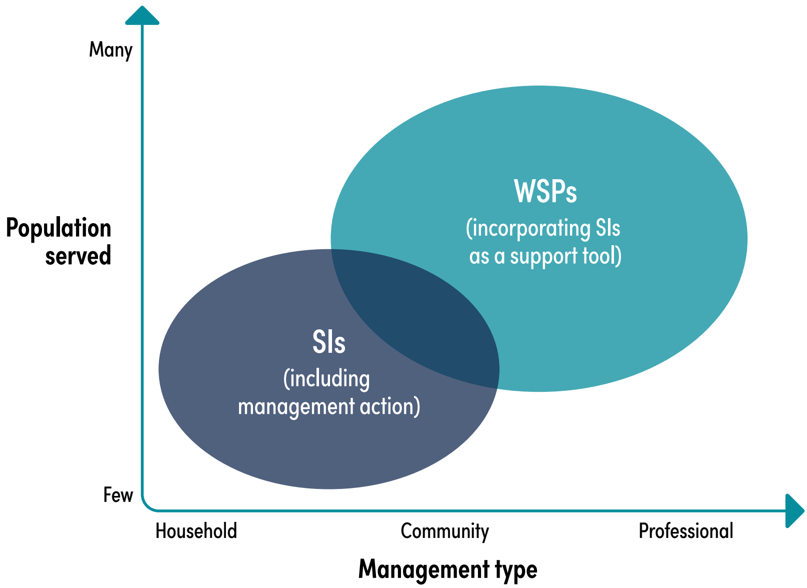


Table 4.1 • **Minimum risk management recommendations according to water supply management model**

<table>
<tr><th>Management model (as described in Table 1.1)</th><th>Minimum recommended risk management approach[a]</th><th>Key considerations</th></tr>
<tr><td>Household managed</td><td>SIs should be carried out by the household 1–2 times per year.</td><td rowspan="3">SI considerations
– SIs should ideally capture seasonal variations.
– Additional SIs (above the minimum recommended) should be carried out as the situation demands, e.g. after extreme weather or a natural disaster.
– SIs should be combined with remedial action, ongoing maintenance and monitoring as outlined in the management advice sheet for each SI package (see Annex 4).
WSP considerations
– A basic WSP may be developed using simple templates that are prepared by national or subnational authorities, for example.
– Where multiple supplies are aggregated for management by a single entity, an area-wide WSP may be developed that covers multiple sources. Such an “umbrella” WSP may identify common risks to the various supplies and define standard operating procedures, monitoring schedules and emergency response procedures that apply across the management entity’s jurisdiction.</td></tr>
<tr><td>Community managed</td><td>For simple water supplies with smaller populations served and lower management capacity, basic WSPs should be implemented by the community management entity, if feasible. If sustainable implementation of WSPs is not considered feasible, SIs should be carried out as an interim risk management approach at least four times per year[b] (e.g. quarterly).
For water supplies with greater populations served and/or more management capacity, basic WSPs to more comprehensive WSPs should be implemented by the community management entity.</td></tr>
<tr><td>Professionally managed</td><td>Basic WSPs to more comprehensive WSPs should be implemented by the professional management entity.</td></tr>
</table>

a Wherever WSPs are undertaken, SIs may be incorporated (e.g. as assessment and monitoring tools). In such cases, SIs should be carried out as and when indicated in the WSPs.

b The appropriate SI frequency depends on the type and condition of the water supply. For example, dug wells should be inspected more frequently than boreholes with hand pumps because of their greater vulnerability to microbial contamination. Piped and treated surface water supplies may require more frequent inspection (monthly), in which case WSPs incorporating routine operational monitoring may be a more suitable risk management approach (as opposed to frequent SIs only).

Sources: adapted from *Surveillance and control of community supplies (8)* and the GDWQ *(6)*.

Box 4.5 ▸ Water safety planning for health care facilities and schools

These facilities should be covered by a WSP[a] to the fullest extent possible. (See section 5.3.2 for guidance on prioritizing surveillance activities at these locations.)

Where these facilities are served by a professionally managed piped supply, the water supplier should give special attention to these sites within its WSP(s).[b] For example, the supplier should explicitly consider risks to these vulnerable water users, establish these facilities as routine monitoring locations and establish communication protocols for promptly advising these facilities of any changes to water quality.

Where these facilities are responsible for their own water supplies (e.g. on-site supplies), risk management may fall to facility staff who have many competing demands on their time and limited training in drinking-water supply management. In these situations, staff capacity should be further developed and risk management roles formally integrated into job descriptions, or alternative arrangements should be made to ensure provision of safe drinking-water to facility users. One such arrangement would be the engagement of qualified operators (e.g. professional service providers) who implement WSPs as part of their formal responsibilities.

a In the case of health care facilities, WSPs should be linked to broader WASH risk management approaches, such as the approach described in *Water and sanitation for health facility improvement tool (WASH FIT) (37)*.

b Water quality may also be compromised within pipe networks inside buildings, and these risks must also be managed to ensure water safety. Refer to *Water safety in buildings (38)* for more information.

4.3.3 Consider a staged approach to risk management requirements

It may be appropriate to allow more time for small water suppliers to comply with regulatory requirements for risk management practice as compared to larger suppliers. This approach reflects the time that may be needed to provide the necessary training and technical support to small water suppliers, which are often numerous and remote.

Other phased approaches to introducing risk management requirements could also be considered. For example, a regulatory authority may initially issue an advisory note encouraging WSPs, and work towards formal WSP requirements as implementation and enforcement capacities and resources are strengthened. Or, WSPs may be required for all newly constructed water supplies, with requirements applied to existing supplies over time. Alternatively, risk management requirements may be modest initially and become more ambitious over time, for example shifting from SIs only (as an interim measure) to full WSPs in due course.

At the level of the individual water supply, a staged approach to WSP implementation may also be needed. Water suppliers can be encouraged to take a stepwise approach to their risk management practice. WSPs are tools to guide water suppliers on a path towards informed and sustained improvement, and even partial implementation brings benefits. Water suppliers may need to focus on a few key risks initially and/or particular parts of their water supply, and the depth and scope of their efforts can grow over time.

See Case A3.34 for a country example of regulations that allow more time for rural water suppliers to comply with WSP requirements as compared to urban suppliers.

4.3.4 Provide water suppliers training and guidance in risk management

Small water suppliers require ongoing technical assistance to effectively and sustainably implement WSPs and SIs. In addition to training on WSP and SI processes and tools, water suppliers often need external guidance and support to address the risks identified. For example, operators may require guidance on prioritizing water safety risks and developing incremental improvement plans that will provide the best health protection from the investment of limited resources. Representatives of health and environmental agencies may need to provide information and act on catchment-level risks when required improvements are beyond the water supplier's influence or control. Similarly, identified risks related to user practices may be beyond the water supplier's purview, and the health authority may need to act (e.g. design and deliver a hygiene education campaign).

Government staff who have been trained on WSPs and SIs at the local or regional level (e.g. staff at the local health office) have an important role to play as focal points to support risk management and ongoing implementation. Additionally, small supply operators can play an important role in supporting one another. Exchange visits and/or opportunities for combined training will allow operators to learn from each other and build relationships for ongoing collaboration.

WSPs tend to require greater external support than SIs, as WSPs are a more comprehensive risk management tool. For example, SIs can be carried out with only basic training and refresher opportunities, whereas WSP training and refresher events tend to be more complex and typically require the use of standardized training packages (often developed for use nationally) to support consistent and high-quality instruction. Also, verifying the effective application of SIs by water suppliers can be done relatively quickly and easily (e.g. during a community visit involving several aims and tasks). A thorough audit of WSP implementation, on the other hand, requires considerably more resources, time and training (see Chapter 5).

For household managed supplies, support agencies should plan for mass education and advocacy campaigns (e.g. using online formats, distributing pamphlets and incorporating guidance into household visits by health staff).

Advocacy is an important element of capacity development. Small water suppliers who understand the benefits of proactive risk management are more likely to engage with water safety planning, especially where regulatory requirements are not in place or enforced.

Support agencies should also ensure easy access to necessary tools and information, including where to go for further support (see section 3.3.1). For community managed and professionally managed supplies, water supplier training on WSPs and SIs should be integrated into broader operator training and certification programmes. Programmes to build, sustain and certify technical capacity among operators will support the safe operation and management of water supplies and contribute to the professionalization of water service delivery (see Chapter 3). In all cases, capacity development programmes should seek to understand and overcome barriers to risk management practice by water suppliers.

See Case A3.35 for a country example of an operator training programme for small water suppliers that incorporates risk management principles and tools.

4.3.5 Provide water suppliers practical tools to support risk management

Essential support for small drinking-water suppliers also includes guidance materials and tools to facilitate WSP and SI application, which should be tailored for different types of water supplies. Useful tools include guidance notes, infographics with pictorial representations of risks, locally relevant SI forms, WSP templates and simple computer programs or applications to guide risk assessment and risk management. Consideration should be given to water suppliers with lower literacy levels and those who speak different languages or dialects.

The SI packages presented in WHO's *Sanitary inspection packages (7)* (and summarized in Annex 4) can support SI application. The SI forms in these packages can be used directly in the format provided, although small water supplies vary widely and certain aspects of the forms may not be relevant in all contexts. If needed, and as capacity and resources permit, authorities should adapt the material to the local context. (See Annex 4 for further guidance on adapting SI packages.)

To support WSP implementation, the WSP templates included in *A field guide to improving small drinking-water supplies (34)* are valuable tools for water suppliers. WSP templates clarify the steps to be taken by a WSP team and aid documentation. Like SI forms, WSP templates should be adapted to the local context if needed and as capacity and resources permit. Adaptation ensures consideration of locally relevant hazards, which may vary according to water supply technology and activities in the catchment, for example. Tailored templates help WSP team members understand priority threats and focus their efforts. Templates are particularly useful when water suppliers are constrained in terms of staff numbers or capacity. WSP templates also assist surveillance staff with WSP oversight (including WSP auditing; see Chapter 5) by clarifying what should be included within a WSP. Although templates are useful tools, each WSP should reflect the specific conditions at a given water supply. Therefore, it is important that adequate capacity development is provided along with the templates to encourage and enable critical thinking about site-level risks, improvement needs and ongoing management plans. This will contribute to better WSP ownership and engagement by water suppliers, which are fundamental to WSP effectiveness.

See Cases A3.36 and A3.37 for country examples of WSP templates and tools that have been tailored to different types of small water suppliers.

4.3.6 Establish sustainable financing for risk management programmes

There are costs involved in implementing risk management approaches. At national and subnational levels, sustainable financing is needed to support WSP training and the ongoing oversight of implementation by water suppliers (including WSP auditing; see Chapter 5). For some water supplies, revenue from user fees may be sufficient to allow these costs to be borne by water suppliers. However, this will not be the case for many small water supplies. Further, funding is needed for regional or national collation and review of risk assessment findings (as part of surveillance; see Chapter 5), and for taking appropriate action. Risk management programme support and oversight by national and subnational authorities will therefore require dedicated budget allocations to allow all relevant institutions to undertake their respective roles.

There are also costs to consider at the level of the individual water supply, particularly when WSPs or SIs reveal deficiencies that need to be addressed. Although there are generally some improvements that can be made with available resources, such as fencing around a water source or awareness-raising campaigns, other improvements may require more substantial financial investment. If water suppliers cannot fund priority improvements, it is important to establish mechanisms by which they may secure financing, whether from government, donor agencies or other sources. For example, WSP improvement plans can be systematically used to inform annual budget allocations (e.g. to local government and in turn to water suppliers). As another example, grant schemes can be established to fund improvement needs for household managed supplies that are identified through SIs.

See Cases A3.38 and A3.39 for country examples of government programmes to finance water supply improvements, including risks identified through WSPs.

4.3.7 Link to other WASH initiatives

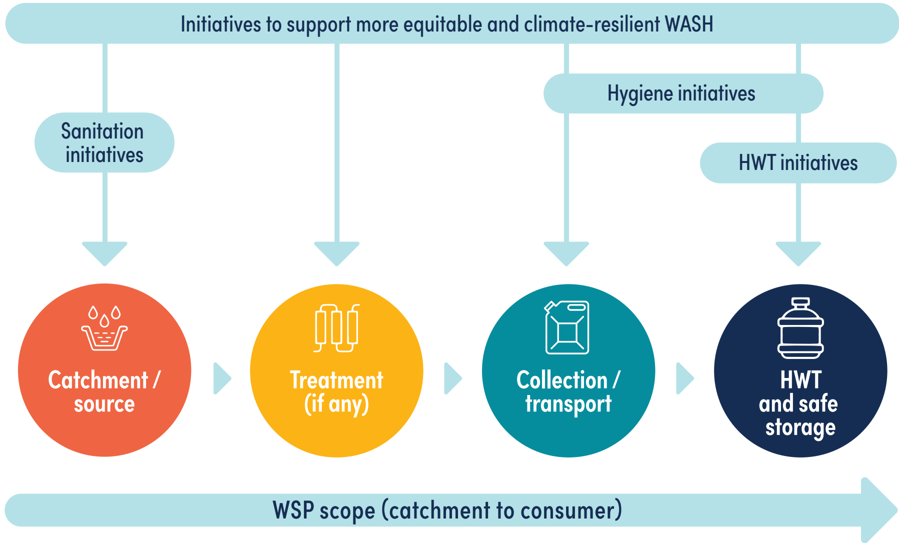
Water safety planning should be approached as part of holistic WASH programming given its strong linkages to sanitation and hygiene, and to climate-resilient and equitable WASH services. Unsafe sanitation is a critical threat to drinking-water sources, and poor hygiene practices can lead to water supply contamination at points of collection and use. Climate variability and change threaten WASH services, including the quality and quantity of drinking-water supplies, and inadequate WASH is disproportionately experienced by vulnerable groups *(39)*. Approaching these related WASH improvement programmes jointly will therefore create synergies and efficiencies. Further, the same government entity may oversee water, sanitation and hygiene programmes, particularly in the case of small supplies. Therefore, national and subnational authorities should link WSP programming to other WASH programmes.

As WSPs address risks along the entire water supply chain, they provide an effective framework to integrate various WASH programmes and initiatives (see Fig. 4.5). For example, WSPs facilitate exploration of climate-related risks, vulnerabilities and management solutions to build climate resilience, including emergency response planning to strengthen preparedness. (See the Selected further reading section for resources on managing climate risks through WSPs.) Also, efforts to improve HWT, safe storage and hygiene practices help to manage risks at points of collection and use, and are therefore important components of water safety planning. At the other end of the water supply chain, sanitation initiatives (such as sanitation safety planning, community-led total sanitation and activities to reduce open defecation) support water safety planning by contributing to source water protection.

The WSP approach also provides a framework to support meaningful participation by vulnerable and marginalized groups and to facilitate their active involvement in decision-making for WASH improvements. Resources are available (see the Selected further reading section) that provide guidance on considering gender equality, disability and social inclusion through the WSP process, both in communities and in health care facilities.

See Case A3.40 for a country example of water supplier efforts to strengthen the climate resilience of drinking-water services.

Fig. 4.5 • An example of integrated WASH programming using the WSP framework



5 Surveillance

This chapter addresses risk-based surveillance of drinking-water quality in the context of small supplies.

Questions addressed include:

- How often should surveillance activities be carried out for small water supplies and how can they be progressively expanded as resources allow?
- What training and tools do surveillance staff need in the context of small water supplies?
- Why is it important to consider water quality findings alongside results from SIs and WSP audits?
- How should surveillance findings be shared and followed up to support remedial action by small water suppliers?

5 Surveillance

This chapter addresses risk-based surveillance of drinking-water quality in the context of small water supplies. The information in this chapter is intended for those responsible for establishing surveillance requirements in official governance instruments (see section 3.3.8) and for those developing associated training programmes and tools to support surveillance practice.

The guidance in this chapter focuses on the surveillance of water quality (safety and acceptability) in particular. However, surveillance should also cover the accessibility, quantity, continuity and affordability of drinking-water supplies, which are critical to the protection of public health (see section 2.3.1). As drinking-water surveillance agencies may not oversee all of these basic service parameters, other stakeholders have important complementary roles to play. For example, economic regulators will often lead tariff setting, balancing considerations of affordability and adequate cost recovery.

The guidance in this chapter covers the use of surveillance data to support action and improvement, particularly at the site level. The wider collation, analysis, reporting and use of data for higher-level decision-making is also central to surveillance and is covered in Chapter 6.

5.1 Guidelines recommendation

Recommendation 5

Practise risk-based surveillance, including verifying risk management practice by water suppliers and applying limited resources to address priority public health concerns.

Governments should establish risk-based surveillance programmes to realize the greatest public health benefit from limited resources. This involves:

- assessing proactive risk management practice by water suppliers by carrying out WSP audits and/or SIs (see Chapter 4);
- ensuring that water quality testing parameters, frequencies and locations reflect local risk (see Chapter 3);
- identifying higher-risk sites and populations and prioritizing a subset of testing parameters as needed;

- adjusting the frequency of surveillance activity based on water supply performance as appropriate, e.g. visiting poorly performing (higher-risk) sites more frequently; and
- considering risk management findings alongside water quality test results to gauge water safety and inform improvements.

An overview of core drinking-water quality surveillance activities and functions is presented in Box 5.1 and Fig. 5.1.

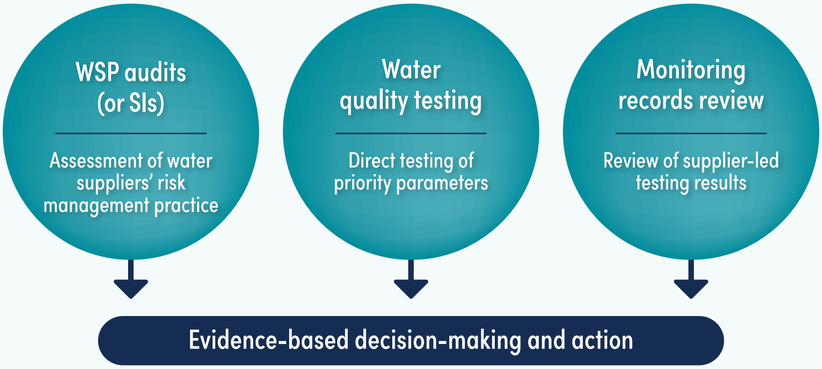
Box 5.1 ▸ Core drinking-water quality surveillance activities

Drinking-water quality surveillance is an independent assessment of the safety and acceptability of a drinking-water supply and a core public health function. Surveillance should be undertaken by an agency that is separate from the water supplier, as quality control by a water supplier and independent oversight are distinct and complementary functions. In many countries, the health authority is responsible for surveillance. Surveillance functions include:

- verify the safety and acceptability of drinking-water, including for vulnerable groups;
- build consumer awareness of drinking-water safety;
- contribute to ongoing mentoring and technical support to water suppliers;
- check that risks are being effectively managed to prevent problems from occurring;
- promote and support incremental improvement of drinking-water supplies;
- understand national and subnational trends on drinking-water safety – and the overall drinking-water supply situation more broadly – to inform policies, planning and programming (see Chapters 2 and 6); and
- participate in waterborne disease outbreak investigation, response and reporting.

Drinking-water quality surveillance generally involves the assessment of risk management practice by water suppliers, direct testing of water quality and the review of water supplier monitoring records (see Fig. 5.1).

Fig. 5.1 • Elements of drinking-water quality surveillance programmes



Box 5.1 continued ▸ Core drinking-water quality surveillance activities

WSP audits and SIs

An essential surveillance activity is to conduct site visits to verify risk management practice by the water supplier. Where water suppliers are implementing WSPs, WSP audits should be carried out by the surveillance agency (or another agency designated by the surveillance agency) to provide an independent check that core WSP components have been developed and are being implemented in practice to effectively manage risks. As the term "audit" may not be suitable for all small water supplies, alternative terminology may be used, such as "WSP check" or "WSP support visit". Guidance on preparing for, carrying out and following up on a WSP audit is available in *A practical guide to auditing water safety plans* (40).

Alternatively, SIs can be carried out by the surveillance agency to confirm that priority risks are being effectively managed, e.g. where WSPs have not been implemented. SIs can also be conducted between WSP audit events. As SIs focus primarily on risks related to microbial hazards, surveillance agencies should also confirm that priority chemicals (e.g. arsenic and fluoride) are being appropriately managed and monitored.

If resources do not allow direct testing of water quality by the surveillance agency, WSP audits and/or SIs should still be conducted to support the identification and management of priority risks.

Water quality testing

Direct assessment of water quality by the surveillance agency (or by another agency designated by the surveillance agency) may be important to independently verify that drinking-water quality standards or targets are being met. This independent assessment complements compliance monitoring undertaken by the water supplier, and for small water supplies with limited resources, it may be the only water quality testing undertaken.

Monitoring records review

Where regulations allow compliance monitoring to be carried out by water suppliers, the review of the water suppliers' monitoring results is an important surveillance activity. Systems should be established for reporting of monitoring results to, and review by, the surveillance agency (see section 3.3.7). Where WSP audits are undertaken, water supplier monitoring records should also be reviewed as part of the audit. In addition, where water suppliers carry out SIs to support risk management, the surveillance agency should review these records as a verification activity.

5.2 Rationale

Surveillance has a critical role to play in confirming the safety and acceptability of drinking-water *(6)*. However, data indicate that surveillance practice commonly falls considerably short of regulatory requirements, especially in the case of small water supplies *(12)*. This is largely a result of insufficient human resources and funding, along with other gaps in the necessary surveillance support structure (e.g. equipment, transportation, supply chains). In many countries, weak surveillance practice perpetuates a lack of awareness of the status of small water supplies, including vulnerabilities and support needs.

The potential for surveillance programmes to inform and drive improvement is further impacted by weak linkages between surveillance findings and remedial action by water suppliers. Data indicate that surveillance findings from small water supplies are commonly not publicly reported or used to compel water suppliers to take corrective action *(12)*. There is also a need to improve the use of surveillance data to assess national and subnational trends to inform higher-level planning and programming (see Chapters 2 and 6).

Strengthening surveillance programmes, practice and follow-up therefore represents an important opportunity to improve the safety of small water supplies. This requires a practical, risk-based approach that focuses on the issues that are most important for the protection of public health.

5.3 Implementation guidance

This section presents guidance to support the practical implementation of the Guidelines recommendation, including actions to create an enabling environment for effective surveillance programmes. Decision-makers should consider the guidance in this section when defining surveillance requirements within regulatory instruments (see section 3.3.8).

5.3.1 Define minimum frequencies for surveillance activities

Tables 3.4 to 3.9 in Chapter 3 set out minimum frequency recommendations for compliance monitoring. This monitoring may be conducted by the surveillance agency and/or by water suppliers (with results reported to the surveillance agency at a frequency set out in regulations). Even if compliance monitoring is carried out in large part by the water supplier, the surveillance agency should visit water supplies periodically to perform SIs or WSP audits, and generally to conduct complementary and independent water quality testing.

The minimum recommended frequency for carrying out SIs and/or WSP audits as a routine surveillance activity should consider risk as well as available resources and other practical considerations, including the number and locations of water supplies, the number of trained surveillance personnel and the time required at each site to carry out the activity. WSP audits will generally require more time than SIs, as audits involve a desktop review of the WSP document and associated records, including monitoring results and records of improvement works, as well as field observations and discussions with operators. While SIs are generally less time-intensive than WSP audits, some water supplies will involve multiple SI forms (e.g. for the source, treatment works, pipe network, storage tanks and tapstands). If it is not feasible to complete a WSP audit or an SI of the full water supply in a single visit, the various water supply components may be visited on a rotational basis, with the aim of visiting all parts of the water supply over time.

Minimum frequency recommendations for WSP audits and SIs to be undertaken by the surveillance agency are presented in Table 5.1. These assessments by the surveillance agency are intended to complement more frequent WSP and/or SI activity led by water suppliers, which is addressed in Chapter 4. If the surveillance agency visits a water supply more frequently than indicated in Table 5.1 to conduct water quality monitoring (e.g. for 6-monthly microbial monitoring), SIs should be conducted during these monitoring visits, if feasible.

To provide support to the most at-risk water supplies and ensure optimal use of surveillance resources, it may be appropriate to adjust the frequency of surveillance activities according to water supplier performance. For example, where repeat surveillance findings indicate that risks are consistently well managed and water quality complies with standards, it may be appropriate to reduce surveillance frequency at these sites. Conversely, sites found to present a higher risk may need more frequent surveillance activity to identify and support remedial action.

See Cases A3.41 and A3.42 for examples of risk-based approaches to surveillance frequency, including prioritizing higher-risk sites for surveillance visits.

Table 5.1 • Minimum frequency of WSP audits and SIs by the surveillance agency according to water supply management model

Management model (as described in Table 1.1)	**Minimum frequency of WSP audits and SIs by the surveillance agency**[a]	**Key considerations**
Household managed	Undertake an **SI** each time water quality testing is undertaken by the surveillance agency (see Tables 3.4 to 3.9).	**Household managed** – Additional SIs (above the minimum recommended) should be carried out as needed, e.g. upon user request, receipt of non-compliant test results or reports of waterborne disease.
Community managed	Undertake a **WSP audit** every 3–5 years depending on performance, e.g. every 5 years for better-performing suppliers.	**Community and professionally managed** – In between WSP audit events, or where WSPs are not yet implemented, undertake an SI annually[b] and as the situation demands, e.g. known or suspected outbreak of waterborne disease, extreme weather or natural disaster.
Professionally managed	Undertake a **WSP audit** every 2–3 years depending on performance, e.g. every 3 years for better-performing suppliers.	

[a] Table 4.1 provides recommendations for SI frequency by water suppliers (if they are not yet able to implement WSPs), whereas this table suggests minimum frequencies for SIs (and/or WSP audits) by the surveillance agency. SIs should be carried out more frequently by water suppliers than by the surveillance agency as part of proactive risk management practice to ensure drinking-water quality control.

[b] If resources do not allow the surveillance agency to visit all sites annually to undertake SIs, sites should be visited on a rotational basis in sufficient numbers to establish trends to inform planning and programming.

Sources: adapted from *Surveillance and control of community supplies* (8) and *A practical guide to auditing water safety plans* (40).

5.3.2 Progressively expand surveillance activities

The surveillance programme requirements set out in regulations should be risk-based and realistic, including a manageable set of prioritized monitoring parameters and frequency requirements that are appropriate for various types of small water supplies (see Chapter 3). However, even where regulatory requirements are considered appropriate, surveillance agencies may lack the support structures to fully implement surveillance programmes. Essential components of this support structure include:

- enough trained staff to cover all water supplies (see section 5.3.3);
- laboratories capable of testing priority parameters;
- field testing equipment for parameters that must be tested in the field or where access to laboratories is limited;
- effective material supply chains, including for testing reagents and other consumables;
- transportation;
- data management systems; and
- sustainable financing (see section 5.3.4).

Often it will be necessary to progressively strengthen surveillance programme support structures and carry out more limited surveillance activity in the interim. In these cases, surveillance authorities will need to make strategic judgments about how to apply limited resources for the greatest public health benefit. A risk-based approach to optimizing surveillance efforts may involve one or more of the following strategies.

- **Prioritizing sites according to risk:** Priority sites should be determined based on risk, e.g. where SI scores, WSP audit scores and/or water quality test results indicate higher levels of contamination or potential for contamination. Risk associated with source water type may also be considered, with surface water and shallow groundwater sources being more at risk of microbial contamination than deep groundwater. Water supplies for health care facilities, schools, aged care facilities and other facilities serving vulnerable populations should be prioritized. Small water supplies serving more people (and therefore representing greater exposure potential) may be prioritized initially, with those serving fewer people addressed as resources allow.
- **Targeting representative sites:** A sufficient number of the most common types of water supplies may be prioritized for annual surveillance visits in order to establish trends and to inform national and subnational planning

and programming, with the aim of visiting all sites over time on a rotational basis. Sites representative of those serving vulnerable populations should also be considered.

- **Prioritizing a subset of regulatory parameters:** If it is not possible to test the complete set of priority parameters set out in regulations (e.g. those recommended in section 3.3.3), surveillance agencies should prioritize the microbial quality of water supplies by testing for *E. coli*. If resources are highly constrained and only occasional *E. coli* testing is feasible, free chlorine residual monitoring should be prioritized in chlorinated supplies (ideally combined with testing for turbidity and pH to confirm that conditions are optimal for effective chlorination) to provide an indication of microbial water quality between *E. coli* monitoring events.
- **Scaling back monitoring frequency:** If it is not feasible to monitor at the frequencies (and locations) recommended in Tables 3.4 to 3.9, more limited monitoring may be targeted.
- **Focusing on SIs and WSP audits:** Surveillance agencies should carry out SIs and WSP audits to support proactive risk management of water supplies, even when water quality testing cannot be conducted (e.g. due to a lack of equipment, reagents or funds for testing). If surveillance agencies do not have the capacity to conduct WSP audits, regulations should allow surveillance agencies to appoint independent auditors to act on their behalf (see section 3.3.8). Alternative practices can also be applied as surveillance agencies develop WSP audit capacity, including informal peer-to-peer auditing or engaging larger water supplies to informally audit small supplies.

Further, different water quality testing options can be explored for cost-effectiveness. Field test kits (see section 3.3.6) and testing methods with less sensitive detection limits may present lower-cost options. Presence–absence (P/A) testing can also be considered due to the low cost of supplies and ease of use. Although P/A testing will not quantify the magnitude of contamination, positive results can be used to prompt corrective action (e.g. chlorinating a storage tank). P/A testing may also serve as a screening tool to trigger additional quantitative testing where contamination is detected. Use of P/A testing is most appropriate where samples are generally expected to be free from the contaminant, for example in distribution systems where chlorine residual is maintained. P/A testing may also be useful for awareness-raising campaigns or behaviour-change communication, for which a simple visual indicator of contamination can help to reinforce water safety risks among water suppliers and water users.

When prioritizing surveillance activities, it is important to consider how surveillance findings are used and by whom to ensure that the most essential information is collected. (Refer to Chapter 6 for further guidance on giving due consideration to data users and their needs.)

See Case A3.43 for a country example of the strategic use of limited surveillance resources to optimize the public health benefit.

5.3.3 Invest in training and tools for surveillance staff

In the case of small supplies, surveillance is often the responsibility of environment or public health staff whose duties extend beyond simply verifying compliance with regulatory requirements. Surveillance staff play an important role in educating small water suppliers and providing technical support and encouragement. Staff must be well versed not only in water quality sampling and testing, but also in water supply design, operations and maintenance, as well as risk management. Further, surveillance support generally encompasses the whole of WASH, as poor hygiene and unsafe sanitation represent significant risks to drinking-water safety in the context of small supplies. Therefore, comprehensive training is necessary for staff at all levels.

A strategy for capacity development should be drawn up and implemented, involving training programmes specific to staff at various levels (e.g. field staff, laboratory staff and coordinators at regional and national levels). Training should not be viewed as a one-time activity but as an ongoing commitment that includes refresher courses and field supervision for on-the-job training. Opportunities for continuing education are fundamental to sustaining capacity development. For field staff that liaise directly with water suppliers, topics to be addressed in training programmes include those presented in Box 5.2.

Box 5.2 ▸ Example training programme topics for surveillance field staff

- **Water and health:** The links between drinking-water quality and health, namely issues stemming from inadequate drinking-water quality and quantity.
- **National regulations and standards:** National and subnational regulatory requirements applying to drinking-water, including drinking-water quality standards, surveillance programme elements, powers of enforcement (where applicable), and approaches to make standards and regulations accessible to water suppliers with more limited professional capacity.
- **Water supply types and basic characteristics:** An understanding of the overall water supply situation in the country, including common water supply types and their basic characteristics.
- **Risks and protective measures:** Common risk factors and effective protective measures for water supplies typically encountered, including those related to source water, treatment, distribution, storage and user practices; this should consider relevant climate-related risks and appropriate shorter and longer-term remedial actions.
- **Water supply design and operation:** Basic principles of design and operation for water supplies typically encountered, including common methods of water treatment.
- **HWT and safe storage:** Basic principles of commonly used household treatment and safe storage methods; products used and approved for use (including products evaluated by WHO and confirmed to meet WHO microbial health-based criteria; see section 3.3.9); and how to assess correct and consistent use.
- **WSP process and audit procedures:** The core principles and steps involved in the WSP process, and the procedures and tools involved in preparing for, carrying out and following up on a WSP audit.
- **Conducting an SI**: How to correctly and consistently conduct an SI and provide appropriate management advice (including on corrective actions).
- **Sample collection and handling:** How to select water quality sampling locations and collect, label, store and transport samples for laboratory testing.
- **Field testing:** How to test water quality using field equipment, calibrate the equipment and replenish consumables.
- **Data recording and interpretation:** How to record and interpret surveillance results in light of national or subnational standards and targets, including determining which findings require further action.
- **Communicating results:** How and to whom to report findings in routine and incident situations, including recommendations for remedial action.
- **Holistic WASH**: The interplay between safe sanitation, good hygiene practices and safe drinking-water, including the impacts of sanitation and hygiene on water quality, as well as the importance of sufficient supplies of water to support hygiene and sanitation.
- **Water supplier engagement and relationship building**: Participatory learning techniques and engagement approaches that create rapport and trust between surveillance staff and the water supplier (including households) and help to overcome disincentives to sharing information.
- **Value of surveillance:** Clear messaging on the critical role of surveillance in improving and sustaining water safety to motivate surveillance staff to contribute to a culture of surveillance-driven improvement.

Equipping surveillance staff with well designed tools and templates to support their work will also contribute to surveillance practice and impact. The SI packages presented in WHO's *Sanitary inspection packages* *(7)* are valuable surveillance tools. (See Annex 4 for further information on SI package components and functions, as well as guidance on adaptation and use.) WSP audit criteria and scoring guidance are also important tools for surveillance staff, as they help to ensure that WSP audits are robust and undertaken consistently from site to site and over time. An example WSP audit form for small water supplies is provided in Appendix B of *A practical guide to auditing water safety plans* *(40)*. WSP auditing is also supported by WSP templates (for use by water suppliers) that have been adapted to the local context, as such templates set out what should be included in WSPs (see section 4.3.5). All surveillance forms and tools should be standardized to allow national and subnational comparisons and facilitate risk ranking (see Chapter 6). They should also encourage critical thinking about findings and appropriate remedial actions.

In addition to training and tools to build technical capacity, it is important to consider the motivation of surveillance staff to actively contribute to a culture of surveillance-driven improvement. Creating awareness of the critical role that surveillance plays in improving and maintaining drinking-water safety may help to provide motivation. Formal systems to routinely follow up to confirm that remedial actions are implemented (see section 5.3.7) may serve to motivate staff by raising awareness of the concrete improvements that follow from their efforts. Staff rewards programmes to acknowledge good practice may also provide motivation.

See Cases A3.44 and A3.45 for country examples of ensuring that those carrying out surveillance activities have the training and tools needed to fulfil their duties.

5.3.4 Establish sustainable financing for surveillance

Surveillance is a significant direct support cost that must be adequately financed for safe and sustainable drinking-water service delivery. (Refer to the life-cycle costs shown in Fig. 2.1.) These costs include staffing, mobilization, water quality analysis, training and educational materials, and fixed assets (e.g. office and laboratory space). There are also costs associated with the management, collation and review of surveillance data to inform programming at national and subnational levels. Surveillance costs can be relatively high for small water supplies owing to the sheer number of supplies and their geographical spread.

For some water supplies, revenue from user fees may allow water suppliers to cover some of these costs, for example the cost of a WSP audit. This will not be the case for many small water supplies, however, and dedicated budget allocations are essential.

See Case A3.46 for a country example of sustainable financing of regulatory activities, including water quality surveillance.

5.3.5 Jointly analyse risk management scores and water quality

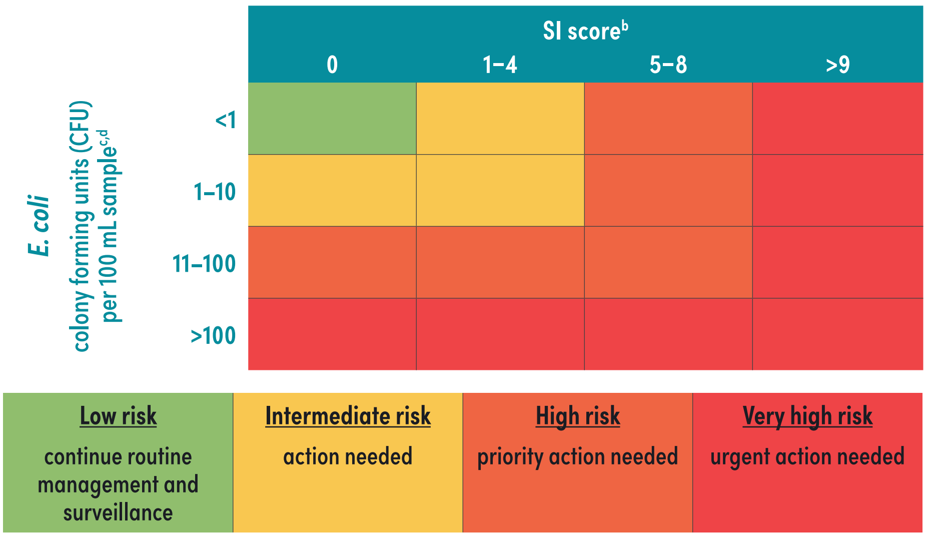
Combined analyses of risk management scores (from SIs or WSP audits) and microbial water quality data are important to verify the continuous safety of a water supply. This is particularly true in the case of small water supplies, where infrequent testing may miss contamination events and create a false sense of security in the safety of a water supply. SIs and WSP audits aim to identify water supply vulnerabilities that can lead to contamination. Therefore, combining findings from SIs or WSP audits with water quality test results provides a more appropriate indication of risk level. Understanding relative risk allows surveillance agencies and other stakeholders to identify water supplies that require increased attention and guidance. It also provides a mechanism for setting priorities for action, allocating resources and assessing the impacts of improvement programmes.

Grading schemes are a useful tool to support the assessment of water quality test results alongside risk management scores. For microbial water quality, the aim should always be to produce water in which *E. coli* is not detected in a 100 mL sample (see Table 3.4) *(6)*. However, achieving this can often be a challenge, especially for small water suppliers that lack capacity or resources to effectively manage microbial risks (including through water treatment). In such situations, establishing categories for microbial quality can help distinguish between lower- and higher-risk sites. An example grading scheme based on microbial water quality results and SI scores is shown in Fig. 5.2. Another grading scheme, based on microbial water quality and WSP audit findings, is shown in Fig. 5.3.

Grading schemes should be adapted to local conditions as needed. Grading schemes should also target divisions that will result in a reasonably balanced spread of water supplies across the various risk categories. As the objective is to produce classifications that will facilitate prioritization, there is little value in adopting a grading scheme that will place an overwhelming proportion of water supplies in the highest risk category.

See Case A3.47 for a country example of a national assessment combining water quality test results and SI scores, including the use of grading schemes, to compare risk levels across small water supplies.

Fig. 5.2 • Example matrix indicating priority for remedial action based on microbial water quality results and SI scores[a]



a When there is a potential discrepancy between the results of the microbial water quality assessment and the SI, further follow-up or investigation is required.

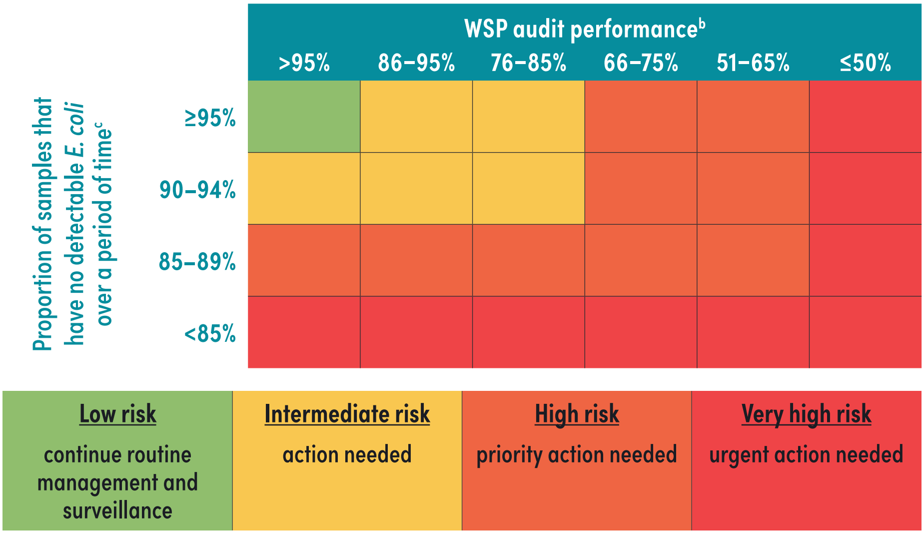
b The score is determined by the total number of yes responses to the SI questions included in the SI form checklist. This total provides an indication of the susceptibility of the water supply to contamination. See Annex 4 for a discussion of differential weighting of SI risk factors where preferred.

c If a significant proportion of samples are in the highest category of microbial contamination (>100 CFU/100 mL), it may be appropriate to include an additional category to further support site prioritization. For example, the grading scheme could be adjusted to include categories for >100–1000 CFU/100 mL and >1000 CFU/100 mL.

d Other microbial water quality grading schemes (such as that shown in Fig. 5.3) can replace the one shown here.

Sources: *Surveillance and control of community supplies (8)* and the GDWQ *(6)*.

Fig. 5.3 • Example matrix indicating priority for remedial action based on microbial water quality results and WSP audit scores[a]



a When there is a potential discrepancy between the results of the microbial water quality assessment and the WSP audit, further follow-up or investigation is required.

b The score is calculated as the number of WSP audit points earned divided by the total number of points available. As the aim of the grading scheme is to identify the highest risk sites to support prioritization, the scheme can be adjusted as needed. For example, where WSP audit scores are generally higher or lower, the categories shown here can be adjusted upward or downward (respectively).

c When there are multiple water quality test results to consider (e.g. from monthly sampling, see Table 3.4), the microbial water quality grading scheme shown may be more suitable than that shown in Fig. 5.2. Just as the categories for WSP audit performance can be adjusted upward or downward, so can the categories for microbial water quality. For example, where microbial water quality is generally lower, the categories shown can be adjusted downward, e.g. to ≥90%, 80–89%, 70–79% and <70%. Alternatively, the categories should be adjusted upward where microbial water quality is generally higher, e.g. to >99%, 95–99%, 90–94%, <90%, to better align with WHO's recommended guideline value for *E. coli* (see Table 3.4).

Sources: adapted from the GDWQ *(6)* and *A practical guide to auditing water safety plans (40)*.

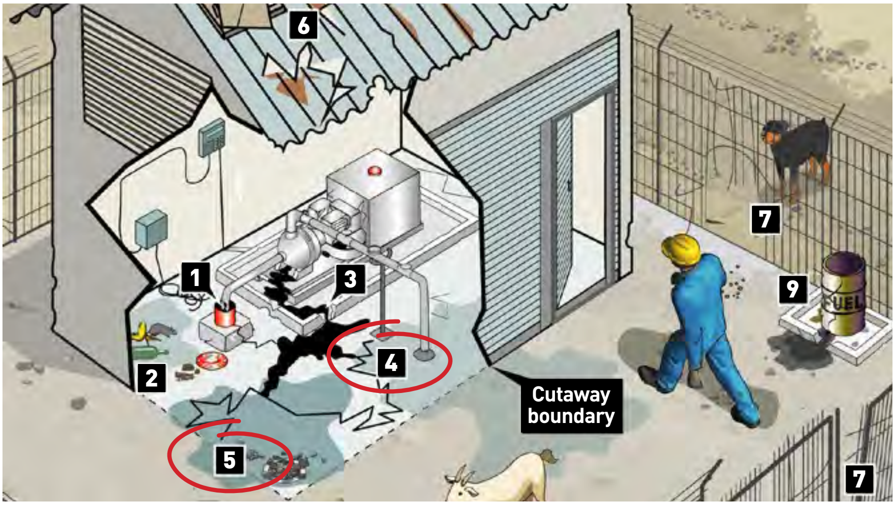
5.3.6 Share surveillance findings promptly and clearly

Surveillance staff should be encouraged to share findings with water suppliers before leaving the site whenever possible, including highlights from SIs, WSP audits, on-site water quality testing and records review. A more formal and comprehensive report may follow the visit (e.g. including results from water samples processed at a laboratory off site), but major findings identified during the site visit should ideally be shared right away. Sharing findings while on site creates a valuable opportunity for discussion and learning, for example about results and improvement opportunities. These exchanges can strengthen water suppliers' technical understanding, in line with the important education and support role played by surveillance staff in the context of small supplies. These exchanges can also help to build relationships and rapport, creating an atmosphere of collaboration around the common goal of improving drinking-water safety. Importantly, when findings indicate that urgent attention is needed, information should be shared immediately to support a timely response.[10] (See section 5.3.8.) Delayed feedback can result in drinking-water contamination or a disease outbreak. Further, surveillance activity can generate interest and momentum to improve water safety, and timely feedback is important to avoid demotivation. Lastly, sharing findings while on site can help to overcome logistical challenges inherent to communicating with remote communities.

Formats for sharing surveillance findings with water suppliers should be clear, concise and sensitive to different levels of technical training and education. Findings that are easy to understand and that deliver direct messages regarding concerns and necessary improvements are more likely to result in improvement action. Where technical knowledge is more limited, pictorial formats highlighting points that require attention (e.g. by circling) can be helpful (see Fig. 5.4). Findings should also be presented in a way that aids understanding rather than being presented in raw form only. For example, water quality test results should be presented alongside target values or standards, with any required action clearly indicated. (See Chapter 6 for guidance on collating information, including surveillance data, and reporting to various audiences besides water suppliers.)

10 If results from off-site water quality analysis reveal that urgent action is needed, results should be communicated by the most rapid means available (e.g. telephone, email or social media), followed as appropriate by hard copy reporting.

Fig. 5.4 • Excerpt from a completed SI form with issues circled and notes made on improvement actions needed



	Sanitary inspection questions	NA	No	Yes	If Yes, what corrective action is needed?
3	**Is the pump in a location where fuel or oil could enter the borehole?** Chemical contaminants could enter the borehole from fuel or oil leaks if the pump is located above, or immediately beside, the borehole. This could also happen if there is accidental spillage during re-fuelling or maintenance.	☐	☑	☐	
4	**Does the floor around the borehole allow water to pass through it?** Contaminants could enter the borehole if the floor is permeable and allows water to pass through it (e.g. an earthen floor). This could also happen if the floor has deep cracks or gaps that allow water to pass through.	☐	☐	☑	Reseal floor due to deep cracks
5	**Is drainage inadequate, which could allow water to accumulate in the borehole area?** Stagnant water could contaminate the borehole if there is no drainage system in place. This could also happen if the drainage system is damaged (e.g. deep cracks) or blocked (e.g. from leaves, sediment). *Note* – the presence of pooled water during the inspection may indicate poor drainage.	☐	☐	☑	When resealing, raise low spots where water now pools
6	**Are the borehole and pump inadequately covered?** Contaminants may enter the borehole if the borehole and pump are not covered (e.g. housed outside in the open). This could also happen if they are housed in a structure that is in poor condition and open to the environment (e.g. a pump house with a damaged roof).	☐	☑	☐	

Source: adapted from *Sanitary inspection packages* (7).

Sharing findings with those who have the appropriate authority to take (or direct) remedial action is another important factor to ensure that improvement needs are actioned by the water supplier. Accountability is a key driving force that should be leveraged to encourage improvement. For professionally managed water supplies, for example, it will generally be appropriate to share surveillance findings directly with management. Also, where applicable and in accordance with established information flows (see section 3.3.7), surveillance reports detailing water quality test results, risk factors identified and recommended short- and long-term improvement actions should be delivered to the local office of the water authority, the regional surveillance office and/or the regulator with enforcement authority (if a different body).

Surveillance findings should also be shared with consumers, who have a right to information on their water supply. (Requirements for reporting to consumers should be addressed in regulations, as noted in section 3.3.7.) This practice may serve to strengthen water suppliers' sense of accountability and further incentivize improvement action. Water suppliers and health authorities should develop strategies for disseminating information to water users, including during water quality emergencies (see section 5.3.8). For less urgent communication, results can be shared through annual reports or posted in a community forum. Local organizations (e.g. local councils, women's groups, religious groups and schools) may have regular meetings that provide an opportunity to relay important information to many people. As it will not always be feasible to share surveillance findings directly with an entire community, these organizations can serve as valuable "multipliers" to reach others within the community. In all cases, communication with consumers should involve clear messaging that is accessible to various groups, including messaging on what consumers can do to protect their water supply (e.g. through source protection and good practices related to drinking-water collection, household treatment, storage and handling).

See Case A3.48 for a country example illustrating the practice of sharing key surveillance findings with small water suppliers and water users during site visits, followed by formal reporting.

5.3.7 Strengthen surveillance-driven remedial action

Surveillance findings should trigger and guide remedial action by water suppliers. Linking surveillance findings to specific recommendations for improvement action at a water supply can be especially important in the context of small supplies, where water suppliers' technical knowledge and access to external expertise may be limited and where guidance from surveillance staff may be essential to an effective response. Surveillance findings are also important to make comparisons between sites to prioritize where support for remedial action is most needed, and to support broader programming, as discussed in Chapter 6.

When surveillance staff consider findings of concern, both short- and long-term improvement needs should be identified. Findings with immediate public health implications should be dealt with urgently, as described in section 5.3.8. For less urgent needs, it is important to consider available resources when recommending action and target incremental improvement where needed (including interim solutions). There is little value in impractical recommendations that can discourage or delay action. In some cases, necessary actions can be undertaken readily at little cost, such as those listed in Box 5.3. In other cases, necessary improvements will require considerable funding, such as substantial upgrades to treatment works or other infrastructure. In such circumstances, water suppliers may need to raise tariffs or obtain funding through government or other sources, which may take time. Water suppliers should be encouraged to develop remedial action plans outlining what will be done, by whom, when and the resources required.

Box 5.3 ▸ Examples of remedial actions that can be undertaken by water suppliers readily and at little cost

- Improving drainage away from pumps, wellheads or spring boxes.
- Adding or improving fencing around a wellhead or spring to protect source water.
- Increasing disinfectant dosing and corresponding monitoring.
- Deep cleaning and disinfection of storage tanks.
- Minor distribution network repairs.

Not all remedial actions will be the sole responsibility of the water supplier. Some actions may be the responsibility of relevant catchment authorities, for example. The environment and health authorities will also generally bear some responsibility for addressing awareness-raising needs related to community member activities near the water source, safe wastewater disposal, effective risk management of household supplies, and safe and hygienic water user practices (e.g. collection, storage, household treatment and handling). Educational and promotional activities addressing unsafe practices by water users and other community members will be important corrective (and preventive) measures for many small water supplies. Ongoing training and support to water suppliers for proactive risk management through WSPs and SIs will also be needed (see Chapter 4).

Surveillance agencies should follow up with water suppliers to confirm that remedial actions have been carried out as planned. This provides an important accountability mechanism for follow-through by water suppliers. It also provides a valuable opportunity for further discussion and feedback between surveillance staff and water suppliers. Systems for follow-up should be formalized, and records should be kept. For example, surveillance staff should monitor and report to the local office of the water authority and the regional surveillance office at routine intervals on the implementation of remedial actions.

It is important to understand and leverage water supplier motivations to undertake remedial action before turning to punitive measures such as sanctions. Applying penalties should generally be considered a last resort for many small supplies, especially for minor violations. Instead, surveillance agencies should aim to use the various tools available to incentivize improved performance, including financial incentives (such as grants), results-based payments and public awards. Public reporting of surveillance findings may also serve to motivate improved performance, particularly for professionally managed water supplies.

See Case A3.49 for an example that illustrates the role of surveillance in identifying and following up on appropriate corrective actions by water suppliers.

5.3.8 Address parameter exceedances

When water quality testing reveals non-compliance with drinking-water quality standards and regulations, investigative and possibly corrective action should be taken to ensure the protection of public health. For detailed guidance on responding to microbial and chemical exceedances, including assessing health risks, refer to sections 7.6 and 8.6 of the GDWQ *(6)*, and to Annexes 1 and 2 of *Developing drinking-water quality regulations and standards (15)*.

It is important that findings of non-compliance are addressed with a view to supporting progressive improvement rather than only enforcing standards, especially in the case of lower-capacity supplies. Many such supplies may struggle to meet standards, and regulatory responses should be practical and constructive. Surveillance staff should help water suppliers identify effective and achievable remedial measures, with sufficient time allowed for implementation where the risk to public health is acceptable.

It is also important that decisions are taken in consultation between the water supplier, health authority and, where appropriate, the drinking-water quality regulator (if a different body).

▶ Microbial exceedances

Waterborne disease can result from even a single exposure to microbially contaminated water. For this reason, any *E. coli* exceedance should be investigated and remedied urgently. Actions to be taken immediately by the surveillance agency and/or the water supplier include the following.

- **Disinfection:** In chlorinated supplies, consider increasing the concentration of chlorine as a minimum immediate response, as well as chlorinating storage tanks and flushing pipelines. In non-disinfected supplies, consider chlorination as a temporary emergency measure. (See Table 3.5 for guidance on target chlorine residuals.)
- **Additional sampling:** In parallel to the above, and where capacity and resources permit, collect further samples to confirm the presence of *E. coli* and to identify possible sources and the extent of the contamination. Also, further samples should be tested for *E. coli* to confirm the effectiveness of increasing the chlorine dose. In chlorinated supplies, chlorine residual should be tested in addition to (or in lieu of, if resources are more limited) further *E. coli* testing.
- **Inspection:** If the contamination is widespread, carry out an inspection to identify and rectify any failures (e.g. in the catchment area, water supply infrastructure or processes, or user practices).
- **Public communication and advice:** If *E. coli* is detected in repeat samples, or if investigations reveal issues that could lead to repeat events, further action should be determined by the health authority, including communicating the need for emergency point-of-use treatment by households (e.g. a boil water advisory). Where *E. coli* detection is found to be common in a particular water supply, users should be advised and supported to consistently apply HWT and safe storage practices, or to use alternative safe drinking-water sources, until the water is deemed to be safe for consumption.

Boil water advisories are serious measures that should only be issued when there is an ongoing risk to public health that outweighs any risk from the advice to boil water.

It is important to develop strategies for disseminating information to consumers in the event of a water quality emergency. (Note that emergency response planning is part of WSP development, as discussed in Chapter 4.) For instance, rapid communication may be required to notify consumers of the need to boil water if significant microbial contamination is confirmed. Advisories should indicate that water can be made safe by bringing it to a rolling boil. The need for safe storage should also be communicated, as water can be contaminated through unsafe storage and handling practices. Means of rapidly communicating to users of small water supplies may include mobile phone messaging systems, media releases (e.g. radio and online media, including social media), posting of written notices in public places, and in-person notification (e.g. door knocking). To ensure equitable access to information, special attention must be given to barriers that vulnerable or marginalized groups may experience, including issues related to literacy, language, physical disabilities, remote location or media access. In some cases, community organizations can play a valuable role in delivering messages.

▶ Chemical exceedances

Chemical exceedances almost invariably require long-term exposure to elevated levels to cause health effects, and there is generally a substantial margin of safety and an assumption of lifetime exposure reflected in the WHO guideline values included in the GDWQ *(6)*. Therefore, chemical exceedances generally do not pose a significant health risk in the short term. Chemical exceedances should be investigated to confirm the original results and to determine the extent, cause and expected duration of the exceedance. The health risk will depend on the extent and duration of the exceedance, and on the sensitivities of specific user groups (e.g. bottle-fed infants in cases of nitrate/nitrite exceedances, particularly where there is endemic diarrhoea in infants). Short-term exceedances due to temporary events or incidents may be readily remedied, for example through pipeline flushing to remove sediments containing chemicals of concern. Where an exceedance is expected to endure and remedial measures cannot be promptly implemented (e.g. due to resource limitations), a derogation may be granted to temporarily authorize the exceedance following an assessment of the risk to public health. Derogations are particularly important to consider where there is no alternative water supply, as the risks of having no drinking-water supply may outweigh the risk posed by the exceedance. Water avoidance advisories due to chemical exceedances are less common than boil water advisories for microbial contamination, and they should only be used when necessary to manage a substantial health risk.[11]

11 During periods of water avoidance, alternative sources of safe drinking-water must be provided, e.g. bottled, carted or tankered water that has been approved by the responsible authorities. Particular consideration should be given to the microbial safety of the alternative sources used. Even where water avoidance advisories have been issued, supply should generally be maintained for other domestic uses, including hygiene.

6 Improving data use

This chapter addresses the systematic collation and use of information on small water supplies at national and subnational levels to inform decision-making and drive improvement.

Questions addressed include:

- What factors contribute to a culture of data use for decision-making and improvement action in the context of small water supplies?
- What strategies can be applied to progressively strengthen data use?
- How can data on small water supplies be collated from across a region or country, clearly reported and systematically used to support decision-making?

6 Improving data use

This chapter addresses the systematic use of information on small water supplies at national and subnational levels to inform decision-making and drive improvement. Data use is essential for planning, implementation and evaluation of efforts to improve the delivery of safe water. The information in this chapter is intended for those responsible for establishing regulatory requirements related to data collection and reporting (see Chapter 3) and for developing processes and tools to facilitate data review and use.

The guidance in this chapter complements sections 5.3.6 and 5.3.7, which address reporting and use of surveillance findings from an individual water supply to effect improvement at that supply. This chapter, on the other hand, addresses the collation and use of information from across a region or country to support higher-level decision-making. The guidance in this chapter applies not only to surveillance findings, but also to information gathered through other data collection efforts (e.g. water supply inventory information, community survey findings or results from water quality testing included in household surveys).

6.1 Guidelines recommendation

Recommendation 6

Strengthen systems of data sharing and use to inform decision-making and action at all levels.

Governments should strengthen systems involved in the collection, management, reporting and use of information on small water supplies to support evidence-based decision-making at all levels of government. This involves ensuring that programmes for information collection duly consider target data users and their information needs, and that stakeholder capacity, tools and processes contribute to effective data use.

Examples of data that should be prioritized for use, as well as potential users and uses of data, are presented in Box 6.1.

Box 6.1 ▸ Types, users and uses of data on small water supplies

A wide range of information may be collected on small water supplies, including locations, technologies and ownership; water quality monitoring results; WSP audit findings; SI scores; operations and maintenance information; key performance indicator data; consumer feedback; and more. Potential users of this information include consumers, water suppliers, surveillance agencies, regulators, and authorities responsible for planning, finance, health, environment and local government. Data users may also include research institutes, nongovernmental organizations, external support agencies, and those involved in international reporting and benchmarking. Uses of data by these stakeholders within the context of these Guidelines include:

- **prioritize** high-risk water supplies most in need of remedial action and allocate resources accordingly;
- **inform policies, strategies and costed plans** that highlight and address common or recurrent problems;
- **track progress** towards service delivery targets, e.g. targets on water quality, quantity and accessibility (coverage);
- **confirm compliance** with drinking-water quality standards and regulations; and
- **inform consumers** of the safety of their drinking-water supply in accordance with their right to information.

Refer to Box 6.2 for examples of decision-making processes that should be informed by data on small water supplies.

6.2 Rationale

Data alone do not result in safer water. Rather, the effective interpretation, communication and use of data to inform decisions and interventions lead to improvement. As there are commonly fewer resources available for data collection for small water supplies as compared to larger supplies, it is important to optimize the use of data that are collected on these supplies. Benefits include:

- **public health protection:** proactive data use is fundamental to public health protection, including the prevention of waterborne disease outbreaks;
- **inclusion:** effective use of data available on small supplies will help ensure that the needs of those served by these supplies are not overlooked during programming, prioritization and resource allocation;
- **informed decision-making and action:** effective data use allows evidence-based decision-making and improvement action, from site-level interventions to national plans and programmes;
- **optimal use of resources:** effective data use allows for strategic allocation of limited human and financial resources for optimum impact;
- **greater levels of accountability:** regular collection and dissemination of data

allow regulators and consumers to better hold water suppliers to account in terms of the quality and level of service provided; and

- **consumer confidence:** proactive data sharing with consumers has the potential to increase confidence in water supplies and ultimately improve revenue collection.

Despite the clear benefits, research indicates widespread potential to better use data on water supplies, including in the case of small supplies. In many countries, valuable data are collected but are not optimally managed, reported and acted upon to effect change *(12)*. Breakdowns in data use have been linked to insufficient management of microbial risks and waterborne disease outbreaks in areas served by small water supplies.

Strengthening systems of data use therefore represents an important area of opportunity to improve drinking-water service delivery. Ensuring that priority data are well used may be as or more impactful than efforts to collect more data, as there is limited value in collecting information that is not meaningfully applied.

6.3 Implementation guidance

This section presents guidance to support the practical implementation of the Guidelines recommendation, including how to assess and progressively strengthen systems of data use.

6.3.1 Assess factors that contribute to effective data use

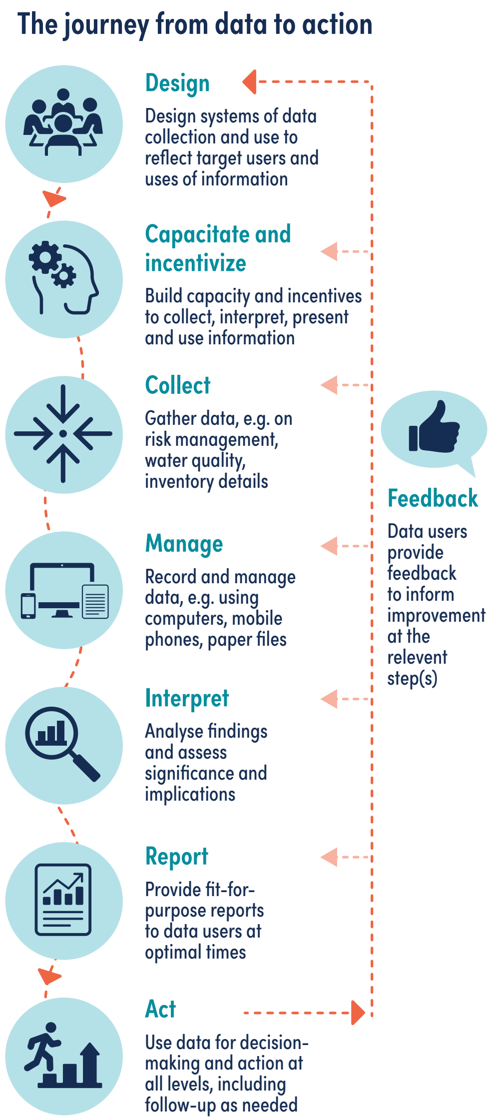
There are many factors that support and enable data use. Fig. 6.1 depicts an optimal data "journey" that begins with identifying what decisions need to be made, by whom, and what data are required to make those decisions, and ends with evidence-based decision-making and action. Each step along this path contributes to the consistent and impactful use of information. In most settings, there will already be systems in place addressing some or all of these steps. However, there may also be opportunities to improve or expand these systems and their application in the context of small water supplies. Key weaknesses along the pathway from data collection to use should be identified and addressed. Fostering and rewarding a broad culture of data use and data-informed decisions are of critical importance.

The journey shown in Fig. 6.1 is impacted by the broader enabling environment for data use, including relevant regulations and associated policies, strategies and processes. The supporting enabling environment should include well defined roles and responsibilities for all relevant stakeholders. As data collection, communication and use will generally involve multiple actors (see Box 6.1), stakeholder arrangements should be clear and contribute to an atmosphere of collaboration, trust and mutual support. See Chapter 2 and section 3.3.7 for further guidance on the enabling environment related to effective data use.

It is valuable to assess systems and practices related to the various factors shown in Fig. 6.1 through a small water supply lens to identify strengthening opportunities. Important considerations include the following.

- **Design:** Are the intended users and uses of the various data collected from small supplies clear? Are target data users involved in the design of data collection programmes such that their needs are adequately reflected? Do data collection programmes reflect due consideration of resource and logistical challenges?
- **Capacitate and incentivize:** Are individual and organizational capacities and motivations sufficient as they relate to data collection, interpretation, reporting and use? Is a culture of data use being fostered, including peer expectations and incentives? Are disincentives to data sharing (e.g. reputational, financial) being adequately managed? Are programmes, tools and training to develop capacity effectively reaching those most in need of technical expertise?
- **Collect:** Do data collection practices contribute to data use (e.g. by building confidence among data users that the data are current, accurate and credible)? Are appropriate protocols followed for the use of field testing equipment and SI forms? Are the tools being provided to data collectors aligned with the needs of data users?

Fig. 6.1 • Factors contributing to effective data use



- **Manage:** Are information management systems working effectively (and sustainably) to facilitate data analysis, sharing and use? Do systems adequately serve small water supplies (e.g. accounting for typical challenges related to remoteness, computer access and internet connectivity)? Are the data accessible to all relevant stakeholders, are privacy protections in place and is ownership of data clearly delineated?
- **Interpret:** Are data effectively interpreted and presented so the significance and implications of findings are clear (e.g. findings compared to national standards, remedial actions recommended, trends assessed and relative risk levels explored)? Are linkages made between related findings, such as SI scores and microbial water quality test results?
- **Report:** Are reports tailored to various data users (e.g. water users, water suppliers and national planners) and delivered at the times and frequencies that optimize data uptake and use? Are reports clear enough to support data users in acting upon the information, including those who lack technical expertise and require clear guidance? Are data users aware of the reports and are they accessible to all?
- **Act:** Are processes and platforms in place to encourage and facilitate data use by intended users (e.g. joint review processes or similar; see section 6.3.5)? Are data being used in practice to guide relevant decisions and actions by all target data users, from those managing household supplies to national authorities? Do decision-makers have the authority to require remedial action based on the evidence provided and to leverage the resources needed? Are there follow-up and accountability mechanisms to support action? Are evidence-based decisions and actions working to improve water supplies?
- **Seek feedback:** Is feedback sought from data users on the value and utility of data provided, including on the quality, quantity, relevance, accessibility, timeliness and clarity of information? Are the data fit for purpose? What improvements would better support data use?

This type of data system analysis should be led and coordinated by key sector entities (e.g. apex ministries, regulators) and include the participation of a variety of stakeholders that are involved in the various steps and stages of data collection, interpretation and use, such as surveillance agencies, standards agencies, water suppliers and consumers.

See Case A3.50 for a country example describing an assessment of breakdowns in the use of data on small water supplies, and the resulting changes in systems for data management and sharing.

6.3.2 Progressively strengthen data use

Assessing existing systems of data use as described in section 6.3.1 will commonly reveal the need for improvements. In some cases, findings may suggest a need to revisit regulatory requirements for data collection, sharing and use, including those related to monitoring parameters and frequencies (see Chapter 3). Critical assessments of how and by whom monitoring data are (and are not) ultimately used may, for example, highlight information that could be collected less frequently to save resources. Or, they may reveal a need for additional monitoring data, for example additional parameters or greater frequencies. In other cases, findings will reveal that the appropriate data are being collected but are not adequately used. In these cases, an incremental approach should be taken to improve data use as resources allow. Such improvement will generally be a continuous process, as data use goals and related systems continue to evolve.

Acting on data related to the microbial safety of drinking-water is the highest priority.

The highest priority use of water supply data is to address any immediate threats to user health, in particular to prevent waterborne disease. For example, data indicating that drinking-water supplies are microbially contaminated or significantly at risk of microbial contamination (e.g. high SI scores, inadequate chlorine residual) must be promptly followed up. (Refer to section 5.3.8 for guidance on addressing urgent findings.) After needs related to the consistent use of data for immediate health protection are addressed as the top priority, the systematic and comprehensive use of additional data to inform site-level improvements and higher-level planning can be progressively strengthened. The following list presents examples of strategies and focus areas to incrementally improve data use. These strategies and focus areas offer guidance on where to target efforts initially where human and financial resource constraints necessitate a stepwise approach to improvement.

- **Build on existing systems:** Before working to establish new systems related to data use, strengthen the implementation of systems already in place.
- **Start small:** As needed, focus on a subset of the factors shown in Fig. 6.1 initially. For example, attention may be given to data collection and reporting in the beginning, with systems incrementally built to better manage and interpret data as the complexity and volume of information grows.
- **Address priority questions:** If resources do not permit the routine collection of all data of interest, focus on answering the questions that are most likely to directly influence management decisions and improvement actions.

- **Consider exposed populations:** Prioritize data use for supplies serving entire communities (e.g. community and professionally managed supplies) initially, with household managed supplies more fully addressed over time.
- **Progress through levels of data use:** Consider strengthening site- and local-level use of data initially and working towards more effective regional and national data use over time.
- **Harmonize data collection:** Support harmonized data collection (e.g. through standardization of target information, forms and tools) to facilitate data sharing and comparison (see section 6.3.3).
- **Improve reporting:** Ensure that reports are fit for purpose and accessible to target data users to improve data understanding and uptake. Different groups of data users will require different forms of data presentation and aggregation (see section 6.3.4).
- **Systematize data review processes:** Strengthen practices of systematic data review as part of decision-making, including in planning and resource allocation processes (see section 6.3.5).

See Cases A3.51 and A3.52 for country examples of progressive improvements to systems related to the collection, analysis and use of data on small water supplies, as well as the benefits that have resulted from these changes.

6.3.3 Harmonize data collection and management

To avoid fragmentation of data sets and to help ensure that data collected can be readily compared nationally and subnationally, harmonization of tools and approaches is critical. Standardized data collection tools and indicators are essential to allow data collation and comparison. SI forms, WSP audit scoring systems and small supply inventory forms, for example, should be standardized to reflect a common set of questions and indicators. For small water supplies in particular, it is also valuable to harmonize the collection of information on water quality and safety with that on other aspects of water supply (e.g. data on functionality and affordability), as well as on sanitation and hygiene. An integrated approach to WASH data collection will streamline efforts and highlight linkages between these areas. Standardizing WASH data collection tools should involve consultation with stakeholders at various levels to ensure that local perspectives are reflected in the tools and approaches adopted.

Where multiple stakeholders are collecting and using related data (e.g. both the water and health authorities are monitoring water quality), integrated databases and platforms will allow all parties access to the larger body of data. Access and editing capabilities can be tailored for different stakeholders to ensure data protection. In addition to contributing to efficiencies, shared data platforms can foster a sense of common purpose and mutually supportive stakeholder relationships. If relevant, development partners and programmes (e.g. international nongovernmental organizations and bilaterally funded investment programmes) should be strongly encouraged to use national data systems, including performance indicators.

Where feasible, electronic data entry, storage and sharing (in contrast with paper-based systems) can support efficiency, facilitate trend analysis, reduce processing errors, and optimize reporting and response times. In settings with poor internet access or inconsistent power supplies, it may be necessary to collect and store data using an offline mode and transmit data as and when connections permit. Mobile phones and tablets can support data entry and transmission, including in remote settings, thereby optimizing speed. An important consideration for electronic data management is reliable data hosting. Where such systems or services do not exist nationally, well established, open-source data management platforms may be used. In addition to the dependability and user friendliness of the platform, features such as login authentication, server backup, responsible use policies, disaster recovery plans and affordability (including management and maintenance costs) should be considered. It is important to remember that as reliance on electronic data grows, so must cybersecurity measures to protect against the unintentional release or manipulation of data through cyberattacks. Appropriate privacy protection protocols must also be followed.

See Cases A3.53 and A3.54 for country examples of the use of digital platforms for data on rural water supplies to support planning and decision-making.

6.3.4 Prepare timely and fit-for-purpose reports

To support evidence-based prioritization and decision-making at national and subnational levels, data from across sites and regions should be collated, interpreted, summarized and presented in reports that are clear and fit for purpose. Reports should be delivered at a time and frequency that will encourage their use in work planning and budgeting cycles; longer-term priority-setting and strategic planning; and other decision-making activities that are (or should be) informed by the data available on small water supplies. Reporting frequencies should be defined in regulations (see section 3.3.7) and established in consultation with target data users.

Reporting should be rapid wherever urgent action is needed to protect public health at a particular water supply (see sections 3.3.7 and 5.3.8), whereas routine reporting frequencies will vary by stakeholder and intended data use. For routine reporting within the surveillance agency, frequencies of reporting from local to regional offices may be relatively high (e.g. monthly) as compared to reporting from regional to national offices (e.g. annually). For periodic reports intended for use by various other stakeholders to support decision-making at local or regional levels, annual reporting is often appropriate. In contrast, national level priority-setting and planning tend to be longer-range processes for which less frequent reporting may suffice, for example every 3–5 years.

Reports that deliver relevant information clearly and concisely are more likely to contribute to decision-making. Specific reporting needs, like content and formatting, will vary by use and user and should be determined through stakeholder consultation and feedback (see Fig. 6.1). Relevant reporting considerations include the following.

- **Clarity:** Reports should present information in a way that is clear and accessible to target data users.
- **Interpretation:** All data uses benefit from reporting that reflects thoughtful consideration of the significance and implications of data, including comparison of findings to established targets (e.g. national standards).
- **Quantity:** Too much or too little information may discourage data use. In cases of too much information, summaries or dashboard formats facilitate communication of key findings. In cases of too little information, supplemental short-term data collection campaigns may be possible with the help of local schools, research groups or citizen scientists while longer-term solutions are pursued.
- **Resolution:** Some data uses at the local government level, for example, will require site-level details such as test results to determine and prioritize infrastructure upgrade needs. Other data uses, such as national or regional programming, will benefit from composite information such as mean SI scores or WSP audit scores, the proportion of supplies with given degrees of *E. coli* contamination, or overall compliance with chemical standards.
- **Trends:** Understanding trends, both across sites and over time, is fundamental to planning and programming. For example, widely experienced or recurrent problems indicate an opportunity for policy and programming improvements rather than repeated localized remedial action. Also, recognizing improvement or deterioration over time provides valuable information on the effectiveness and sustainability of interventions that should inform course corrections.
- **Comparison:** To support prioritization and the allocation of limited resources, reports should compare findings across sites and regions to indicate relative risk (e.g. to identify high-risk districts).

- **Visualization:** Data visualization is a powerful tool for data assimilation and use. Information that is summarized in tables, graphs, maps and other visual formats is more likely to be understood and applied.
- **Public dissemination:** Making information publicly available to various stakeholder groups helps to address consumers' rights to information about their drinking-water supplies, promotes transparency and incentivizes improvement. Sensitivities related to the public sharing of water supplier data should be considered and managed.
- **Joint action:** Ensure that reports and associated data are fed into sector review platforms and can be reflected upon and used to inform collective action as part of formal multistakeholder processes (see section 6.3.5).

See Case A3.55 for study findings describing how optimal data analysis and reporting vary according to target data users and uses; and see Cases A3.56 and A3.57 for country examples of user-friendly reporting formats.

6.3.5 Systematize data use in decision-making processes

Consistent use of data requires that clear processes and platforms for data collation and review are embedded in all relevant planning and funding cycles. These processes should be supported by regulatory requirements for data sharing and use (see section 3.3.7).

Box 6.2 provides examples of decision-making processes that should involve a systematic review of available data.

See Cases A3.58 and A3.59 for country examples describing the systematic use of information on small water supplies to inform planning and budgeting decisions.

Box 6.2 ▸ Examples of decision-making processes that should be informed by available data

Site improvements

Decisions (e.g. by local government or the regional office of the water authority) on where to focus technical or financial support for site improvements are made through joint analysis of water quality test results and SI findings or WSP audit scores to gauge relative risk.

Training programmes

Local and regional health offices periodically review the most common risk factors identified through SIs for prevalent water supply technologies to inform educational programmes for households and communities.

Funding allocations

Available surveillance data and information from small water supply inventory activities are reviewed by finance agencies to inform regional and national funding allocations for investment in water supplies. Actions include financing high-priority improvements identified through audited WSPs.

Strategic planning

Available surveillance data and information from small water supply inventory activities are reviewed by the water, health and national planning authorities as part of a regular review process to identify trends, common challenges and good practices, and to guide longer-term strategic planning. Actions include establishing working groups to consider and pilot technical or managerial solutions to persistent problems (e.g. limited capacity for effective maintenance of small supplies).

Course corrections

Annual summaries of breaches of water quality standards, water safety incidents and responses, and various remedial work undertaken by water suppliers are prepared by local authorities and reviewed by regional and national offices of the water authority to identify common challenges and improve strategies and programmes accordingly.

Operating licence renewal

Local government reviews water quality test results and WSP audit findings to confirm compliance with national regulations as a condition of operating licence renewal for small private utilities.

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23. Water safety plan manual: step-by-step risk management for drinking-water suppliers, 2nd edition. Geneva: World Health Organization; 2023 (https://apps.who.int/iris/handle/10665/366148, accessed 14 August 2023).

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Selected further reading

The following list contains a selection of further reading material to support and elaborate on the guidance presented in Chapters 2 through 6 of this publication. This is not intended to be a comprehensive list; there are numerous additional resources available to support the topics covered in these Guidelines.

▶ Chapter 2: Assessing the enabling environment

- Costing and financing of small-scale water supply and sanitation services. Copenhagen: World Health Organization. Regional Office for Europe; 2020.
- Huston A, Moriarty P. Building strong WASH systems for the SDGs: understanding the WASH system and its building blocks. The Hague: IRC; 2020.
- OECD principles on water governance. Paris: Organisation for Economic Co-operation and Development; 2018.
- Sustainability assessment of rural water service delivery models: findings of a multi-country review. Washington (DC): World Bank; 2017.
- UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) data portal.[1]
- Water supply and sanitation policies, institutions, and regulation: adapting to a changing world. Washington (DC): World Bank; 2022.
- World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) data portal.[2]
- World Health Organization, United Nations Children's Fund, World Bank. State of the world's drinking water: an urgent call to action to accelerate progress on ensuring safe drinking water for all. Geneva: World Health Organization; 2022.

▶ Chapter 3: Health-based regulations

- Compendium of drinking-water systems and technologies from source to consumer. Geneva: World Health Organization; in preparation.
- Developing drinking-water quality regulations and standards: general guidance with a special focus on countries with limited resources. Geneva: World Health Organization; 2018.

1 See this portal for the latest GLAAS survey data (including on governance, monitoring, human resources and finance); published reports on the global status of water, sanitation and hygiene (WASH) systems and needs; and to create customized reports to inform decision-making processes.
2 See this portal for the latest JMP data (global, regional, national) and reports on progress on WASH.

- Evaluating household water treatment options: health-based targets and microbiological performance specifications. Geneva: World Health Organization; 2011.
- Guidelines for drinking-water quality: 4th edition incorporating the 1st and 2nd addenda. Geneva: World Health Organization; 2022.
- Lead in drinking-water: health risks, monitoring and corrective actions: technical brief. Geneva: World Health Organization; 2022.
- Protecting groundwater for health: managing the quality of drinking-water sources. Geneva: World Health Organization; 2006.
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- Water quality and health – review of turbidity: information for regulators and water suppliers. Geneva: World Health Organization; 2022.
- World Health Organization International Scheme to Evaluate Household Water Treatment Technologies.[3]
- World Health Organization. Regional Office for Europe, United Nations Economic Commission for Europe. Taking policy action to improve small-scale water supply and sanitation systems: tools and good practices from the pan-European region. Copenhagen: World Health Organization. Regional Office for Europe; 2016.

▶ Chapter 4: Water safety planning

- A field guide to improving small drinking-water supplies: water safety planning for rural communities. Copenhagen: World Health Organization. Regional Office for Europe; 2022.
- A guide to equitable water safety planning: ensuring no one is left behind. Geneva: World Health Organization; 2019.
- Climate-resilient water safety plans: managing health risks associated with climate variability and change. Geneva: World Health Organization; 2017.

3 See this website for the latest results and summary reports on household water treatment products evaluated under the Scheme.

- Global status report on water safety plans: a review of proactive risk assessment and risk management practices to ensure the safety of drinking-water. Geneva: World Health Organization; 2017.
- Guidelines for drinking-water quality: 4th edition incorporating the 1st and 2nd addenda. Geneva: World Health Organization; 2022.
- Local participatory water supply and climate change risk assessment: modified water safety plans. New York: United Nations Children's Fund; 2015.
- Setty K, Ferrero G. Water safety plans. Oxford Research Encyclopedia of Global Public Health. 2021.
- Think big, start small, scale up: a roadmap to support country-level implementation of water safety plans. Geneva: World Health Organization; 2010.
- Water safety planning for small community water supplies: step-by-step risk management guidance for drinking-water supplies in small communities. Geneva: World Health Organization; 2012.
- Water safety planning: a roadmap to supporting resources. Geneva: World Health Organization; 2017.
- World Health Organization and International Water Association Water Safety Portal.[4]

Chapter 5: Surveillance

- A practical guide to auditing water safety plans. Geneva: World Health Organization; 2015.
- Developing drinking-water quality regulations and standards: general guidance with a special focus on countries with limited resources. Geneva: World Health Organization; 2018.
- Guidelines for drinking-water quality: 4th edition incorporating the 1st and 2nd addenda. Geneva: World Health Organization; 2022.
- Howard G. Water quality surveillance: a practical guide. Loughborough: Water Engineering and Development Centre, Loughborough University; 2002.
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- World Health Organization. Regional Office for Europe, United Nations Economic Commission for Europe. Surveillance and outbreak management of water-related infectious diseases associated with water-supply systems. Copenhagen: World Health Organization. Regional Office for Europe; 2019.

4 See this portal for water safety planning resources and information on news and events.

Chapter 6: Improving data use

- Boulenouar J, Adank M. Data in water and sanitation: bridging the gap between "technically brilliant" and "real-world decision-making". Final report. Phase 2: from lessons to recommendations. Aguaconsult; 2022.
- Consolidation, improvement and expansion of the rural water and sanitation information system (SIASAR). Report No. AUS11483. Washington (DC): World Bank; 2017.
- Danert K, Furey S, Mechta M, Gupta S. Effective joint sector reviews for water, sanitation and hygiene (WASH). Washington (DC): World Bank; 2016.
- Data for decision-making: water and sanitation in low-resource settings. Nairobi: Aquaya; 2022.
- From data to decisions: developing user-centred monitoring programmes for water, sanitation and hygiene. London: WaterAid; 2020.

Annex 1: Approach to content development and declarations of interest

The need for updating the World Health Organization's (WHO's) 1997 *Guidelines for drinking-water quality. Volume 3: surveillance and control of community supplies* (or *Surveillance and control of community supplies*) *(1)* was identified by the WHO Drinking-water Quality Committee at the *Guidelines for drinking-water quality* expert meeting in Singapore (2008). A key driver for the update was the need for full alignment with the central recommendation in the *Guidelines for drinking-water quality*, namely the framework for safe drinking-water, including water safety planning. Following a detailed review of *Surveillance and control of community supplies* to identify key areas that required updating, an expert international meeting was convened in Dübendorf, Switzerland (2013) to review the target audience, scope and content of this updated publication. An expert Working Group was established in 2014 to oversee development of this publication and the supporting *Sanitary inspection packages – a supporting tool for the Guidelines for drinking-water quality: small water supplies* (or *Sanitary inspection packages*) *(2)*. The Working Group was composed of small water supply experts and experienced practitioners, including in the areas of drinking-water supply management, surveillance and regulation. The structure and key messages of this publication were further developed during expert meetings in Seattle, United States of America (2014) and Bishkek, Kyrgyzstan (2014).

A first draft of this publication was prepared in 2015 by select Working Group experts, and reviewed by the broader Working Group at an expert meeting in Guildford, United Kingdom of Great Britain and Northern Ireland (2015). This draft was further revised in 2016 based on the Working Group's recommendations, and discussed at a meeting in Chișinău, Republic of Moldova (2017). As part of this process, WHO commissioned a study in 2015 on the evidence base and experiences on sanitary inspections, which informed the updated guidance on sanitary inspections included in this publication and the supporting *Sanitary inspection packages*. See Annex 1 in *Sanitary inspection packages* for details regarding the study.

This publication was further developed between 2018 and 2021 in line with the Working Group recommendations, additional expert and practitioner feedback, and relevant literature. Between 2019 and 2021, a literature review was undertaken to ensure that the recommendations and good practice guidance in this publication (which are underpinned by the recommendations in the *Guidelines for drinking-water quality*) reflect the latest evidence base. The literature review broadly covered aspects relating to drinking-water quality regulation, risk management and surveillance as they relate to small drinking-water supplies. The review encompassed existing WHO publications, grey literature (e.g. technical guidance materials, research reports) as well as peer-reviewed research articles. The literature was retrieved through searches in targeted databases, including the WHO Institutional Repository for Information Sharing, Google Scholar and PubMed. In addition to the database searches, key experts were consulted to comment on the references cited and to provide additional key references to be considered. Also, in 2020, a global survey was undertaken to support the development of tailored guidance for small water supplies. Feedback was received from reviewers representing 36 countries and areas across all WHO regions,[1] which informed the development of a reference typology of small water supplies (see Table 1.1) and corresponding tailored guidance, with a particular focus on appropriate compliance monitoring frequencies for priority parameters (see Tables 3.4 to 3.9).

The draft publication was issued for global peer review in 2022, and feedback was received from small water supply experts and practitioners representing 24 countries across all six WHO regions.[2] The publication was subsequently revised based on peer-review feedback and expert opinion, and finalized in 2023.

All Working Group members and expert meeting attendees submitted declarations of interest to WHO to disclose any potential conflicts of interest that might affect, or reasonably be perceived to affect, their objectivity and independence in relation to the subject matter of this publication. WHO reviewed each of the declarations and concluded that none could give rise to a potential or reasonably perceived conflict of interest related to the subjects discussed at the meetings or covered by these Guidelines.

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[1] Argentina, Bangladesh, Belarus, Bolivia (Plurinational State of), Cabo Verde, Cambodia, Cameroon, Canada, Czechia, Ethiopia, Ghana, Guatemala, Guinea, Honduras, Hungary, Indonesia, Japan, Kenya, Liberia, Malaysia, Mali, Mauritius, Mozambique, Nepal, Nicaragua, occupied Palestinian territory, including east Jerusalem, Philippines, Senegal, Sudan, Uganda, United Kingdom of Great Britain and Northern Ireland, United Republic of Tanzania, United States of America, Uruguay, Viet Nam, Zambia.

[2] Australia, Cameroon, Canada, Ecuador, France, Germany, Ghana, Indonesia, Italy, Japan, Kenya, Madagascar, Nepal, Netherlands (Kingdom of the), New Zealand, Nigeria, Pakistan, Portugal, Sweden, Switzerland, Uganda, the United Kingdom, the USA, Zimbabwe.

Annex 2: Checklist of implementation actions to address Guidelines recommendations

Chapter 2 • Assessing the enabling environment

Recommendation 1

Assess enabling environment conditions that affect small water supply service delivery to inform system strengthening.

Implementation actions:

- Review service levels and trends
- Review governance arrangements
- Review financing
- Review capacity and human resources
- Review monitoring frameworks and practices
- Develop a strategic plan to strengthen the enabling environment

Chapter 3 • Health-based regulations

Recommendation 2

Establish regulations for small water supplies that promote risk management practice and define priority monitoring parameters and frequencies on the basis of risk.

Recommendation 3

Adopt regulatory approaches that promote a shift towards professionalized operation and management of small water supplies.

Implementation actions:

- Engage and support small water suppliers
- Promote catchment-to-consumer risk management
- Define priority water quality parameters
- Set protective and realistic parameter limits
- Establish monitoring frequencies and locations
- Specify analytical requirements (including for field test kits)
- Establish reporting requirements and incident protocols
- Define a risk-based surveillance programme
- Establish suitable additional regulations

Chapter 4 • Water safety planning

Recommendation 4

Promote and support water safety plans, which should be implemented by water suppliers to most effectively manage risks from catchment to consumer.

Implementation actions:

- Understand the distinctions between risk management approaches
- Establish risk management requirements
- Consider a staged approach to risk management requirements
- Provide water suppliers training and guidance in risk management
- Provide water suppliers practical tools to support risk management
- Establish sustainable financing for risk management programmes
- Link to other water, sanitation and hygiene initiatives

Chapter 5 • Surveillance

Recommendation 5

Practise risk-based surveillance, including verifying risk management practice by water suppliers and applying limited resources to address priority public health concerns.

Implementation actions:

- Define minimum frequencies for surveillance activities
- Progressively expand surveillance activities
- Invest in training and tools for surveillance staff
- Establish sustainable financing for surveillance
- Jointly analyse risk management scores and water quality
- Share surveillance findings promptly and clearly
- Strengthen surveillance-driven remedial action
- Address parameter exceedances

Chapter 6 • Improving data use

Recommendation 6

Strengthen systems of data sharing and use to inform decision-making and action at all levels.

Implementation actions:

- Assess factors that contribute to effective data use
- Progressively strengthen data use
- Harmonize data collection and management
- Prepare timely and fit-for-purpose reports
- Systematize data use in decision-making processes

Annex 3: Case examples

This annex presents good-practice examples from countries and areas around the world that relate to the recommendations in these Guidelines. These examples are provided to demonstrate how the guidance in this publication can be, and has been, implemented in practice in a wide variety of contexts. The cases presented are summarized in Table A3.1.

Table A3.1 • Summary of case examples, including linkages to Guidelines chapters and sections

Case no.	Title	Related Guidelines section
Chapter 2: Assessing the enabling environment		
A3.1	Reviewing rural water supply performance in Uganda to inform sector strengthening	2.3.1
A3.2	Integrating water quality testing into household surveys in Ecuador to fill data gaps	2.3.1
A3.3	Addressing gaps in drinking-water regulatory frameworks and mechanisms in Cabo Verde	2.3.2
A3.4	Overcoming institutional fragmentation within the water sector in Israel	2.3.2
A3.5	Financing drinking-water service delivery in rural areas in Uganda	2.3.3
A3.6	Planning for capacity development of small water supply operators in the United States of America	2.3.4
A3.7	Adapting monitoring frameworks for small water supply conditions in Peru	2.3.5
A3.8	Undertaking strategic planning to improve rural drinking-water service provision in Zambia	2.3.6
Chapter 3: Health-based regulations		
A3.9	Professionalizing community-based water supply management in Uganda	3.2
A3.10	Expanding utility management of rural and small-town drinking-water services in Africa and Asia	3.2
A3.11	Engaging small water suppliers in the development of regulations in New Zealand	3.3.1
A3.12	Contributions of an Indigenous-owned water supplier to regulatory processes in Canada	3.3.1
A3.13	Guidance and support for unregulated household managed supplies in Ireland	3.3.1
A3.14	Incentive-based regulation of drinking-water service providers in South Africa	3.3.1
A3.15	Legal frameworks and technical support for catchment protection in Germany	3.3.2
A3.16	Taking a risk-based approach to updating regulatory parameters in the Philippines	3.3.3
A3.17	Interim arsenic limits applied to rural water supplies in the Lao People's Democratic Republic	3.3.4
A3.18	Water quality monitoring frequency requirements that vary according to population served in Iceland	3.3.5

Table A3.1 continued • **Summary of case examples, including linkages to Guidelines chapters and sections**

Case no.	Title	Related Guidelines section
A3.19	Permitting risk-based deviations from minimum monitoring requirements in the European Union	3.3.5
A3.20	Allowing the use of field test kits for *Escherichia coli* testing in Canada	3.3.6
A3.21	Allowing the use of field test kits to overcome challenges with laboratory testing in Nepal	3.3.6
A3.22	Certification requirements and technical guidance for field testing of chlorine in Portugal	3.3.6
A3.23	Surveillance reporting requirements set out in standards and guidelines in Bhutan	3.3.7
A3.24	Defining surveillance roles and responsibilities in governance instruments in the Philippines	3.3.8
A3.25	Required treatment techniques and associated guidance in the United States of America	3.3.9
A3.26	Treatment requirements and alternative "acceptable solutions" in New Zealand	3.3.9
A3.27	Household water treatment standard and associated product certification scheme in Ghana	3.3.9
A3.28	Training and competency requirements for operators of small water supplies in Finland	3.3.9
A3.29	Phased implementation of material safety standards in the occupied Palestinian territory, including east Jerusalem	3.3.9
A3.30	Regulatory initiatives to strengthen enforcement of material safety standards in Ghana	3.3.9
Chapter 4: Water safety planning		
A3.31	Improved microbial water quality linked to water safety planning in Wales	4.2
A3.32	Strengthened operations and maintenance linked to water safety planning in the Asia–Pacific region	4.2
A3.33	Risk management requirements that vary by water supply size in Germany	4.3.2
A3.34	Allowing rural water suppliers sufficient time to comply with water safety plan requirements in the Lao People's Democratic Republic	4.3.3
A3.35	Standardized operator training and tools that incorporate risk management principles in Madagascar	4.3.4
A3.36	Water safety plan templates that reflect different water supplier capacities in Bhutan	4.3.5
A3.37	Water safety plan tools tailored for different water supply sizes in Finland	4.3.5
A3.38	Grants to support well owners in managing water safety risks in Ireland	4.3.6
A3.39	Water safety planning as a mechanism to prioritize and fund improvement works in Vanuatu	4.3.6
A3.40	Strengthening the climate resilience of rural drinking-water supplies in Cambodia	4.3.7

Table A3.1 continued • Summary of case examples, including linkages to Guidelines chapters and sections

Case no.	Title	Related Guidelines section
Chapter 5: Surveillance		
A3.41	Prioritizing higher-risk sites for more frequent surveillance activity in Nigeria	5.3.1
A3.42	More frequent surveillance activity at sites serving vulnerable populations in South Australia	5.3.1
A3.43	Strategic use of limited surveillance resources to optimize public health benefit in England	5.3.2
A3.44	Establishing a training course and knowledge exchange forum to support surveillance practice in India	5.3.3
A3.45	Developing digitized sanitary inspection forms to support surveillance in Iceland	5.3.3
A3.46	Sustainable financing of regulatory activities (including surveillance) in Zambia	5.3.4
A3.47	Joint analysis of water quality and sanitary inspection scores to assess risk across rural water supplies in Serbia	5.3.5
A3.48	Discussing surveillance findings with water suppliers and users during site visits in Indonesia	5.3.6
A3.49	Surveillance follow-up to drive corrective action by water suppliers in the occupied Palestinian territory, including east Jerusalem	5.3.7
Chapter 6: Improving data use		
A3.50	Improved data management in Sierra Leone informed by assessing gaps and root causes	6.3.1
A3.51	Progressively improving collection and use of data on water, sanitation and hygiene sector spending in Mali	6.3.2
A3.52	Strengthening collection, analysis and use of water, sanitation and hygiene data in Ghana	6.3.2
A3.53	Improving evidence-based planning and decision-making in Nepal through a digital data platform	6.3.3
A3.54	Expanding use of a digital platform for data on rural water and sanitation service delivery in Latin America and Africa	6.3.3
A3.55	Differing needs for data analysis and reporting according to target data users and uses in Latin America and Africa	6.3.4
A3.56	Simple and accessible reporting of water quality data for non-technical audiences in Ethiopia	6.3.4
A3.57	Accessible reports on water supplier performance in Kenya and the United Republic of Tanzania	6.3.4
A3.58	Systematic use of data on water safety risks to support routine funding allocations in Vanuatu	6.3.5
A3.59	Annual planning and budgeting processes informed by rural water supply monitoring data in Myanmar	6.3.5

Case A3.1 ▶ Reviewing rural water supply performance in Uganda to inform sector strengthening

The community-based management system has historically been Uganda's dominant model for small-scale rural water supplies. However, the government has had long-standing concerns over the sustainability of these services. To inform strengthening initiatives, the Ministry of Water and Environment spearheaded the review of a range of information sources to assess conditions under the community-based management system, including:

- national and subnational data on water point functionality[1] and other priority indicators, such as percentage of the population using an improved drinking-water source and the percentage of water points with active water and sanitation committees;
- targeted studies on the barriers to effective operations and maintenance under the community-based management system;
- data from formalized approaches to operations and maintenance in Uganda; and
- best practices from other comparable country contexts.

This review revealed priority challenges, including that functionality rates had stagnated at around 85% over several years. It also provided an evidence base to drive sector reform related to the operations and maintenance of rural water supplies. Central to this reform was publication of the National Framework for Operation and Maintenance of Rural Water Infrastructure in Uganda (2020), which introduced professionalized area service providers offering regular maintenance and repair services. These services are provided under management contracts with local government water authorities and are overseen by water supply services boards at the district level. (See Case A3.9 for more information on professionalized operations and maintenance services for rural water supplies in Uganda.)

Sources:

National framework for operation and maintenance of rural water infrastructure in Uganda. Ministry of Water and Environment, Uganda; 2020 (https://www.mwe.go.ug/sites/default/files/library/O%26M%20Framework%20for%20rural%20water%20services_V6_24.07.2020.pdf, accessed 13 November 2023).

Water and environment sector performance report 2020. Ministry of Water and Environment, Uganda; 2020 (http://envalert.org/wp-content/uploads/2020/09/SPR-20-Final-Combined.pdf, accessed 13 November 2023).

1 The functionality rate is defined as the percentage of improved water facilities found functional at the time of the spot check.

Case A3.2 ▶ Integrating water quality testing into household surveys in Ecuador to fill data gaps

In rural areas of Ecuador, municipalities often delegate drinking-water service provision to small community organizations. With 221 municipal governments and an estimated 7000 community water service providers in rural areas, the quality of service provision is highly variable across the country. As there are limited regulatory data on drinking-water quality in Ecuador, water quality testing has been integrated into household surveys to measure compliance with national standards.

In 2016, the National Institute of Statistics and Censuses integrated testing for *Escherichia coli* (*E. coli*) in household drinking-water sources into the National Survey on Employment, Unemployment, and Subemployment. Furthermore, an indicator on drinking-water quality was included in the National Development Plan *"Toda una vida"* 2017–2021, encouraging national monitoring systems to continue regular water quality testing in national household surveys to measure progress. As such, the 2019 National Survey on Employment, Unemployment, and Subemployment again involved *E. coli* testing, this time also at the point of consumption to allow an assessment of any water quality degradation following collection from the source.

Data from the 2016 and 2019 surveys indicated that water quality was the main bottleneck to achieving safely managed drinking-water services (as compared to accessibility and availability). Improving risk-based water quality management and surveillance is therefore essential. The data also indicated that household water treatment (specifically boiling) should be promoted alongside hygiene practices such as safe storage and handwashing with soap.

In 2022, testing for *E. coli* and residual chlorine was integrated into the National Institute of Statistics and Censuses National Survey on Child Malnutrition. This is a continuous survey, covering around 1900 households per month, that provides ongoing information on microbial safety and seasonal influences on water quality.

Sources:

Moreno L, Pozo M, Vancraeynest K, Bain R, Palacios JC, Jácome F. Integrating water-quality analysis in national household surveys: water and sanitation sector learnings of Ecuador. npj Clean Water. 2020;3. doi:10.1038/s41545-020-0070-x.

Principales resultados: encuesta nacional sobre desnutrición infantil - ENDI. Instituto Nacional de Estadística y Censos, Ecuador; 2023 (in Spanish) (https://www.ecuadorencifras.gob.ec/documentos/web-inec/ENDI/Presentacion_de_Resultados_ENDI_R1.pdf, accessed 13 November 2023).

Case A3.3 ▸ Addressing gaps in drinking-water regulatory frameworks and mechanisms in Cabo Verde

Cabo Verde has made considerable progress improving rural water supply service provision, with the proportion of the rural population accessing at least a basic water supply service[2] increasing from 72% in 2012 to 83% in 2022. This progress can be linked to sector reform efforts, including substantial progress made in regulating water supply services.

Two autonomous regulatory agencies, the National Water and Sanitation Agency and the Multisector Economic Regulatory Agency, share responsibilities for regulating water supply services. The former is a technical regulator dedicated to water supply and sanitation, while the latter has a multisectoral mandate focused on economic regulation. The mandates and functions of the two agencies are established in separate legal instruments, but the agencies collaborate to regulate service providers (e.g. by conducting joint inspections and publishing a joint sector report). Since establishment of the National Water and Sanitation Agency in 2013 and the Multisector Economic Regulatory Agency in 2018, the agencies have developed comprehensive regulatory mechanisms, including standards and guidelines, incentives (reputational and financial), sanctions, monitoring (quality of service, economic efficiency and operational sustainability) and performance reporting. (Previously, key regulatory responsibilities were held within ministries, and vital gaps existed in the regulatory mechanisms applied.)

Cabo Verde has also introduced a comprehensive benchmarking process for all regulated service providers, including those managing small-town and rural water supply facilities. This involves benchmarking service providers on 15 service quality indicators (including water quality) and 16 economic and financial indicators, and publicly sharing the results.

***Sources*:**

The status of the water supply and sanitation regulatory landscape across Africa: Cape Verde country report. Eastern and Southern Africa Water and Sanitation Regulators Association; 2022.

World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply, Sanitation and Hygiene data portal [website]. Estimates on progress in household drinking water, sanitation and hygiene, 2000-2022 (www.washdata.org/data/household#!/, accessed 23 October 2023).

Case A3.4 ▸ Overcoming institutional fragmentation within the water sector in Israel

The Israeli Water Authority was established in 2007 as an autonomous government agency with wide-ranging responsibilities. These span the planning, development, management and regulation of the water sector (including small drinking-water suppliers), inclusive of the operation and conservation of natural water resources. Its creation is linked to several improvements through the evolution of the country's water supply sector.

[2] The World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply, Sanitation and Hygiene defines basic drinking-water as that from an improved source with a round-trip collection time of no more than 30 minutes.

Integral to the functioning of the Israeli Water Authority is the Israeli Water Authority Council. The Council is a regulatory body that is independent and interministerial, with a strong legislative mandate. It is chaired by the Director General of the Israel Water Authority, and its members (which are defined by law) comprise senior officials from relevant government ministries and two representatives of the public. The Council has served to overcome sector fragmentation in Israel by providing a formalized body and mechanism for coordinated planning and decision-making between the Ministry of Environmental Protection, Ministry of Health, Ministry of Finance, Ministry of Interior Affairs, Ministry of Agriculture, and the Ministry of National Infrastructure, Energy and Water Resources. Since the establishment of this decision-making body, sector planning and policy development have become more cohesive and effective.

Sources:

Slepner O, Governmental Authority for Water and Sewage, personal communication, 2023.

Water management in Israel: key innovations and lessons learned for water scarce countries. Washington (DC): World Bank; 2017 (https://openknowledge.worldbank.org/entities/publication/710b3061-a461-546b-af1d-9d615e88ed34, accessed 13 November 2023).

Case A3.5 ▶ Financing drinking-water service delivery in rural areas in Uganda

Uganda's water supply sector has been evolving rapidly, with the Ministry of Water and Environment transforming the six regional water and sanitation support organizations into utilities focused on small towns and rural growth centres. These utilities, referred to as umbrella organizations (or umbrellas), support the Ministry of Water and Environment in meeting its significant mandate to extend water services to 100% of urban and 85% of rural areas by 2025.[3]

Since 2017, the umbrellas have gone from providing technical support to water boards on operations and maintenance to directly managing over 300 facilities serving over 4.4 million people (as of December 2022). Despite some challenges, the umbrellas have considerably improved access, service delivery reliability and water quality. Nationally, the proportion of the rural population using water supplies that are available when needed increased from 58% in 2015 to 70% in 2022, and the proportion of the rural population using water supplies that are free from contamination increased from 34% to 56% over the same period.

Three sources of sustainable financing have proven essential to these efforts to improve service delivery in rural areas.

- **User fees.** Improved revenue collection efficiency (78% in 2019/2020 increased to 87% in 2021/2022) and the doubling of household connections from 2019 to 2022 have increased revenue generation.
- **Subsidies.** The challenge of delivering financially viable water supply services in small towns, peri-urban areas and rural areas is recognized by the Ministry of Water and Environment, which regularly provides subsidies. For example, in 2019/2020, the Ministry provided US$ 650 000 in subsidies to the umbrellas to help cover the cost of service provision.

3 These targets are unlikely to be realized due to various challenges, but the contributions of the umbrellas have been considerable.

- **Revenue from other activities.** The umbrellas are involved in other activities, such as cesspool emptying and water quality testing services, that generate some income (albeit minimal) to complement the revenue from water user fees.

It is hoped that ongoing improvements to the financial viability and the overall professionalization of the umbrellas will eventually enable them to access commercial lending from the financial sector. Uganda's National Water and Sewerage Corporation is a well documented example of a sub-Saharan African utility that has been able to access such financing.

Sources:

Annual water utilities regulation report. Ministry of Water and Environment, Uganda; 2023.

Progress on household drinking water, sanitation and hygiene, 2000-2022: special focus on gender. New York: United Nations Children's Fund and World Health Organization; 2023 (https://www.who.int/publications/m/item/progress-on-household-drinking-water--sanitation-and-hygiene-2000-2022---special-focus-on-gender, accessed 13 November 2023).

Water and environment sector performance report. Ministry of Water and Environment, Uganda; 2020 (https://mwe.go.ug/sites/default/files/library/Water%20and%20Environment%20Sector%20Performance%20Report%202020.pdf; accessed 20 November 2023).

Case A3.6 ▸ Planning for capacity development of small water supply operators in the United States of America

In the United States of America, more than 97% of the 156 000 public water systems are small supplies, serving 10 000 or fewer people. Capacity development of small water supply operators is a fundamental component of the 1996 Safe Drinking Water Act Amendments, which provide a framework for states and water suppliers to work together to protect public health. Every state must formulate a capacity development programme to assist public water systems in building technical, managerial and financial capacities, including operator training and certification (and re-certification), asset management and water supplier partnerships. The federal government's Environmental Protection Agency is responsible for ensuring state compliance in operator certification, which is executed through state programmes. Support for capacity-building and certification is also provided by non-state actors and networks, for example the Rural Community Assistance Program and the National Rural Water Association.

Most state certification programmes differentiate operator certification requirements by the size and complexity of small water facilities. For example, in Hawaii, all water treatment plant operators must have at least a high school diploma (or equivalent) and pass a certification exam with a minimum grade of 70%. Additionally, there are work experience requirements that vary according to facility classification. Water treatment plants, for instance, are classified from Class 1 to Class 4 according to the complexity of treatment. Operating a Class 1 plant requires only 1 year of work experience, while operating a Class 4 plant requires up to 4 years of work experience (less with higher levels of educational attainment), including experience at sufficiently complex treatment facilities.

In Hawaii, certification of public water system operators is carried out by a board established by the state Department of Health. The Hawaii Rural Water Association provides continuous support and training for operators of small water supplies, with funding from the Environmental Protection Agency and the Department of Health, as well as income from fee-based services. Circuit Riders from the Hawaii Rural Water Association and the Rural Community Assistance Cooperation help operators with compliance, maintenance and management issues. They work with operators to troubleshoot problems, provide training, evaluate alternative technological solutions, recommend operational improvements, assist with leak detection, and respond to natural disasters and other emergencies.

Sources:

Learn about capacity development [webpage]. United States Environmental Protection Agency; 2023 (https://www.epa.gov/dwcapacity/learn-about-capacity-development, accessed 13 November 2023).

Lopez G, Hawaii Department of Health, personal communication, 2023.

Operator certification [webpage]. State of Hawaii, Department of Health; 2023 (https://health.hawaii.gov/sdwb/operatorcert/, accessed 13 November 2023).

Seto J, Hawaii Department of Health, personal communication, 2023.

Summary of state operator certification programs. Washington (DC): United States Environmental Protection Agency; 2016 (https://www.epa.gov/sites/default/files/2016-03/documents/summary_of_state_operator_certification_programs.pdf, accessed 13 November 2023).

Water circuit rider programs [webpage]. Hawai'i Rural Water Association; n.d. (https://www.hrwa.net/water-circuit-riders.html, accessed 13 November 2023).

Case A3.7 ▸ Adapting monitoring frameworks for small water supply conditions in Peru

In Peru, important steps have been taken to support effective monitoring and regulation of water service provision in rural areas. Community-based organizations are the predominant management model, with more than 24 000 of these organizations representing 92% of service providers (as of October 2023). These organizations are responsible for the daily operations and maintenance of rural water services, and they receive technical assistance from nearly 1000 local government outreach units known as Municipal Technical Areas. Sector reforms have accelerated, beginning with the 2016 Framework Law on the Management and Provision of Sanitation Services, focusing on:

- providing a new framework for ensuring more efficient and sustainable management of rural water services and a revised monitoring and regulatory mandate for rural water areas;
- developing policy to define the role of central, regional and local levels of government to improve water quality and safe excreta disposal; and
- adopting a strategy to specifically improve rural water quality.

The public regulator, the National Superintendence of Sanitation Services, was established in 1992 and initially focused on urban utilities. In 2016, it began to progressively monitor the performance of community-based organizations and service levels in rural areas through standardization and benchmarking. Through this process, the National Superintendence of Sanitation Services has recognized the importance of adapting the monitoring approach in rural areas to account for different conditions rather than simply replicating urban approaches. A different monitoring regime is applied for rural service providers (e.g. a limited number of parameters assessed and a lower frequency of reporting). Small supplies also have different performance metrics. For example, the threshold for good service is 18 hours of supply per day in rural areas, whereas in urban areas, the threshold is set at 24 hours per day.

The National Superintendence of Sanitation Services uses monitoring results to identify those supplies that require assistance and provides guidance to improve performance. It produces yearly benchmarking reports and shares data transparently through an information system for rural service providers. Looking forward, there is scope for the agency to continue to expand coverage of rural water supplies and more fully operationalize its regulatory functions.

***Sources*:**

Agua con calidad para la población rural 2017-2019. Ministerio de Desarrollo e Inclusión Social, Peru; 2020 (in Spanish) (https://cdn.www.gob.pe/uploads/document/file/1277904/Agua%20Más%20-%20Agua%20con%20calidad%20para%20la%20población%20rural.pdf, accessed 13 November 2023).

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Información general [webpage]. Sistema de Registro de Información de Área Técnica Municipal, Peru; 2023 (in Spanish) (http://aplicaciones.sunass.gob.pe:8080/RegistroATM/indicadoresATM.html, accessed 13 November 2023).

Case A3.8 ▶ Undertaking strategic planning to improve rural drinking-water service provision in Zambia

Zambia has undertaken significant reforms for rural and small-town water supply service provision, with its 11 commercial utilities mandated since 2018 to ensure safe and reliable provision of these services. When these reforms were initiated, stakeholders recognized that strengthening key elements of the enabling environment as required for this transition would be a considerable and long-term undertaking. A comprehensive review of required changes and improvements was conducted, and Zambia's water supply and sanitation sector regulator – the National Water Supply and Sanitation Council – developed the Rural Water Supply and Sanitation: Framework for Provision and Regulation in Zambia in 2018.

This framework goes beyond setting out a vision for rural and small-town water supply service provision, and is helping to ensure a much more coordinated and harmonized approach to the substantive process of professionalizing rural water supply services in Zambia by:

- outlining the wide-ranging modifications and reforms required to achieve the vision, including changes to institutional arrangements, licences and permits, regulations, by-laws, monitoring and performance reporting, and standards and guidelines;
- detailing roles and responsibilities of different actors (i.e. the regulator, various ministries, local governments, service providers and development partners) in effectively making and operationalizing the required changes;
- providing an implementation plan and outlining the process for monitoring and tracking progress; and
- specifying the required budget.

The 2018 framework helps to operationalize the National Rural Water Supply and Sanitation Programme 2019–2030, which aims to ensure sustainable and equitable access to safe water supply and adequate sanitation for all of Zambia's rural population.

***Sources*:**

National rural water supply and sanitation programme (NRWSSP) 2019-2030. Ministry of Water Development, Sanitation and Environmental Protection, Zambia; 2023 (https://www.mwds.gov.zm/wp-content/uploads/2023/02/MWDSEP_NRWSSP_Programme_Final-2019-2030.pdf, accessed 13 November 2023).

Rural water supply and sanitation: framework for provision and regulation in Zambia. Lusaka: National Water Supply and Sanitation Council; 2018 (https://www.susana.org/en/knowledge-hub/resources-and-publications/library/details/3328#, accessed 13 November 2023).

Case A3.9 ▶ Professionalizing community-based water supply management in Uganda

The community-based management system in Uganda has been linked to functionality concerns for rural water supply infrastructure, and to lengthy downtimes (periods when water supplies are unavailable). The Ministry of Water and Environment identified inadequate operations and maintenance as the main weakness in the community-based management system arrangement, despite the Ministry's prior efforts to formalize maintenance services through establishing the Hand Pump Mechanics Association model in 2011.

In 2020, the Ministry of Water and Environment published the National Framework for Operation and Maintenance of Rural Water Infrastructure in Uganda (see Case A3.1). This framework sets out a professionalized form of the community-based management system, referred to as Community Based Management Plus. Under this arrangement, key maintenance and repair functions linked to persistent technical and financial challenges experienced under the community-based management system are delegated to area service providers – usually private operators – through performance contracts involving local government and water boards. The area service providers employ local hand pump mechanics, provide training (including refresher training), source spare parts, and ensure preventive maintenance schedules are followed and immediate repairs are made.

One such area service provider is Whave Solutions. Providing services across 17 districts and over 3000 hand pumps, Whave Solutions reports a functionality rate of 94–97%, and further reports that 90% of repairs are performed within 1 day. These results represent marked improvements in water supply performance as compared to facilities managed under the non-professionalized form of the community-based management system.

***Sources*:**

National framework for operation and maintenance of rural water infrastructure in Uganda [webpage]. Ministry of Water and Environment, Uganda; 2023 (https://www.mwe.go.ug/library/national-framework-operation-and-maintenance-rural-water-infrastructure-uganda#:~:text=The%20National%20Framework%20for%20Operation,Royal%20Danish%20Embassy%20and%20UNICEF, accessed 13 November 2023).

Our results [webpage]. Kampala: Whave Reliability Assurance; 2023 (https://www.whave.org/our-results, accessed 13 November 2023).

Case A3.10 ▸ Expanding utility management of rural and small-town drinking-water services in Africa and Asia

The expansion of utility-managed rural and small-town water supply service provision is a crucial development in the professionalization of small water supplies in many low- and middle-income countries, including in Africa and Asia. Utilization of rural and small-town water supplies is occurring through various pathways and in a diverse range of countries.

- **Expansion of single town, regional or national utilities into rural areas through expanding the physical water supply scheme and management responsibilities.** Examples include town utilities in Ethiopia, Kenya and Viet Nam, as well as regional and national utilities in Burkina Faso (National Office of Water and Sanitation), Uganda (National Water and Sewerage Corporation) and Zambia (commercial utilities, see Case A3.46).
- **Service delivery model change, with a regional, national or dedicated rural utility taking over the management of existing schemes previously managed under other service delivery models (e.g. community or municipal management).** Examples exist in Rwanda (Byumba Local Public Private Partnership Model), Senegal (Hydraulic Works Operating Company), Uganda (umbrella water authorities) and Viet Nam (Centre for Rural Water Supply and Environmental Sanitation).

- **Establishment of a new rural utility to manage newly constructed rural schemes.** Examples include the emergence of rural utilities managing multi-village schemes in Ethiopia and ongoing efforts in Viet Nam to attract private capital for developing new schemes to be managed by rural utilities. Examples also include privately owned-and-operated facilities such as those in Ghana and India.

Performance varies considerably among utilities. However, the water utilities typically perform markedly better than the service providers (often water committees) they are replacing against a broad set of indicators, including hours of supply, water quality, non-revenue water, climate resilience and operational cost coverage. In Uganda, for example, the National Water and Sewerage Corporation's expansion into some rural areas and the establishment of umbrella water authorities have contributed to a comparatively rapid increase in service levels and more sustainable financing of rural and small-town water supply services (see Case A3.5).

Source:

Adank M, van Lieshout R, Ward R. Utility-managed rural water services: models, pathways, drivers, performance and areas for support. The Hague: IRC; 2021 (https://www.ircwash.org/resources/utility-managed-rural-water-services-models-pathways-drivers-performance-and-areas-support, accessed 13 November 2023).

Case A3.11 ▸ Engaging small water suppliers in the development of regulations in New Zealand

In New Zealand, the Water Services Act 2021 expanded the scope of regulated water supplies to include all facilities except those serving a single domestic household. Regulated supplies now include what are referred to as "very small community supplies" that serve up to 25 people, and this regulatory expansion requires an estimated 75 000 additional facilities to be registered by 2025 and to meet national drinking-water quality standards by 2028. This represents a significant undertaking for Taumata Arowai, New Zealand's independent drinking-water regulator.

During initial efforts to operationalize this change, Taumata Arowai became aware that many service providers were resistant to being brought under its regulatory purview and did not intend to register their supplies or comply with standards. Taumata Arowai recognized that imposing a regulatory regime in these circumstances would not be successful. Therefore, it sought to gain an in-depth understanding of the reality for very small community supplies and how they could be assisted to understand the need for safe drinking-water to secure their buy-in to participate in regulatory activities. Taumata Arowai therefore released draft standards and regulations to small water suppliers, solicited their feedback and visited many facilities. These engagements directly informed substantial revisions to the standards and rules, reducing the scope of activities that small water suppliers were responsible for undertaking. Following these revisions, a further 10 week consultation period was coordinated, resulting in additional changes to the standards and rules. Revisions made through these consultations included modifications to water treatment and monitoring requirements to address cost and feasibility concerns while ensuring public health protection, as well as increased emphasis on the financial and technical support to be provided to water suppliers.

The relationship building and changes made to the standards and regulations through these extensive consultations are expected to increase regulatory compliance by small water suppliers and thereby maximize the public health benefit. Looking forward, Taumata Arowai expects to progressively increase regulatory requirements in areas such as treatment (e.g. requiring ultraviolet disinfection) as circumstances allow.

***Sources*:**

Graham J, Taumata Arowai, personal communication, 2023.

Water services act 2021. New Zealand; 2023 (https://www.legislation.govt.nz/act/public/2021/0036/latest/LMS374564.html, accessed 13 November 2023).

Case A3.12 ▸ Contributions of an Indigenous-owned water supplier to regulatory processes in Canada

There is currently a regulatory vacuum for drinking-water services for First Nations communities on reserves in Atlantic Canada. First Nations communities do not have legally enforceable safe drinking-water protections comparable to what is in place in provinces and territories. In 2013, the Safe Drinking Water for First Nations Act intended to support the development of federal regulations for First Nations' access to clean, reliable drinking-water and effective treatment of wastewater. First Nations voiced concerns about this legislation, citing lack of adequate, predictable and sustainable funding; non-recognition of Aboriginal water rights; potential infringements on Aboriginal and treaty rights; lack of proper protection of source water; and insufficient engagement. In response to these concerns, and aligned with the Safe Drinking Water Class Action Settlement Agreement, the Government of Canada repealed the 2013 Safe Drinking Water for First Nations Act.

The Government of Canada is currently developing new proposed First Nations drinking-water and wastewater legislation in consultation with First Nations. The new proposed legislation would establish national standards for drinking-water quality and quantity and wastewater on First Nations lands, and enable the development of regulations. Water service provider engagement in this process is understood to be essential to regulatory success. In developing regulations and standards, the Government of Canada would build on the guidance and initiatives of knowledgeable and proactive water service providers, such as the Atlantic First Nations Water Authority.

The Atlantic First Nations Water Authority was established in 2018 as the first Indigenous-owned water utility in Canada. It is responsible for the operation, maintenance and capital upgrades of all centralized water and wastewater assets of participating First Nations in Atlantic Canada. The water authority's board of directors – composed of community Chiefs, regional Chiefs, and technical and financial experts – has been a leading proponent of regulations and standards for drinking-water service providers serving First Nations communities. Taking a bottom-up approach to filling the regulatory gap, the water authority has developed its own interim Drinking Water Regulatory Guidance and Compliance Standards, which cover source water withdrawal and protection, treatment and distribution requirements, operator certification, and monitoring and reporting, among many other topics. The water authority has also successfully requested that Indigenous Services Canada, through the First Nations and Inuit Health Branch, leads a collaboration with Nova Scotia Environment and Climate Change to provide interim support until a First Nations Regulatory regime can be established by First Nations. This includes providing a third-party review of the water authority's performance in adhering to the Drinking Water Regulatory Guidance and Compliance Standards, as well as reviewing drinking-water quality test results and providing environmental public health guidance to the water authority to address any adverse water quality test results. While this is a review and advisory function, it provides an important foundation for future legally mandated regulatory activities.

The involvement of the Atlantic First Nations Water Authority and other service providers in informing regulations and standards is recognized by the Government of Canada as crucial to ensuring requirements are feasible and balanced with programmes and tools that enable and promote compliance.

***Sources*:**

Backgrounder and timeline for consultation draft: proposal for an act respecting drinking water, wastewater and related infrastructure on First Nations. Canada; 2023 (https://www.canada.ca/en/indigenous-services-canada/news/2023/03/proposal-for-an-act-respecting-drinking-water-wastewater-and-related-infrastructure-on-first-nations-lands.html, accessed 13 November 2023).

Mackinnon J, Atlantic First Nations Water Authority, personal communication, 2023.

Mercer J, Indigenous Health Services Canada, personal communication, 2023.

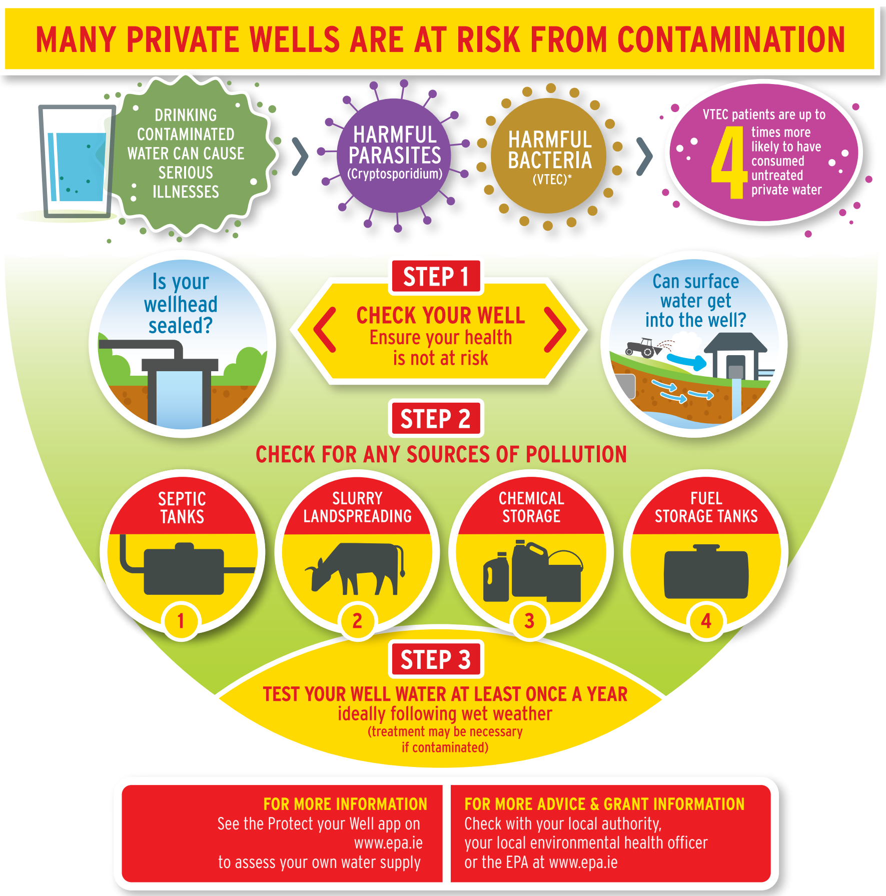
Case A3.13 ▶ Guidance and support for unregulated household managed supplies in Ireland

In Ireland, approximately 11% of the population relies on private water supplies. These water supplies, which provide water to only one household for drinking and domestic purposes, are exempted from national drinking-water regulations. However, the Environmental Protection Agency – which regulates public water supplies in Ireland – encourages private well owners to conduct sanitary inspections routinely to maintain the safety of their supplies, and to test water quality at least annually to verify safety. Importantly, these recommendations are complemented by resources to raise awareness and offer technical support to private well owners. The Environmental Protection Agency website includes a dedicated page on household wells that offers various tools and resources, such as:

- a brief **video** explaining in simple terms the importance of inspecting wells for potential sources of contamination, carrying out routine water quality testing, and taking corrective action as needed;

- a **Protect Your Well web application** that facilitates a step-by-step process of inspecting wells to confirm they are adequately protected, and to determine what actions should be taken where protection is lacking;
- **guidance** on water quality testing, including which parameters should be tested and how often, and what to do when contamination is detected;
- an **infographic** summarizing health risks, common sources of contamination, water quality testing guidance and where to go for support (see the figure); and
- a general **frequently asked questions** page with more information, such as how to disinfect a well, additional treatment options and grants available to address water safety issues (see Case A3.38).

Infographic to support the protection of household wells



*Verotoxin-producing *Escherichia coli* (VTEC)

Source: adapted from Household wells [webpage]. Environmental Protection Agency, Ireland; 2023 (https://www.epa.ie/environment-and-you/drinking-water/household-wells/, accessed 13 November 2023).

In addition to the website, leaflets covering key water safety topics are distributed at various events and locations typically frequented by private well owners (e.g. farming and livestock events). The leaflets have also been made available to local authorities for use in their relevant activities (e.g. farm and septic tank inspections).

Sources:

Household wells [webpage]. Environmental Protection Agency, Ireland; 2023 (https://www.epa.ie/environment-and-you/drinking-water/household-wells/, accessed 13 November 2023).

Private wells [webpage]. Ireland; 2021 (https://www.gov.ie/en/publication/1d9d8-private-wells/#, accessed 13 November 2023).

S.I. No. 99/2023 - European Union (Drinking water) regulations 2023. Ireland; 2023 (https://www.irishstatutebook.ie/eli/2023/si/99/made/en/print, accessed 13 November 2023).

Case A3.14 ▶ Incentive-based regulation of drinking-water service providers in South Africa

In South Africa, the Blue Drop certification programme was initially introduced in 2008 by the Department of Water and Sanitation as a form of incentive-based regulation of drinking-water service providers (small and large). An equivalent programme, referred to as Green Drop, was introduced for wastewater services.

Through rewards (and penalties), the Blue Drop programme seeks to induce changes in behaviour to support the continuous improvement of drinking-water services, the adoption of best management practices and regulatory compliance. The programme measures the ability of water suppliers to provide acceptable services through the assessment of various key performance areas, which have evolved over time. For the 2021–2022 Blue Drop audit period, the five key performance areas were: (i) capacity management, (ii) drinking-water quality risk management (through water safety planning), (iii) financial management, (iv) technical management and (v) drinking-water compliance. Bonus points were awarded for process control training, performance agreements, publication of drinking-water quality results and water demand management. Point deductions were applied where data variances and discrepancies were detected and where water services institutions failed to notify on drinking-water quality failure.

To encourage regulatory compliance and good performance, the Blue Drop programme leverages two main forms of reputational incentives.

- **Performance reporting and benchmarking.** Blue Drop reports are made publicly available and benchmark water service institutions' performance against a wide-ranging set of indicators. Results are presented in a highly visual manner, enabling the reader to clearly distinguish the provinces, municipalities and individual water supplies performing well, in addition to those where significant challenges persist.

- **Awards.** Blue Drop status is awarded on a water supply system basis to those that meet the required criteria, with municipalities often achieving Blue Drop status for several systems (especially in rural areas). This is done in a ceremony that acts as a highly public form of recognition, which is usually timed to align with the main water conference in the sector.

Sources:

Blue Drop progress report. Department of Water and Sanitation, Republic of South Africa; 2022 (https://ws.dws.gov.za/IRIS/releases/2021_BD_PAT_report_final-28Mar22_MN_web.pdf, accessed 13 November 2023).

Muir A, Department of Water and Sanitation, personal communication, 2023.

Case A3.15 ▸ Legal frameworks and technical support for catchment protection in Germany

In Germany, an important complement to water safety planning by small water suppliers (see Case A3.33) are decrees that protect the quality of drinking-water sources, including sources for small supplies. In line with the German Federal Water Act (2019), state authorities designate drinking-water catchment protection areas, with a decree issued for each of these areas that defines local protective measures.

These decrees may be complemented by voluntary cooperative agreements between water suppliers and farmers, which encourage compliance with protective measures and offset adverse impacts to farmers. The agreements, which are formalized and binding, promote farming practices that prevent contamination of drinking-water sources from pesticides, pathogens and nitrates. Through the agreements, farmers receive expert advice on techniques and practices that protect water resources. Advice is provided through individual and group consultations, site visits and circular letters. It covers topics such as fertilization regime, manure use, erosion control and pesticide control. In some cases, programme costs are covered by abstraction fees from licensing programmes. In the federal state of Lower Saxony, for instance, at least 40% of abstraction fees is to be used to finance protective measures like cooperative agreements. Smaller drinking-water supplies have merged to form larger subregional cooperatives to meet eligibility thresholds for cooperative agreement financing.

Sources:

Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz - WHG). Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection; 2023 (in German) (https://www.gesetze-im-internet.de/whg_2009/WHG.pdf, accessed 13 November 2023).

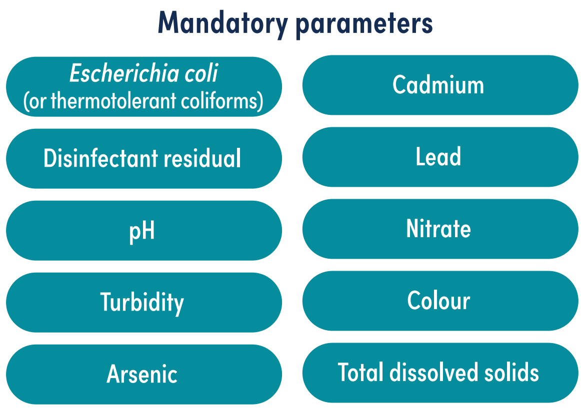
Taking policy action to improve small-scale water supply and sanitation systems: tools and good practices from the pan-European region [webpage]. Copenhagen: World Health Organization Regional Office for Europe; 2016 (https://www.who.int/europe/publications/i/item/9789289051606, accessed 13 November 2023).

Water protection policy in Germany [webpage]. Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, Germany; n.d. (https://www.bmuv.de/en/topics/water-management/overview-water-management/policy-goals-and-instruments/water-protection-policy-in-germany, accessed 13 November 2023).

Case A3.16 ▸ Taking a risk-based approach to updating regulatory parameters in the Philippines

In 2017, the Philippine Department of Health issued the revised Philippine National Standards for Drinking Water, which apply to all types and sizes of water supplies in the country. There were several drivers for the revision, including the need to integrate the 2014 national policy requiring all water suppliers to implement water safety plans. Another key driver was the history of non-compliance by many water suppliers with respect to meeting water quality monitoring requirements, indicating issues with the feasibility of the previous standards. Previous monitoring requirements were considered too onerous, particularly for small water suppliers with limited resources and/or limited access to equipment or testing laboratories accredited by the Department of Health.

Mandatory parameters required by the Philippine National Standards for Drinking Water of 2017



Source: adapted from the Philippine national standards for drinking water of 2017. Administrative order no. 2017-0010. Department of Health, Philippines; 2017 (https://www.fda.gov.ph/wp-content/uploads/2021/08/Administrative-Order-No.-2017-0010.pdf, accessed 13 November 2023).

The standards were revised using a risk-based approach that involved grouping parameters into different categories and prioritizing them for monitoring according to risk to health and local occurrence. This process yielded the following three categories of parameters.

- **Mandatory parameters.** This set of 10 core parameters (see the figure) must be monitored by all water suppliers. These minimum monitoring parameters were prioritized based on their ability to directly affect health (or to indicate the possible presence of contaminants that can affect health), and based on their presence at concentrations of concern across the Philippines. Parameters to ensure the microbial safety of drinking-water are included in this group. (The Department of Health also considered that each of these parameters can be analysed using field test kits, which is important for testing at remote sites where laboratory access is limited.)
- **Primary parameters.** These parameters are chemicals that can also directly affect health, but they are site specific and may be adopted as mandatory parameters by local governments if natural or anthropogenic sources are identified in the area as part of local risk assessments.

- **Secondary parameters.** These parameters are those that may render the water unacceptable for drinking or affect operations, including the efficacy of water treatment. As with the primary parameters, requirements to monitor these parameters are determined by local risk assessments.

In addition to prioritizing the parameters to be tested, the revised standards allow for reductions in the required monitoring frequency for certain mandatory parameters (namely those unrelated to microbial water quality) if a minimum of 3 years of data indicate undetectable levels of the contaminant. (See Case A3.19 for another example from the European Union of risk-based reductions in monitoring frequency requirements.)

***Source*:**
Philippine national standards for drinking water of 2017. Administrative order no. 2017-0010. Department of Health, Philippines; 2017 (https://www.fda.gov.ph/wp-content/uploads/2021/08/Administrative-Order-No.-2017-0010.pdf, accessed 13 November 2023).

Case A3.17 ▶ Interim arsenic limits applied to rural water supplies in the Lao People's Democratic Republic

When the national drinking-water quality standards were revised in the Lao People's Democratic Republic in 2014, they established a limit for arsenic of 10 µg/L for urban water supplies. However, for rural water supplies, a phased approach was taken to establishing the parameter limit for arsenic. Recognizing the limited treatment capacity of rural water supplies nationally, the standards set an interim limit of 50 µg/L for 5 years, after which time the limit became 10 µg/L for rural supplies as well.

***Source*:**
Minister's decision on water quality standard management for drinking and domestic use. Ministry of Health, Lao People's Democratic Republic; 2014.

Case A3.18 ▶ Water quality monitoring frequency requirements that vary according to population served in Iceland

In Iceland, drinking-water quality regulations provide tiered minimum requirements for assessing water quality based on the population served by the water supply facilities, with more frequent testing carried out at larger supplies. This approach reflects practical considerations (e.g. human and financial resources available for monitoring), as well as consideration of consumer populations exposed in the event of water safety breaches. Minimum monitoring frequency requirements by population served are as follows:

- 150 or less = 1 test every 2 years
- 151–500 = 1 test per year
- 501–1000 = 4 tests per year
- 1001–5000 = 4 tests per year
- 5001–10 000 = 7 tests per year
- 10 001–15 000 = 10 tests per year
- 15 001–20 000 = 13 tests per year
- 20 001–25 000 = 16 tests per year
- 25 001–30 000 = 19 tests per year
- 30 001–35 000 = 22 tests per year
- 35 001–40 000 = 25 tests per year
- 40 001–45 000 = 28 tests per year
- 45 001–50 000 = 31 tests per year
- over 50 000 = 34 tests per year plus an extra 3 tests for every additional 5000 users.

Source:
Reglugerð um neysluvatn, 536/2001. Iceland; 2001 (in Icelandic) (https://www.reglugerd.is/reglugerdir/allar/nr/0536-2001, accessed 13 November 2023).

Case A3.19 ▶ Permitting risk-based deviations from minimum monitoring requirements in the European Union

The European Union has adopted a risk-based approach to the requirements set out in the Drinking Water Directive, including requirements for water quality monitoring. The Directive applies to all water supplies, although individual supplies providing less than 10 m^3 per day on average or serving fewer than 50 people may be exempted, unless the water is supplied as part of a commercial or public activity. The Directive indicates that the list of parameters to be monitored and/or the frequency of monitoring may be reduced on the basis of local risk assessments, provided certain conditions are met. For instance, reducing the monitoring frequency requires that monitoring results over a period of at least 3 years show concentrations below 60% of the parameter limit. Removing a parameter from the list requires that monitoring results over the same period show concentrations below 30% of the parameter limit. Additionally, in both cases, the risk assessment must confirm there is no factor that can be reasonably anticipated to cause deterioration of water quality.

Source:
Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption. O.J.E.U. 2020, L 435 (https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32020L2184, accessed 13 November 2023).

Case A3.20 ▸ Allowing the use of field test kits for *Escherichia coli* testing in Canada

The *Escherichia coli* (*E. coli*) technical document (2020) that forms part of the Guidelines for Canadian Drinking Water Quality explicitly acknowledges that some situations necessitate on-site testing by trained operators using commercial testing kits (e.g. in rural areas without suitable access to accredited laboratories). In such cases, the document specifies that validated equipment should be used, and analysis should be in accordance with manufacturer's instructions. The *E. coli* technical document further indicates that presence–absence testing, which will not provide any information on the concentration of organisms present, may be approved for use in some jurisdictions. As the national limit for *E. coli* in drinking-water is none per 100 mL, a positive detection (regardless of quantity) may be sufficient for decision-making and action related to the protection of public health.

Source:

Guidelines for Canadian drinking water quality: guideline technical document - *Escherichia coli*. Ontario: Health Canada; 2020 (https://www.canada.ca/en/health-canada/services/publications/healthy-living/guidelines-canadian-drinking-water-quality-guideline-technical-document-escherichia-coli.html#a5, accessed 13 November 2023).

Case A3.21 ▸ Allowing the use of field test kits to overcome challenges with laboratory testing in Nepal

Nepal's revised National Drinking Water Quality Standards and associated implementation and monitoring directives establish the water quality parameters to be tested and the required frequency of testing. They also specify acceptable analytical methods, which include the use of an approved portable water test kit with membrane filtration for microbial parameters. The use of the field test kit was approved to enable increased water quality testing and address pressing challenges with the consistent collection of water quality data, especially for small supplies. More specifically, the field test kit was approved because of:

- severe water quality challenges, especially faecal contamination (which can be measured with the approved field test kit);
- prohibitive costs of laboratory testing;
- challenges accessing laboratories for testing from remote locations;
- effectiveness of the field test kit in reliably measuring the fundamental parameters included in the National Drinking Water Quality Standards;
- comparative ease of use of the field test kit; and
- the National Water Supply, Sanitation and Hygiene Management Information System driving and facilitating greater collection, entry and analysis of water quality data (see Case A3.53 for more information).

As of 2023, the field test kit was being used in more than 200 of Nepal's 753 municipalities by water suppliers and government agencies responsible for monitoring or surveillance, contributing to increased data entry to the National Water Supply, Sanitation and Hygiene Management Information System.

***Sources*:**

National drinking water quality standards, 2022. Nepal; 2022.

Ojha R, Ministry of Water Supply, personal communication, 2023.

Panthi SR, World Health Organization Nepal, personal communication, 2023.

Case A3.22 ▶ Certification requirements and technical guidance for field testing of chlorine in Portugal

The Water and Waste Services Regulation Authority is the independent regulator for water and waste services in Portugal and the competent authority for drinking-water quality. It regulates around 250 water operators in the country through common legislation (based on the European Union Drinking Water Directive), regardless of their size. Although accredited laboratories are responsible for testing most regulatory parameters in Portugal, residual chlorine may be measured directly in the field by water operators that are certified by the Association of Accredited Laboratories of Portugal.

To ensure compliance of the field tests with existing legislation and comparability of results across the water quality tests carried out in laboratories and in the field, the regulatory authority developed a 12-page recommendation (Recommendation no. 01/2017) to guide water operators through a standardized procedure for sampling and testing drinking-water. This recommendation has been developed in conjunction with the Association of Accredited Laboratories of Portugal and other entities (the Portuguese Accreditation Institute, the National Institute of Health, laboratories and water suppliers) and has been designed as a simplified version of the International Organization for Standardization (ISO) standards that is better suited to the skills of small water supply operators.[4]

***Sources*:**

Certificação de técnicos de colheita de amostras de água destinada ao consumo humano. DDE-CER-013. Organismo de Certificação de Pessoal; 2023 (in Portuguese) (https://www.relacre.pt/assets/relacreassets/files/personnelcertification/DDE_CER_013-Ed_13.pdf, accessed 13 November 2023).

Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption. O.J.E.U. 2020, L 435 (https://eur-lex.europa.eu/eli/dir/2020/2184/oj, accessed 13 November 2023).

Procedimento para a colheita de amostras de água para consumo humano en sistemas de: recomendação ERSAR no. 01/2017. Entidade Reguladora dos Serviços de Águas e Resíduos; 2017 (in Portuguese) (https://www.ersar.pt/pt/site-comunicacao/site-noticias/documents/rec-01-2017.pdf, accessed 13 November 2023).

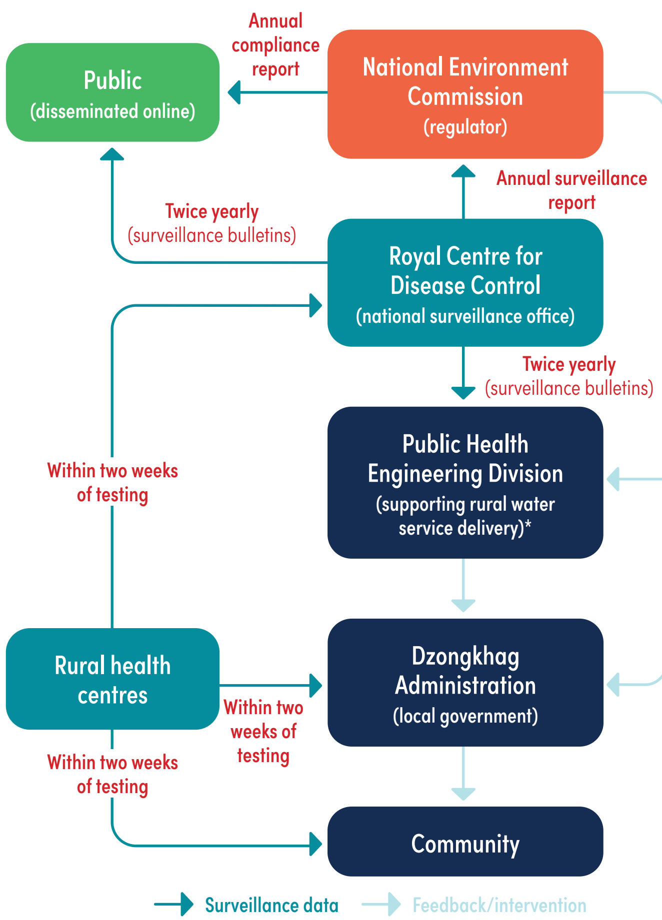
4 The recommendation was based particularly on the following ISO standards: ISO 19458:2006 – Water quality – Sampling for microbiological analysis, ISO 5667-1:2020 – Water quality – Sampling – Parts 1, 3, 5 and 14, and ISO/IEC 17025 concerning the requirements for the competence of testing and calibration laboratories.

Case A3.23 ▸ Surveillance reporting requirements set out in standards and guidelines in Bhutan

Bhutan's National Guideline for Drinking Water Quality Surveillance (2019) and the Bhutan Drinking Water Quality Standard (2016) set out reporting requirements for surveillance data. The guideline and the standard describe what information must be shared, between whom, and how often in urban and in rural contexts.

The figure presents requirements for routine surveillance data flows for rural water supplies. In addition to these routine reporting requirements, immediate reporting to relevant agencies is also required whenever there are non-compliant results that indicate a threat to public health. (As of 2023, the Government of Bhutan was undergoing significant water supply sector reform that will affect the data flow arrangements presented in the figure. The national guideline and standard will be updated accordingly in due course.)

Requirements for routine surveillance data flows for rural water supplies



*The Ministry of Works and Human Settlement has assumed the responsibilities related to rural water service delivery that were previously held by the Public Health Engineering Division.

Source: adapted from National guideline for drinking water quality surveillance. Ministry of Health, Bhutan; 2019 (http://www.rcdc.gov.bt/web/wp-content/uploads/2022/07/National-Guideline-for-Drinking-Water-Quality-Surveillance-V1.pdf, accessed 13 November 2023).

Sources:

Bhutan drinking water quality standard. National Environment Commission, Bhutan; 2016 (https://faolex.fao.org/docs/pdf/bhu181581.pdf, accessed 13 November 2023).

Dorji C, Chophel P, Royal Center for Disease Control, personal communication, 2023.

National guideline for drinking water quality surveillance. Ministry of Health, Bhutan; 2019 (http://www.rcdc.gov.bt/web/wp-content/uploads/2022/07/National-Guideline-for-Drinking-Water-Quality-Surveillance-V1.pdf, accessed 13 November 2023).

Case A3.24 ▸ Defining surveillance roles and responsibilities in governance instruments in the Philippines

The Code on Sanitation of the Philippines (1976) and its supplemental implementing rules and regulations (1995) delegate local government units the responsibility of carrying out drinking-water quality surveillance, including for water supplies serving as few as 15 households. These governance instruments require the establishment of local drinking-water quality surveillance programmes, specifically through the creation of local drinking-water quality monitoring committees.

To help overcome barriers to the operationalization of these requirements and thereby strengthen surveillance practice, the Department of Health and the Department of the Interior and Local Government issued guidelines in 2022 for the establishment of local drinking-water quality monitoring committees. Among the various points covered, the guidelines clarify roles and responsibilities for the various government actors involved in surveillance, including regional and national offices of the two departments, as well as the local government unit health authority.

The guidelines are complemented by an operations manual for surveillance, issued in 2021. This operations manual provides detailed guidance on the formulation of local drinking-water quality monitoring committees and local surveillance programmes, including by defining specific surveillance activities to be carried out. These activities include (but are not limited to):

- comprehensive auditing of water safety plans (every 3 years);
- monitoring water safety plan implementation or conducting sanitary inspections (at least annually); and
- direct assessment of drinking-water quality.

The operations manual also specifies that further investigative and remedial actions must be carried out when surveillance findings indicate water supply deficiencies, and during outbreaks and emergencies. The manual also sets out requirements for surveillance reporting on a monthly, quarterly and annual basis. The dissemination of water quality information to the public is also addressed. (See Case A3.23 for an example from Bhutan of regulatory requirements for surveillance data reporting.)

Sources:

Guidelines on establishing local drinking water quality surveillance (LDWQS) program through the creation of local drinking water quality monitoring committee (LDWQMC) as mandated by the code on sanitation (PD 856). Joint administrative order no. 2022-0002. Department of Health, Philippines; 2022 (https://dmas.doh.gov.ph:8083/Rest/GetFile?id=719454, accessed 13 November 2023).

Implementing rules and regulations of Chapter II – "water supply" of the code on sanitation of the Philippines (P.D. 856). Department of Health, Philippines; 1995 (https://dmas.doh.gov.ph:8083/Rest/GetFile?id=599343, accessed 13 November 2023).

Operations manual for local drinking water quality monitoring committee (LDWQMC) on drinking water quality surveillance (DWQS). Department of Health, Philippines; 2021.

The code on sanitation of the Philippines: presidential decree no. 856. Department of Health, Philippines; 1976 (https://faolex.fao.org/docs/pdf/phi201040.pdf, accessed 13 November 2023).

Case A3.25 ▶ Required treatment techniques and associated guidance in the United States of America

To improve public health protection through the control of microbial contaminants, the United States of America's Environmental Protection Agency has established surface water treatment rules that collectively apply to all public water supplies using surface water or groundwater under the direct influence of surface water. Together, the surface water treatment rules require that all public water supplies – which are defined as drinking-water supplies with at least 15 service connections or serving an average of at least 25 people for at least 60 days per year – filter and disinfect water from surface water sources or groundwater under the direct influence of surface water, unless specific filtration avoidance criteria are met. The surface water treatment rules further establish treatment technique requirements to reduce concentrations of microbial contaminants in finished drinking-water. The requirements call for 99% treatment of *Cryptosporidium*, 99.9% treatment of *Giardia lamblia* and 99.99% treatment of viruses.

To assist small drinking-water supplies in meeting the surface water treatment rule requirements, the Environmental Protection Agency has published guidance manuals that include information on the use of treatment technologies suitable for small supplies. Specific technologies described represent a variety of disinfection and filtration technologies, such as chlorine disinfection, ultraviolet disinfection, bag and cartridge filters, and nanofiltration.

***Sources*:**

Information about public water systems [webpage]. United States Environmental Protection Agency (https://www.epa.gov/dwreginfo/information-about-public-water-systems, accessed 13 November 2023).

Small system compliance technology list for the surface water treatment rule and total coliform rule. United States Environmental Protection Agency; 1998 (https://archive.epa.gov/water/archive/web/pdf/1998_09_28_standard_tlisttcr.pdf, accessed 13 November 2023).

Surface water treatment rules [webpage]. United States Environmental Protection Agency; 2023 (https://www.epa.gov/dwreginfo/surface-water-treatment-rules, accessed 20 November 2023).

Case A3.26 ▶ Treatment requirements and alternative "acceptable solutions" in New Zealand

New Zealand's 2022 Drinking Water Quality Assurance Rules, which apply to all drinking-water supplies except those serving a single domestic household, include specified treatment requirements to ensure water safety targets can be achieved. For example, for supplies serving between 101 and 500 people, all water passing through a treatment plant must be filtered (by a media, membrane or cartridge filter system), treated with ultraviolet disinfection and chlorinated.

Alternatives to complying with the treatment requirements set out in the Drinking Water Quality Assurance Rules are provided in the form of "acceptable solutions" publications, which have been developed to provide drinking-water suppliers with ready-made options to meet regulatory obligations. These acceptable solutions apply to specific water supply types (e.g. roof water, springs and boreholes), and they must be implemented in their entirety. The Drinking Water Acceptable Solution for Roof Water Supplies, for example, sets out technical requirements for roof water collection systems and water treatment, among other requirements.

***Sources*:**

Drinking water acceptable solution for roof water supplies. Taumata Arowai; 2022 (https://www.taumataarowai.govt.nz/for-water-suppliers/new-compliance-rules-and-standards-2/, accessed 13 November 2023).

Drinking water quality assurance rules. Taumata Arowai; 2022 (https://www.taumataarowai.govt.nz/assets/Uploads/Rules-and-standards/Drinking-Water-Quality-Assurance-Rules-2022-Released-25-July-2022.pdf, accessed 13 November 2023).

Case A3.27 ▶ Household water treatment standard and associated product certification scheme in Ghana

In 2022, the Ghana Standards Authority developed a standard entitled Requirements for Performance of Household Water Treatment Products and Technologies – Pathogen Removal GS 1331:2022. The standard sets out the performance requirements for household water treatment (HWT) products and technologies with respect to pathogen removal. More specifically, it defines performance classifications according to log reduction criteria for three classes of pathogens (bacteria, viruses and protozoa). It also defines methods for testing HWT product performance and specifies HWT product labelling and packaging requirements.

The standard was introduced following the influx of a diverse range of HWT products into the Ghanaian market, necessitating performance testing to ensure the quality and effectiveness of these products. As there were previously no standards to guide such testing, the Ghana Standards Authority needed to take prompt action to develop the standard, drawing on the performance criteria used under the World Health Organization International Scheme to Evaluate Household Water Treatment Technologies.

Additionally, in 2023, the Ghana Standards Authority developed a scheme for inspection and testing to certify HWT products and technologies in accordance with standard GS 1331:2022. The scheme provides a clear procedure for the Ghana Standards Authority to follow to support enhanced enforcement of GS 1331:2022. The scheme also provides clarity to manufacturers and importers of HWT products by setting out key requirements concerning manufacturing practices (including laboratory practices, equipment calibration and record keeping) and setting out the schedule of inspection and testing.

***Sources*:**

Frimpong F, Ghana Standards Authority, personal communication, 2023.

Requirements for performance of household water treatment products and technologies – pathogen removal. GS 1331:2022. Ghana Standards Authority; 2022.

Scheme of testing and inspection for certification of household water treatment products and technologies for pathogen removal in accordance with GS 1331:2022. GSA-PCM-STI-1331: 2023. Ghana Standards Authority; 2023.

Case A3.28 ▶ Training and competency requirements for operators of small water supplies in Finland

In Finland, the 1994 Health Protection Act sets out training and competency requirements for the qualification of water supply staff, including those operating small supplies. Since 2006, examinations have been required every 5 years to prove competency concerning water treatment technology from source to distribution, monitoring, legislation and water hygiene. The examinations are obligatory for operators of water supplies providing more than 10 m^3 per day or serving more than 50 people, and they are voluntary for smaller supplies.

The authority responsible for the examination scheme is the National Supervisory Authority for Welfare and Health, which also approves the organizations that provide the examinations on site. Operator competency is tested through a series of 30 questions chosen at random from a set of approximately 600 questions (including questions related to water supply risks, as discussed in Case A3.37). The positive results of the certificate of competency scheme include regularly trained staff, improved knowledge among employees and workers paying more attention to their methods.

***Sources*:**

Subregional workshop on improving small-scale water supplies for better health in European Union countries: 8–20 June 2018, Dessau, Germany, meeting report. Copenhagen: World Health Organization Regional Office for Europe; 2018 (https://iris.who.int/handle/10665/362262?&locale-attribute=pt, accessed 13 November 2023).

Terveydensuojelulaki (763/1994). Finlex; 1994 (in Finnish) (https://finlex.fi/fi/laki/ajantasa/1994/19940763, accessed 13 November 2023).

Case A3.29 ▶ Phased implementation of material safety standards in the occupied Palestinian territory, including east Jerusalem

The Water Sector Regulatory Council of the occupied Palestinian territory, including east Jerusalem, is responsible for performing an expansive set of regulatory functions, including licensing, operational process monitoring, complaints handling, tariff setting and regulation by incentives. It regulates more than 300 water and sanitation service providers, including small water supplies. These regulated water suppliers include municipalities and village councils, water associations, nongovernmental organizations, private water companies and regional water utilities.

As part of its mandate, the Water Sector Regulatory Council has introduced material safety standards governing the composition of products and materials that come into contact with drinking-water (Palestinian Specifications PS-41-2005 and, more recently, the Palestinian Technical Regulations for Water Intended for Human Consumption 108-2023). These standards align with international standards as well as those of neighbouring countries (to facilitate importation of required materials). The standards cover key components of water supply schemes, including materials used in pumps, pipelines and filling stations.

Recognizing the challenges water suppliers face in complying with the standards, the Water Sector Regulatory Council is supporting a phased approach to implementation. It has a monitoring regime to verify compliance and, along with the Ministry of Health, the central water authority and local authorities, it advises water suppliers on necessary corrective actions. This collaborative approach has proven effective in encouraging and enabling water suppliers to progressively upgrade water supply scheme components to align with standards. Further actions, such as regulation by incentives and performance benchmarking, also help to promote compliance.

***Sources*:**

Al Hmaidi MS, Water Sector Regulatory Council, personal communication, 2023.
Drinking water standard. PS-41-2005. Palestinian Standards Institution; 2005.
Palestinian technical regulations for water intended for human consumption. 108-2023.

Case A3.30 ▸ Regulatory initiatives to strengthen enforcement of material safety standards in Ghana

Research undertaken in 2017 revealed that 6% of existing rural water supplies in Ghana had lead levels in water samples above the national limit of 10 µg/L (which aligns with the World Health Organization's guideline value). Furthermore, most water supplies sampled included components with lead in excess of the International Plumbing Code recommended limit of 0.25% lead. Leaded brass components were determined to be the most problematic source of lead contamination in water.

Although material safety standards exist in Ghana to ensure the safety of products and materials in contact with drinking-water, compliance with these standards has been limited, owing to the need for an effective system of quality control and quality assurance. For example, local suppliers of hand pumps have been unable to verify that their products are lead free (defined by national standards and the International Plumbing Code as containing less than 0.25% lead) on the basis of independent product testing. As a result, some manufacturers have made false claims regarding the lead-free status of water supply components, allowing non-compliant products to be sold and installed.

To strengthen compliance with existing material safety standards, the Community Water and Sanitation Agency and other government agencies are taking steps to establish various regulatory processes, including those pertaining to: verification of the quality and conformity of imported materials (including third-party verification); certification of materials appropriate for the construction of boreholes, water pipelines and all related components; and the effective regulatory oversight of all water supply construction activities. Linked to these regulatory initiatives, X-ray florescent spectrometry is being applied to test the composition of water supply components to verify conformity with standards. Furthermore, awareness is being raised among local stakeholders (local governments, suppliers, manufacturers and water research institutions), and capacity is being developed to test materials, even when a certificate of conformity from suppliers has been received.

Actions being taken are expected to have a measurable impact on reducing lead in small drinking-water supplies for the protection of public health. The Community Water and Sanitation Agency, along with key research partners, will continue monitoring to improve understanding of the prevalence of lead contamination in drinking-water and prioritize further actions.

***Sources*:**

Diarra S, Norman R, Questad A, World Vision, Siabi WK, Community Water and Sanitation Agency, personal communications, 2023.

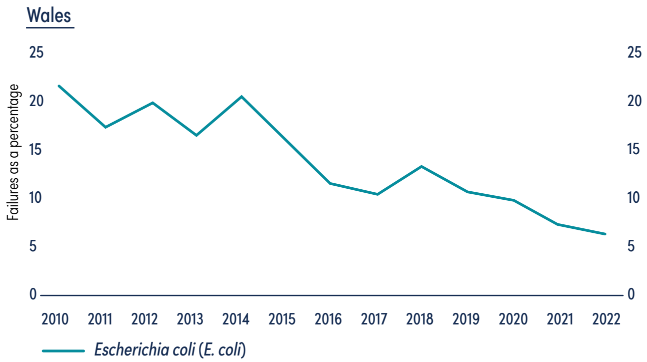
Fisher MB, Guo AZ, Tracy JW, Prasad SK, Cronk RD, Browning EG et al. Occurrence of lead and other toxic metals derived from drinking-water systems in three West African countries. Environ Health Perspect. 2021;129:4. doi.org/10.1289/EHP7804.

Case A3.31 ▸ Improved microbial water quality linked to water safety planning in Wales

In Wales (in the United Kingdom of Great Britain and Northern Ireland), a private water supply is defined as one that is not connected to the public mains network of water companies, including individual household supplies and those serving commercial premises such as hotels, sporting clubs and other businesses. Local authority records indicate there are approximately 15 000 private supplies in Wales (as of 2022).

Beginning with The Private Water Supplies (Wales) Regulations in 2010, risk assessments have been required for all private supplies, except supplies serving a single dwelling not used for a commercial activity. Since that time, water quality in private supplies has been steadily improving, as measured by the percentage of water quality tests indicating faecal contamination. In 2010, more than 20% of samples tested were found to contain *Escherichia coli*, while this value had been reduced to less than 7% in 2022 (see the figure). Proactive risk management is considered to be a key contributor to this significant improvement in microbial water quality.

Percentage of water samples indicating faecal contamination since risk assessments became mandatory in Wales



Source: adapted from Drinking water 2022: private water supplies in Wales. London: Drinking Water Inspectorate; 2023 (https://dwi-content.s3.eu-west-2.amazonaws.com/wp-content/uploads/2023/07/20174242/DWI_Private-water-supplies-in-Wales_Accessible.pdf, accessed 13 November 2023).

***Sources*:**

Drinking water 2022: private water supplies in Wales. London: Drinking Water Inspectorate; 2023 (https://dwi-content.s3.eu-west-2.amazonaws.com/wp-content/uploads/2023/07/20174242/DWI_Private-water-supplies-in-Wales_Accessible.pdf, accessed 13 November 2023).

The private water supplies (Wales) regulations 2010. United Kingdom of Great Britain and Northern Ireland; 2010 (https://www.legislation.gov.uk/wsi/2010/66/regulation/6/made, accessed 13 November 2023).

Case A3.32 ▶ Strengthened operations and maintenance linked to water safety planning in the Asia–Pacific region

An evaluation of the impacts of risk assessment and risk management practice was undertaken in 12 countries throughout the Asia–Pacific region between 2014 and 2016. Of the 99 water supplies included in the study (39 of which were rural supplies serving as few as 22 people), statistically significant improvements in operations and management practices were observed at 93 sites. Reported improvements related to monitoring, operating procedures, emergency response plans, maintenance schedules, caretaker training and consumer education.

***Source*:**

Kumpel E, Delaire C, Peletz R, Kisiangani J, Rinehold A, De France J et al. Measuring the impacts of water safety plans in the Asia–Pacific region. Int J Environ Res Public Health. 2018;15:1223. doi: 10.3390/ijerph15061223.

Case A3.33 ▶ Risk management requirements that vary by water supply size in Germany

The revised European Union Drinking Water Directive requires that drinking-water suppliers practise risk assessment and risk management (equivalent to water safety planning) if they provide at least 100 m^3 per day on average or serve at least 500 persons. To drive proactive risk management for smaller water supplies that may be exempted from the risk assessment and risk management requirements set out in the Directive, some European Union member States also require or encourage risk management activities for smaller supplies. For example, the German Drinking Water Ordinance requires that water suppliers serving more than 50 persons or providing at least 10 m^3 per day also carry out risk assessment and risk management, although these suppliers are allowed more time for implementation as compared to larger suppliers subject to the Drinking Water Directive requirements. Operators of all other water supplies in Germany, excluding individual household supplies, are required to undertake inspections of the catchment and/or abstraction areas at least once per year to identify and manage any changes that may affect drinking-water quality. Furthermore, Germany encourages sanitary inspections for individual household supplies and has made available simple and accessible guidance and tools to support householders in these efforts. (See Case A3.13 for an example of similar regulatory encouragement and support for household-level risk assessment and risk management practice in Ireland.)

***Sources*:**

Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption. O.J.E.U. 2020, L 435 (https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32020L2184, accessed 13 November 2023).

Gesundes Trinkwasser aus eigenen Brennen und Quellen: Empfehlungen für Betrieb und Nutzung. Bonn: Umweltbundesamt; 2013 (in German) (https://www.umweltbundesamt.de/en/publikationen/gesundes-trinkwasser-aus-eigenen-brunnen-quellen, accessed 13 November 2023).

Verordnung über die Qualität von Wasser für den menschlichen Gebrauch (Trinkwasserverordnung - TrinkwV). Bundesministerium für Gesundheit; 2023 (in German) (https://www.gesetze-im-internet.de/trinkwv_2023/TrinkwV.pdf, accessed 13 November 2023).

Case A3.34 ▶ Allowing rural water suppliers sufficient time to comply with water safety plan requirements in the Lao People's Democratic Republic

When water safety plan requirements were introduced into the drinking-water quality standards in the Lao People's Democratic Republic in 2014, urban suppliers were allowed 5 years to comply, and rural suppliers were allowed 10 years. This approach allowed health authorities more time to provide water safety plan training and support to rural suppliers, which greatly outnumber urban suppliers.

***Source*:**

Minister's decision on water quality standard management for drinking and domestic use. Ministry of Health, Lao People's Democratic Republic; 2014.

Case A3.35 ▶ Standardized operator training and tools that incorporate risk management principles in Madagascar

In Madagascar, Tatirano Social Enterprise works closely with the regional offices of the Ministry of Water, Sanitation and Hygiene to support operationalization of the national Water Code (1999), which addresses safe drinking-water provision in rural areas. Tatirano designs, constructs, operates and maintains rainwater harvesting systems serving schools, hospitals and communities across southeastern Madagascar.

Field agents deep cleaning a 10 000 L water tank. Photo credit: H. Chaplin, Tatirano Social Enterprise.

Working in remote and isolated communities and having limited resources for testing, Tatirano gives priority to the proactive inspection and maintenance of water supplies to always ensure microbial and chemical integrity. Awareness-raising on sanitary inspection risk factors has been incorporated into the initial training and quarterly refresher courses offered to field agents, who are local women engaged to inspect the water supplies on a daily basis. Sanitary inspection questions have also been incorporated into standard monitoring checklists used by the field agents, the results of which are displayed publicly online for transparency and accountability.

***Sources*:**

Chaplin H, Tatirano Social Enterprise, personal communication, 2023.

Loi n° 98-029 du 20 janvier 1999 portant Code de l'Eau. Madagascar; 1999 (in French) (https://www.droit-afrique.com/upload/doc/madagascar/Madagascar-Code-1999-Eau.pdf, accessed 13 November 2023).

Case A3.36 ▸ Water safety plan templates that reflect different water supplier capacities in Bhutan

In Bhutan, water safety plans (WSPs) have been required for all water supplies since 2016. To support water suppliers in preparing WSPs, the Ministry of Health and the Ministry of Works and Human Settlement have developed WSP templates and tools tailored to the respective capacities of the two prevailing management models in the country: town supplies managed by municipalities, and smaller community supplies managed by informal water user groups.

Community members sketching a village water supply scheme as part of WSP development. Photo credit: A. Rinehold, World Health Organization.

For the more professionalized (municipally run) supplies, including those serving small towns, an electronic WSP template was prepared for use by WSP team members with computer access and skill sets. The electronic template includes multiple tables to be completed to document WSP team members, descriptive information about the water supply, hazards and associated risks, improvement plans, ongoing monitoring schedules, standard operating procedures and emergency response plans.

For community managed supplies, the WSP template developed is considerably simpler than the electronic template, and it was designed to be completed manually. In practice, the WSPs for community managed supplies have been documented on paper during 3 day WSP training workshops. During these workshops, community members visit all parts of their water supply, they discuss risks and they document priority concerns, improvement needs, and ongoing monitoring and management plans. The photograph shows community members sketching their village water supply scheme for inclusion in a paper-based WSP document.

Sources:

Rural water safety plan (RWSP) workshop facilitator's guide. Ministry of Health, Bhutan; 2013 (https://wsportal.org/wp-content/uploads/sites/3/2016/05/RWS-WSP-Facilitation-Guide-Dec-2013.pdf, accessed 13 November 2023).

Urban water safety plan template for Bhutan. Ministry of Health, Bhutan; 2016 (https://wsportal.org/resource/urban-water-safety-plan-template-for-bhutan/, accessed 21 November 2023).

Case A3.37 ▶ Water safety plan tools tailored for different water supply sizes in Finland

In Finland, water safety plan (WSP) implementation is compulsory for all drinking-water suppliers. However, the requirements vary according to the size of the supply. For supplies serving more than 50 people or providing more than 10 m^3 per day, more robust risk management programmes are required, as detailed in the Health Protection Act (763/1994) and the Government Decree on Risk Management and Operational Monitoring of the Water Supply Chain (7/2023). To facilitate these comprehensive WSPs, the Ministry of Social Affairs and Health has developed a web-based tool. This WSP development tool also serves as a training platform, as for each identified hazard, there is an explanation of where the hazard may originate, what the consequences may be and what management measures could be used to mitigate or remove the risk.

For smaller water supplies (i.e. those serving fewer than 50 people or providing less than 10 m^3 per day), operators may use either the web tool or a simplified checklist developed by the Finnish Environment Institute to guide hazard identification and risk mitigation.

Sources:

Isomäki E, Valve M, Kivimäki A-L, Lahti K. Environment guide: operation and maintenance of small waterworks. Helsinki: Finnish Environment Institute; 2008 (https://helda.helsinki.fi/server/api/core/bitstreams/322f08de-1748-4c5d-af8c-1b6af17b3b98/content, accessed 13 November 2023).

Terveydensuojelulaki (763/1994). Finlex; 1994 (in Finnish) (https://finlex.fi/fi/laki/ajantasa/1994/19940763, accessed 13 November 2023).

Valtioneuvoston asetus talousveden tuotantoketjun riskienhallinnasta ja omavalvonnasta (7/2023). Finlex; 2023 (in Finnish) (https://finlex.fi/fi/laki/alkup/2023/20230007, accessed 13 November 2023).

Case A3.38 ▶ Grants to support well owners in managing water safety risks in Ireland

In Ireland, private well owners are encouraged to conduct simple sanitary inspections routinely and to test water quality at least once a year (see Case A3.13). To address issues identified through risk assessments, water testing or otherwise, well owners are eligible under the Rural Water Programme for grants to support improvement works. Grants are administered by local authorities (known as county councils). Funds may be used to rehabilitate an existing well, construct protective measures (e.g. a pump house or chamber), install treatment works or drill a new well. Grant payments of up to €5000 (depending on the extent and nature of the work undertaken) are made after the work has been completed and inspected, and the water supply has been found to be of sufficient quality and quantity.

Source:

Private wells [webpage]. Department of Housing, Local Government and Heritage, Ireland; 2021 (https://www.gov.ie/en/publication/1d9d8-private-wells/#, accessed 13 November 2023).

Case A3.39 ▸ Water safety planning as a mechanism to prioritize and fund improvement works in Vanuatu

In Vanuatu, the Water Supply (Amendment) Act of 2016, the Water Resource Management (Amendment) Act of 2016 and Vanuatu's National Drinking Water Quality Standards 2019 require community water suppliers to implement drinking-water safety and security plans. While routine operations, monitoring, maintenance and low-cost improvements are expected to be carried out by the community, some improvement needs identified in the drinking-water safety and security plans require technical and financial assistance from outside the community.

In such cases, the community can request funding through the government's Capital Assistance Programme fund for remedial works that are justified by the drinking-water safety and security plan. These requests are initially reviewed and prioritized by a provincial-level advisory committee, which identifies the most at-risk and vulnerable communities with the support of a technical advisory group. Prioritized lists of improvement needs are then submitted to the Department of Water Resources on a quarterly basis for more rigorous project planning and budgeting. Fully costed requests are then forwarded to a national-level advisory committee on an annual basis for final decision-making on budget allocations to provincial governments and, in turn, to communities.

The system has been designed to ensure the highest priority needs identified through drinking-water safety and security plans are funded first, and to subsequently fund lower priority improvement works until funds are exhausted.

Sources:

Drinking water safety planning: a practical guide for Pacific Island countries. Suva: World Health Organization and Pacific Islands Applied Geoscience Commission; 2020 (https://iwlearn.net/resolveuid/5790233ade2bf9585f1e80c58cd0c574, accessed 13 November 2023).

National drinking water quality standards. Republic of Vanuatu; 2019 (https://mol.gov.vu/images/News-Photo/water/DoWR_File/Monitoring_Evaluation/Official_Gazette_No_26_of_2019_dated_13_June_2019_1.pdf, accessed 13 November 2023).

Vanuatu national implementation plan for safe and secure community drinking water: a guide to the plan. Vanuatu; 2018 (https://www.nab.vu/sites/default/files/documents/Vanuatu%20National%20Implementation%20Plan%20for%20Safe%20and%20Secure%20Community%20Drinking%20Water.pdf, accessed 13 November 2023).

Water resources management (amendment) act no. 32 of 2016. Republic of Vanuatu; 2016 (https://faolex.fao.org/docs/pdf/van189684.pdf, accessed 13 November 2023).

Water supply (amendment) act no. 31 of 2016. Republic of Vanuatu; 2016 (https://faolex.fao.org/docs/pdf/van172593.pdf, accessed 13 November 2023).

Case A3.40 ▸ Strengthening the climate resilience of rural drinking-water supplies in Cambodia

Water safety planning can help strengthen the climate resilience of drinking-water services. In Cambodia, climate change is recognized as a critical threat to drinking-water supplies, often manifesting as increased frequency and severity of droughts and floods. As part of the Government of Cambodia's ambitious goal of ensuring that 100% of the rural population has access to an improved water supply by 2025 – as set out in the National Strategy for Rural Water Supply, Sanitation and Hygiene 2011-2025 – climate change and disaster risk reduction have been identified as important focus areas.

One partner in the government's effort to provide safe and climate-resilient drinking-water services in rural areas is Teuk Saat 1001, which is a local nongovernmental organization and professional service provider. Since 2007, Teuk Saat 1001 has operated water treatment and delivery kiosks that are staffed by locally recruited entrepreneurs who receive ongoing technical support and guidance on how to run a profitable business. As climate change increasingly affects source water availability and quality, Teuk Saat 1001 continues to build preparedness and response strategies. Climate adaptation strategies include planning for continued service delivery during flood and drought events (e.g. connecting water kiosks to alternative water sources and coordinating delivery logistics between more and less affected treatment plants), proactively assessing source water vulnerability, and expanding laboratory testing to identify emerging climate-related contaminants that may require changes to treatment processes or monitoring plans.

Sources:

Leveneu E, 1001fontaines, personal communication, 2023.

National strategy for rural water supply, sanitation and hygiene 2011-2025. Phnom Penh: Ministry of Rural Development; 2011 (https://faolex.fao.org/docs/pdf/cam159126.pdf, accessed 13 November 2023).

Case A3.41 ▸ Prioritizing higher-risk sites for more frequent surveillance activity in Nigeria

The 2023 Nigerian Guidelines for Rural Drinking Water Quality Monitoring and Surveillance define a risk-based approach to surveillance frequency, whereby higher-risk sites are prioritized for more frequent surveillance activity. Local government authorities are to conduct sanitary inspections (SIs) and test water quality for the rural water supplies in their areas on a 6 monthly basis, during both the rainy and dry seasons. SIs cover the water sources, transport containers, storage facilities and user practices. In addition, local government authorities are to carry out SIs and water quality testing during waterborne disease outbreaks and whenever community monitoring reveals contamination. As a complement to monitoring by surveillance authorities, each community and household water source is to be tested at least monthly by trained community members to verify microbial safety. Owing to lower costs and ease of use, presence–absence testing with hydrogen sulfide vials is used for community-level monitoring. Contamination detected with these vials is reported to the local government, which arranges for additional (semi-quantitative) microbial testing using field test kits, and for remedial action as needed (e.g. chlorination). The presence–absence testing by communities thereby serves as a screening mechanism to identify high-priority sites requiring greater surveillance support.

***Source*:**

Nigerian guidelines for rural drinking water quality monitoring and surveillance. Federal Ministry of Water Resources and Sanitation, Nigeria; 2023.

Case A3.42 ▶ More frequent surveillance activity at sites serving vulnerable populations in South Australia

In South Australia, surveillance frequency requirements are risk based. The Safe Drinking Water Act 2011 specifies that risk management plans (equivalent to water safety plans) must be audited or inspected by the surveillance authority (or a designated representative) annually or every 2 years, depending on risk. The associated schedule of audit and inspection frequencies establishes that drinking-water supplies representing greater risk should be visited more frequently. For example, standard small rainwater and bore water supplies are inspected every 2 years, whereas regulated care premises and regulated childcare and preschool premises are audited annually, owing to the relative vulnerability of the populations served. Not only are the higher-risk water supplies visited more frequently, but the audits required for these sites are led by practitioners who are more highly qualified than the inspectors assessing the lower-risk sites.

In addition to these routine audit and inspection requirements, follow-up audits or inspections are carried out as needed to confirm that action has been taken to remedy any deficiencies identified.

***Sources*:**

Safe drinking water act 2011: notice of scheme for audits and inspections. The South Australian Government Gazette; 3 April 2014, p. 1462 (https://www.governmentgazette.sa.gov.au/2014/April/2014_026.pdf, accessed 13 November 2023).

South Australia safe drinking water act 2011. South Australia; 2020 (https://www.legislation.sa.gov.au/__legislation/lz/c/a/safe%20drinking%20water%20act%202011/current/2011.16.auth.pdf, accessed 13 November 2023).

Case A3.43 ▸ Strategic use of limited surveillance resources to optimize public health benefit in England

In England (in the United Kingdom of Great Britain and Northern Ireland), 333 local authorities regulate the quality of drinking-water delivered through approximately 35 000 private water supplies (as of 2022), which are those supplies not provided by water companies. Private water supplies are generally located in rural areas, where connection to public mains networks is more difficult.

In accordance with The Private Water Supplies (England) Regulations 2016, local authorities are required to conduct risk assessments and monitor water quality for all private water supplies in their areas (with the exception of water supplies serving single dwellings not provided as part of a commercial or public activity, unless requested to do so by the dwelling's owner or occupant). However, in practice, local authorities have been unable to adhere fully to these requirements. For example, 2022 data indicate that across England, only 38% of private water supplies requiring a risk assessment had one in place that was not expired. With respect to water quality monitoring, data indicate that water quality testing is generally carried out below the required frequency. This is due in part to human and financial resource limitations.

To optimize the public health benefit from limited surveillance activity, local authorities have prioritized higher-risk supplies for site visits. For example, up-to-date risk assessments are in place for a much greater proportion of supplies with larger populations (those providing greater than 10 m^3 per day or serving more than 50 people) and those supplying water for commercial or public activities, given the greater numbers of consumers at risk.

***Sources*:**

Drinking water 2022: private water supplies in England. London: Drinking Water Inspectorate; 2023 (https://dwi-content.s3.eu-west-2.amazonaws.com/wp-content/uploads/2023/07/20174146/DWI-Private-water-supplies-in-England_Accessible.pdf, accessed 13 November 2023).

The private water supplies (England) regulations 2016. United Kingdom of Great Britain and Northern Ireland; 2016 (https://www.legislation.gov.uk/uksi/2016/618/regulation/10/made, accessed 13 November 2023).

Case A3.44 ▸ Establishing a training course and knowledge exchange forum to support surveillance practice in India

In August 2019, the Government of India committed to providing a "functional household tap connection" to every rural household by 2024. The Jal Jeevan Mission was launched with a mandate to ensure that, in full alignment with the Sustainable Development Goal criteria for safely managed drinking-water, every rural household is served with a potable water supply in adequate quantity and of prescribed quality on a regular and long-term basis. This ambitious programme is currently being implemented in partnership with state governments. Across all levels of government, more than US$ 5.6 billion in public sector funding had been committed by 2023.

Water quality monitoring and surveillance is an important part of this programme, combining monitoring by certified laboratories with community-led testing carried out by women in villages. Simple water testing kits are provided to each village, with results reported through an online portal. As of 2023, this Jal Jeevan Mission surveillance programme had tested more than 10 million water quality samples. The programme is helping to build a foundation for long-term water quality surveillance in every village.

The Jal Jeevan Mission has created a forum for nongovernmental organizations called the Rural WASH Partner's Forum, within which the India Natural Resource Economics and Management Foundation coordinates surveillance activities. Key gaps and challenges for the surveillance programme were identified through this forum relating to capacity to recognize water quality problems, identify solutions and communicate necessary corrective actions to operators and households.

In response to these gaps, the India Natural Resource Economics and Management Foundation and other Rural WASH Partner's Forum partners designed and launched a water quality management course that simplifies technical concepts and aims to strengthen understanding of water quality management. This 1 month online course is spread across nine sessions with 24 modules, and has trained 1600 so-called water quality champions for the Jal Jeevan Mission. The course is followed by a knowledge exchange forum to discuss problems encountered on the ground and connect with experts to find solutions. Also, the Jal Jeevan Mission has launched a Digital Academy, which is scaling up this experience to all states in India.

This approach of leveraging technologies, building capacities and enabling women in communities as water quality champions is helping the Jal Jeevan Mission work towards its aim in India.

***Sources*:**

Krishnan S, India Natural Resource Economics and Management Foundation, personal communication, 2023.

Santdasani N, Krishnan S. Professionalizing water quality management by empowered stakeholders: online water quality management (WQM) course for JJM. India Water Portal, Issue XVI; 2022 (https://www.indiawaterportal.org/articles/professionalizing-water-quality-management-empowered-stakeholders, accessed 13 November 2023).

Status of testing of drinking water samples in 2023-24 (as on 12/11/2023) [webpage]. Water Quality Management Information System, Jal Jeevan Mission, Ministry of Jal Shakti, India; 2023 (https://ejalshakti.gov.in/wqmis, accessed 13 November 2023).

Case A3.45 ▸ Developing digitized sanitary inspection forms to support surveillance in Iceland

As of 2022, the population of Iceland was just over 370 000. There are approximately 800 regulated drinking-water supplies in the country, only nine of which are classified as large supplies (serving >5000 consumers), with the remainder classified as medium, small or very small. The smaller supplies are mostly user owned, whereas the large and medium supplies are mostly municipality owned.

Health inspectors from Environmental Health Control perform various functions for many water supplies over an expansive area. This requires a range of skills, including water quality sampling and testing, and risk management. It also requires knowledge of water supply design, operations and maintenance, as well as the ability to work independently. To support surveillance staff in fulfilling their duties, customized (and digitized) sanitary inspection (SI) forms were developed beginning in 2019 and subsequently rolled out for use, especially in more rural areas. The SI forms cover 10 dimensions, including construction and design, scheme maintenance, pollution risks and level of service provided. SIs are undertaken using an iPad. This tool helps to ensure the collection of standardized information, enables ease of access to information on a range of indicators, and supports the identification of high-risk facilities through automatically generated scores. As improvements are implemented by water suppliers, the risk assessment is modified as a follow-up activity.

Use of the tool has led to a much higher degree of professionalization in the performance of health inspector functions. The standardized questions and the requirements to complete questions in a specific format are resulting in a noticeable increase in data quality and reduced variations in data quality.

***Sources*:**

Gunnarsdottir MJ, Gardarsson SM, Schultz AC, Albrechtsen HJ, Truelstrup Hansen L, Bergkvist KSG et al. Status of risk-based approach and national framework for safe drinking water in small water supplies of the Nordic water sector. Int J Hyg Environ Health. 2020;230:113627. doi:10.1016/j.ijheh.2020.113627.

King R, Gunnarsdottir MJ, Narfason TH, Hjaltadottir S, Sigurdsson A, Herschan J et al. Adapting sanitary inspections for the monitoring and surveillance of small drinking water supplies in Iceland. J Water Health. 2022;20(5):755–69. doi: 10.2166/wh.2022.144.

Narfason Þ, Environment and Public Health of West Iceland, personal communication, 2023.

United Nations World Population Prospects 2022 data portal [website]. Total population by sex, 2022 (https://population.un.org/wpp/, accessed 15 January 2024).

Case A3.46 ▸ Sustainable financing of regulatory activities (including surveillance) in Zambia

Zambia's National Water Supply and Sanitation Council was established in 2000, and it performs a wide-ranging set of regulatory functions. These include developing drinking-water standards and guidelines, formulating service-level agreements with water suppliers that specify required minimum service levels and operational performance, monitoring (including water quality surveillance), performance reporting, regulation by incentives and application of sanctions.

As part of this expansive role, the National Water Supply and Sanitation Council reviews the water quality data provided by Zambia's 11 commercial utilities, and it conducts inspections and water quality testing to validate the data. While these 11 commercial utilities principally serve urban and peri-urban contexts, steps have been taken since 2018 to enable and require commercial utilities to progressively manage a greater proportion of rural and small-town water supplies (see Case A3.10).

A sustainable financing mechanism has been established to cover the costs incurred by the National Water Supply and Sanitation Council. The predominant source of funding is a 2% levy on commercial utilities' revenues and fees from licences issued. This covers approximately 90% of the National Water Supply and Sanitation Council's operational costs, with government grants (and development partner resources) also leveraged as needed to fund specific activities, such as developing new strategies.

***Sources*:**

The status of the water supply and sanitation regulatory landscape across Africa: continent-wide synthesis report. Eastern and Southern Africa Water and Sanitation Regulators Association; 2022 (https://esawas.org/repository/Esawas_Report_2022.pdf, accessed 21 November, 2023).

The status of the water supply and sanitation regulatory landscape across Africa: Southern Africa regional report. Eastern and Southern Africa Water and Sanitation Regulators Association; 2022 (https://esawas.org/index.php/list-all-categories?task=download.send&id=66&catid=2&m=0, accessed 21 November, 2023).

Case A3.47 ▸ Joint analysis of water quality and sanitary inspection scores to assess risk across rural water supplies in Serbia

In Serbia, a nationwide survey was undertaken in 2016 to overcome knowledge gaps and identify priority challenges related to rural drinking-water service provision. Sanitary inspection (SI) scores and *Escherichia coli* (*E. coli*) test results from more than 1300 rural water supplies (piped supplies serving more than 20 people and individual supplies serving fewer than five households) were jointly assessed to determine the relative risk level and action priority for the various sites. To allow this joint assessment, *E. coli* counts were categorized as <1, 1–10, 11–100 and >100 colony forming units per 100 mL, and SI scores were categorized as 0–2, 3–5, 6–8 and 9–10.

Approximately one third of samples did not meet microbial standards. In addition, SI scores indicated that approximately 30% and 40% of piped and individual water supplies, respectively, had high or urgent priorities for improvement action. The most common risk factors associated with piped and individual supplies were also assessed (see the table), indicating focus areas for reducing sanitary risk and improving water quality.

The most common risk factors associated with piped and individual water supplies

Type of source	Sanitary risk factor	Piped supplies (%)	Individual supplies (%)
Protected spring	The area around the spring is unfenced	73.2	88.5
	Animals have access to within 10 m of the spring source	61.9	65.4
	The diversion ditch above the spring is absent or non-functional	62.9	69.2
Borehole with electrical pumping	There is a latrine or sewer within 100 m of the pumping mechanism	60.5	72.9
	There is another source of pollution within 50 m of the borehole (e.g. livestock, cultivation, road, industry)	63.7	58.3
	The drainage channel is absent or cracked, broken or in need of cleaning	54.3	64.6
Distribution network	Drinking-water is not chlorinated	72.8	NA
	Piped system is managed by unqualified persons (i.e. with no formal education in water supply management)	66.1	NA
	Households using a dual water supply (i.e. with parallel connections to a piped supply and an individual supply)	57.9	NA

NA: not applicable

Source: adapted from Jovanović DD, Paunović KŽ, Schmoll O, Shinee E, Rančić M, Ristanović-Ponjavić et al. Rapid assessment of drinking-water quality in rural areas of Serbia: overcoming the knowledge gaps and identifying the prevailing challenges. Pub Health Pan. 2017;3:175–85.

Assessment findings underscored the importance of proactive risk management and supported the case for making water safety plans (WSPs) mandatory. Efforts were subsequently initiated to include WSPs in the Serbian law on water for human consumption (in draft status in 2023), in line with WSP requirements in the revised European Union Drinking Water Directive (see Case A3.33).

***Sources*:**

Directive (EU) 2020/2184 of the European Parliament and of the Council of 16 December 2020 on the quality of water intended for human consumption. O.J.E.U. 2020, L 435 (https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32020L2184, accessed 13 November 2023).

Jovanović DD, Paunović KŽ, Schmoll O, Shinee E, Rančić M, Ristanović-Ponjavić et al. Rapid assessment of drinking-water quality in rural areas of Serbia: overcoming the knowledge gaps and identifying the prevailing challenges. Pub Health Pan. 2017;3:175–85.

Case A3.48 ▶ Discussing surveillance findings with water suppliers and users during site visits in Indonesia

In Indonesia, environmental health workers employed by the Ministry of Health perform sanitary inspections (SIs) as a surveillance activity, as required by a 2023 national decree on environmental health (including drinking-water quality surveillance). SI forms have been customized for the national context for the main types of water supply technologies and components, namely dug wells with hand pumps, spring water, rainwater harvesting, tapstands, water kiosks and piped networks. SIs are conducted at least annually, but are often performed more frequently based on the resources available at the district level as well as the extent of water quality challenges in the area and at the specific facility.

During inspections, critical findings are discussed with service providers and water users before the inspector leaves the site. This way, inspectors can ensure problems are understood and can help identify practical solutions to implement. An initial set of corrective actions is agreed upon through these discussions. This prompt and open sharing of findings with service providers and users helps to build a common understanding of the problems and the importance of remedial actions.

All findings are subsequently input into an electronic information management system, after which provincial and district officials prepare reports for service providers that offer greater detail on risks identified and corrective actions. Where water quality testing is carried out in conjunction with SIs, these results are also included in the written report.

Looking forward, SIs will be complemented by water safety plan audits, which will be carried out beginning in 2024 in accordance with the 2023 national decree on environmental health.

***Sources*:**

Deviyanti I, World Health Organization, personal communication, 2023.

Peraturan menteri Kesehatan nomor 2 tahun 2023 tentang peraturan pelaksanaan peraturan pemerintah nomor 66 tahun 2014 tentang kesehatan lingkungan. Ministry of Health, Indonesia; 2023 (https://peraturan.go.id/id/permenkes-no-2-tahun-2023#, accessed 13 November 2023).

Case A3.49 ▶ Surveillance follow-up to drive corrective action by water suppliers in the occupied Palestinian territory, including east Jerusalem

In the occupied Palestinian territory, including east Jerusalem, the Ministry of Health is mandated to ensure water is safe for human consumption for all water supplies in each governorate. It has a surveillance programme that involves testing a range of water quality parameters, including chlorine, *Escherichia coli*, nitrate and heavy metals.

Where issues or deterioration in water quality are identified, the service providers (including community-based organizations and other small water suppliers), water authority and the Ministry of Health come together to conduct additional tests and take further actions, such as sanitary inspections and water safety plan audits. The Water Sector Regulatory Council oversees this process and advises stakeholders on appropriate actions, when required. This process is collaborative, with stakeholders working together to identify the extent of the challenge, understand the root cause and determine the most appropriate solutions.

Importantly, the process does not end for the Ministry of Health or the Water Sector Regulatory Council when required corrective actions are identified and communicated. Rather, the Ministry of Health also plays a major role in monitoring the implementation of remedial actions by service providers and ensuring that targeted improvements are achieved. Furthermore, the Water Sector Regulatory Council requires a record to be kept (and shared) between the Ministry of Health and service providers concerning issues identified, remedial actions taken and the impact of these actions.

Source:

Al Hmaidi MS, Water Sector Regulatory Council, personal communication, 2023.

Case A3.50 ▶ Improved data management in Sierra Leone informed by assessing gaps and root causes

Over the years, multiple efforts have taken place in Sierra Leone to generate data on rural water supplies. These efforts include government-led national inventories (in 2012 and 2016), as well as routine monitoring led by implementation partners. However, beyond the use of summary statistics, these data have remained largely unused to inform decisions for the construction, rehabilitation, and ongoing management and maintenance of water points.

An assessment of breakdowns in the use and upkeep of data revealed root causes that included unclear institutional frameworks, limited technical and financial capacities to analyse existing data and limited incentive structures. These breakdowns led to a rapid loss of data relevance and trust in collected data, thus compounding issues with insufficient use and regular updating of data sets.

Awareness of the technical and capacity issues affecting data use inspired the sector to institutionalize the use of a digital platform for collecting, storing and managing water point data. In 2019, the Ministry of Water Resources launched its National Digital Monitoring Approach, which included a requirement for all data to be shared on the Water Point Data Exchange's global data repository.[5]

Efforts are under way to roll out the National Digital Monitoring Approach and ensure routine monitoring informs the development of district water, sanitation and hygiene plans. As of 2023, the sector had trained over 300 staff (mapping officers, environmental officers, educational officers and all nongovernmental organizations) on data management systems, and five costed monitoring and evaluation plans had been developed covering district and national levels. Looking forward, the focus will be on operationalizing plans to use data for decision-making across levels of government.

***Sources*:**

About WPdx [webpage]. Waterpoint Data Exchange; 2020 (https://www.waterpointdata.org/about/, accessed 13 November 2023).

Bah M, Ministry of Water Resources, Sierra Leone, personal communication, 2023.

Boulenouar J, Adank M. Data in water and sanitation: bridging the gap between "technically brilliant" and "real-world decision-making". Final report. Phase 2: from lessons to recommendations. Aguaconsult; 2022 (https://aguaconsult.co.uk/wp-content/uploads/2022/01/Aguaconsult-D2D_Draft-final_2022-1.pdf; accessed 22 November 2023).

Case A3.51 ▸ Progressively improving collection and use of data on water, sanitation and hygiene sector spending in Mali

Historically, there have been important data gaps related to water, sanitation and hygiene (WASH) sector financing in Mali. To address these gaps, the Government of Mali began developing WASH accounts[6] to track sector progress towards implementing the National Plan for Drinking Water Supply 2004–2015 and to monitor its commitments to the Sanitation and Water for All partnership.

During the first WASH accounts cycle in 2016, data collection efforts focused on water supply and liquid and solid waste sanitation, as these data were considered the most critical to understanding and addressing shortfalls in WASH expenditure. Findings revealed that average annual expenditures covered only 53% of the funding needs identified in the National Plan for Drinking Water Supply 2004–2015, and they highlighted significant disparities in expenditures between rural and urban areas. They also revealed a significant discrepancy between the Malian Ministry of Economy and Finance's Sanitation and Water for All partnership pledge to allocate 5% of the national budget to water and sanitation and the 1.2% average allocation made in practice.

5 The Water Point Data Exchange is a global platform for governments, nongovernmental organizations and donors to publicly share, access and use water point data. A suite of decision support tools allow decision-makers to easily analyse data to inform routine decisions. All aspects of the platform are freely available.

6 WASH accounts are the output of applying the TrackFin methodology to identify and track WASH sector spending at national or subnational levels in a consistent and comparable manner. WASH accounts are used by governments for national benchmarking, cross-country comparisons and providing an evidence base to better plan, finance, manage, and monitor WASH services and systems.

Subsequent WASH accounts cycles from 2017 to 2021 progressively expanded the scope of data collection and analysis to include water resource management, hygiene, and WASH in schools and health centres. Further data provided similar evidence of financing shortfalls. These findings were presented to the Minister of Water's Cabinet and to all relevant stakeholders during annual sector review meetings. Findings have been used to further monitor the implementation of the National Plan for Drinking Water Supply 2004–2015 and for the preparation of water and sanitation programmes. In 2020, results informed WASH funding dialogues, which resulted in recommendations that include the adoption of water tariff reform to generate additional revenue while ensuring equitable service delivery. Additionally, sector funding has increased from the Government of Mali and from donors. The national budget allocation for WASH increased by 112% over the 2019–2021 period, and the per capita annual WASH expenditure increased from less than US$ 6 in 2012 to US$ 23 in 2021. In the water subsector specifically, results have supported the adoption of an ambitious social emergency programme for water supply by the Ministry of Water and an increase in government funding.

Although sector funding remains insufficient to meet the Government of Mali's national targets, the development of WASH accounts has provided robust evidence to track progress, and also to support and influence sector-wide discussions on funding allocations. Over the years, WASH accounts have become a powerful instrument to raise decision-makers' awareness on sector funding gaps and support progressive increases in sector funding.

***Sources*:**

Allély D, personal communication, 2023.

Élaboration de stratégies financières en matière d'eau, d'hygiène et d'assainissement (EAH): Un guide. New York: United Nations Children's Fund; 2022 (in French) (https://www.unicef.org/media/127206/file/UNICEF%20WASH%20Financing%20Strategies%20Guide%20French.pdf, accessed 13 November 2023).

Mali: improved sector financing knowledge leads funding increases [webpage]. Sanitation and Water for All; 2021 (https://www.sanitationandwaterforall.org/impact-story/improved-sector-financing-knowledge-leads-mali-funding-increases, accessed 13 November 2023).

Tracking financing to drinking water, sanitation, and hygiene. Initial findings from the TrackFin initiative in Mali (2012-2014). Mali; 2015.

Case A3.52 ▸ Strengthening collection, analysis and use of water, sanitation and hygiene data in Ghana

In 2018, Ghana's Asutifi North District Assembly brought together local and national government leaders, district Chiefs, women in the community, water service providers, private sector representatives, local nongovernmental organizations and implementation partners to respond to the challenge of reaching unserved populations and increasing service levels in rural areas and small towns in the district. Assessments were conducted to determine the status of water, sanitation and hygiene (WASH) services, and a district WASH master plan was developed outlining the steps to achieve universal and sustainable safe water delivery. Master plan components included a clear vision, a WASH service strategy for the medium (2021) and long (2030) terms, a costed plan with funding sources, and a monitoring and evaluation framework.

An important element of operationalizing the master plan has been to progressively strengthen the collection, analysis and use of data. Since 2018, data collection has taken place on an annual basis to monitor implementation of the master plan, using indicators aligned with the Community Water and Sanitation Agency's Framework for Assessing and Monitoring Rural and Small Town Water Supply Services in Ghana. Importantly, this has been accompanied by efforts to strengthen the capacity of the district assembly to analyse and disseminate data, which has contributed to the adoption of more evidence-based and systematized decision-making processes. Data collected have informed planning and resource allocation processes and sparked action on issues related to tariff setting and revenue collection.

The adoption of the master plan and associated improvements in data collection and use have contributed to an increase in public funding for WASH (e.g. the doubling of district WASH budget allocations from 2018 to 2019), the establishment of stronger coordination mechanisms among partners and greater emphasis on addressing key service delivery challenges such as water safety.

***Sources*:**

Adank M, IRC, personal communication, 2023.

Asutifi North WASH Console [webpage]. ANAM WASH; 2023 (https://www.anamwash.com/anam-wash-console, accessed 13 November 2023).

Boulenouar J, Adank M. Data in water and sanitation: bridging the gap between "technically brilliant" and "real-world decision-making". Final report. Phase 2: from lessons to recommendations. Aguaconsult; 2022 (https://aguaconsult.co.uk/wp-content/uploads/2022/01/Aguaconsult-D2D_Draft-final_2022-1.pdf; accessed 22 November 2023).

District WASH master planning facility [webpage]. IRC; n.d. (https://www.ircwash.org/facility, accessed 13 November 2023).

Framework for assessing and monitoring rural and small town water supply services in Ghana. Community Water and Sanitation Agency; 2014 (https://www.ircwash.org/sites/default/files/framework_assessing_and_monitoring_rural_and_small_towns_wss_in_ghana.pdf, accessed 13 November 2023).

Water, sanitation and hygiene (WASH) master plans. The Hague, Netherlands (Kingdom of the): IRC; 2018 (https://www.ircwash.org/resources/water-sanitation-and-hygiene-wash-master-plans, accessed 13 November 2023).

Case A3.53 ▸ Improving evidence-based planning and decision-making in Nepal through a digital data platform

Historically, Nepal has lacked a consolidated management information system for data on critical aspects of water supply, sanitation and hygiene service provision, with different actors often utilizing their own systems. In 2018, and building on prior data management system initiatives, the National Water Supply, Sanitation and Hygiene Management Information System was developed to address this challenge. This information system covers urban and rural contexts, large and small facilities, and a range of indicators for sustainability, functionality and water quality (added in 2020).

The Ministry of Water Supply is the custodian of the National Water Supply, Sanitation and Hygiene Management Information System, and users have to be registered to upload water quality results (i.e. provide data from a registered laboratory or registered field test kit). Importantly, the Ministry of Water Supply has provided access to the system for a broad set of stakeholders, including other ministries, provincial and local governments, and development partners. This enables active use of the georeferenced data in the information system by various stakeholders to inform a range of decisions, including those involved in the development of national and subnational plans and programmes to support water suppliers.

Looking forward, the Ministry of Water Supply is focused on ensuring the National Water Supply, Sanitation and Hygiene Management Information System is updated regularly, and that data are shared with other ministries (e.g. the Ministry of Health and Population). To encourage regular updates to the information system, the revised 2022 National Drinking Water Quality Standards and associated implementation and monitoring directives require water suppliers to regularly input data (see Case A3.21).

***Sources*:**

National drinking water quality standards, 2022. Nepal; 2022.
Ojha R, Ministry of Water Supply, personal communication, 2023.
Panthi SR, World Health Organization Nepal, personal communication, 2023.

Case A3.54 ▸ Expanding use of a digital platform for data on rural water and sanitation service delivery in Latin America and Africa

The Rural Water and Sanitation Information System is a joint initiative originally launched in 2011 by the governments of Honduras, Nicaragua and Panama, which has expanded to cover 15 countries in Latin America and Africa. As of October 2023, data sets in the system covered 22.5 million rural inhabitants from more than 40 000 communities. The primary aim of the system is to provide a unified, easy-to-use, updated and comparative interface for data and information on rural water and sanitation services to support monitoring, planning, coordination and evaluation of sector performance. In so doing, it helps to avoid fragmentation by harmonizing tools and approaches, and it enables collected data to be readily compared across sites within (and among) participating countries. Furthermore, the use of electronic data entry facilitates more efficient data collection and limits processing errors, while also aiding data analysis and enabling multiple stakeholders to access available data.

Data are collected on the following areas: (i) access to basic services, (ii) a composite index on quality of service, (iii) a composite index on service provider performance (including compliance with drinking-water quality standards) and (iv) an assessment of the presence and competency of entities providing technical support to service providers.

In Colombia, the Rural Water and Sanitation Information System was adopted in 2017 to monitor rural water provision in three departments as a pilot. This enabled systematic collection of data in rural areas, including areas that had not previously been mapped. It contributed to the following decision processes:

- planning and funding of access to drinking-water in 10 Indigenous farming communities in the department of La Guajira in 2018;
- prioritization of water access in seven rural communities in the Distrito Especial de Tumaco, department of Nariño, resulting in the expansion and improvement of water supply in 2017; and
- planning and prioritization of water supply construction for the municipalities of Balboa, Patia and Mercaderes in the department of Cauca in 2021.

Looking forward, there is scope to continue to increase the number of rural communities covered by the Rural Water and Sanitation Information System across participating countries.

Sources:

Boulenouar J, Adank M. Data in water and sanitation: bridging the gap between "technically brilliant" and "real-world decision-making". Final report. Phase 2: from lessons to recommendations. Aguaconsult; 2022 (https://aguaconsult.co.uk/wp-content/uploads/2022/01/Aguaconsult-D2D_Draft-final_2022-1.pdf; accessed 22 November 2023).

Rural Water and Sanitation Information System (SIASAR), internal communication, 2023.

SIASAR data [webpage]. Rural Water and Sanitation Information System; 2023 (https://data.globalsiasar.org, accessed 13 November 2023).

Case A3.55 ▶ Differing needs for data analysis and reporting according to target data users and uses in Latin America and Africa

A study undertaken in Colombia, Ghana, Sierra Leone and Uganda assessed the link between data generation and decision-making. Findings showed the different levels of data processing requirements for planning, funding and operational decisions in the rural water supply sector, as well as the importance of fit-for-purpose reporting of data. Specific findings include:

- the subnational WASH master plan development initiated in Asutifi North, Ghana, in 2017 required data to be less than 1 year old and processed into communication products to be useful for planners and decision-makers;

- the subnational planning and resource allocation for the construction of new water supply facilities in Ntoroko district in Uganda in 2018 required data to be processed in the form of tables, graphs and maps, and disseminated through extensive discussions (called "data dialogues") to be usable; and
- the Safe Water Network in Ghana required only raw data collected at water stations to be used for daily operations.

The study also highlighted the link between the degree to which data needed to be processed and other factors, such as the individual capacity of decision-makers to interpret and apply the data.

***Source*:**

Boulenouar J, Adank M. Data in water and sanitation: bridging the gap between "technically brilliant" and "real-world decision-making". Final report. Phase 2: from lessons to recommendations. Aguaconsult; 2022 (https://aguaconsult.co.uk/wp-content/uploads/2022/01/Aguaconsult-D2D_Draft-final_2022-1.pdf; accessed 22 November 2023).

Case A3.56 ▸ Simple and accessible reporting of water quality data for non-technical audiences in Ethiopia

In Ethiopia, a water quality assessment was undertaken in 2022 in three target districts (*woredas*) through collaboration between a local university and an international research institute. Samples were collected from water points within communities, schools and health care facilities, as well as from household storage containers. The water quality information was summarized and presented to local government actors to help them prioritize resources for infrastructure development and support corrective action to protect public health.

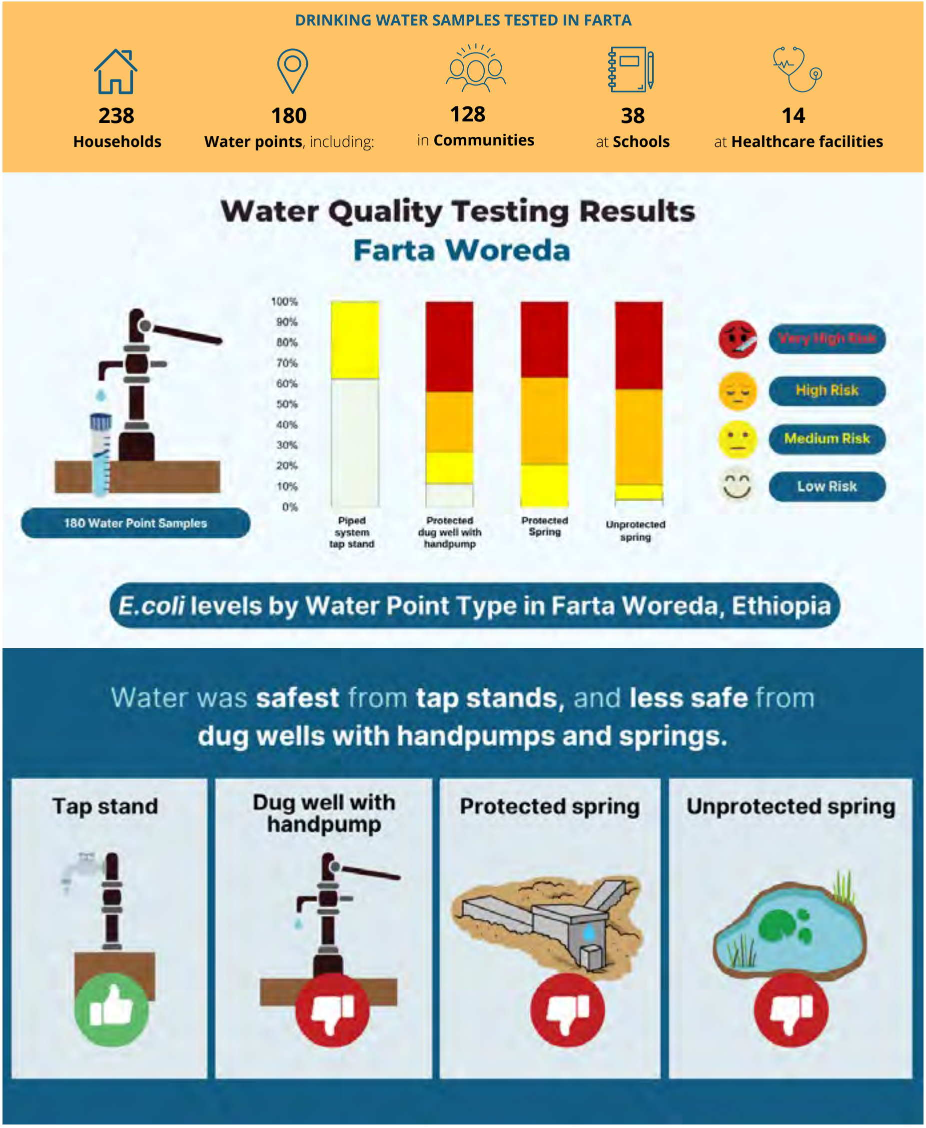
In addition, a simplified overview of results was prepared (see the figure) and shared with community members and leaders during dissemination meetings, where researchers invited questions and discussion about how water-related risks could be better managed. The assessment findings were presented in highly visual formats to ensure the results and their implications were clear and accessible to non-technical audiences. This approach to disseminating findings in user-friendly formats has motivated action. For example, in Farta Woreda, several community members have fenced their water points and requested that the District Water Bureau chlorinates the water.

***Sources*:**

Setty K, Aquaya, personal communication, 2023.

What is the water quality in Ethiopia? [research brief webpage]. Aquaya; 2023 (https://aquaya.org/what-is-the-water-quality-in-ethiopia/#Household-Samples---Farta-Woreda, accessed 13 November 2023).

Water quality testing results from water collection points in Farta Woreda, Ethiopia



Source: adapted from What is the water quality in Ethiopia? [research brief webpage]. Aquaya; 2023 (https://aquaya.org/what-is-the-water-quality-in-ethiopia/#Household-Samples---Farta-Woreda, accessed 13 November 2023).

Case A3.57 ▶ Accessible reports on water supplier performance in Kenya and the United Republic of Tanzania

Regulators in many African countries produce annual performance reports, which benchmark the performance of water supply service providers against a range of key indicators. Water supplies covered by these reports include those serving rural and small towns that are provided by more formalized service providers. Information in these reports is presented in a highly visual manner, including traffic-light colour coding to indicate performance against targets and the inclusion of data from prior years to highlight changes over time. Notable examples include the following.

- In Kenya, the Water Services Regulatory Board produces an annual impact report that benchmarks the performance of over 90 service providers against key indicators such as population served, non-revenue water and drinking-water quality. This covers the largest service providers (those with over 35 000 connections), and also includes 27 small service providers (those with under 5000 connections).
- In the United Republic of Tanzania, the Energy and Water Utilities Regulatory Authority produces two sets of annual benchmarking reports; one focuses on the regional and national levels, and the other on district and township water supply and sanitation authorities. The latter covers services to many rural growth centres and small towns, and includes a comprehensive set of indicators.

Reports are typically produced and shared annually as part of wider workshops and award ceremonies to increase accountability. They are often released in line with annual planning and budgeting cycles to help ensure key findings and recommendations can be accounted for within these processes. Additionally, the regulatory actors producing these reports follow up with water suppliers on specific action points and priorities identified within the reports to help ensure necessary corrective measures are taken.

***Sources*:**

Impact: a performance report of Kenya's water services sector - 2021/22. Issue 15. Nairobi: Water Services Regulatory Board; 2023 (https://wasreb.go.ke/downloads/WASREB_Impact_Report15.pdf, accessed 13 November 2023).

The water supply and sanitation regulatory landscape across Africa: continent-wide synthesis report. Eastern and Southern Africa Water and Sanitation Regulators Association; 2022 (https://esawas.org/repository/Esawas_Report_2022.pdf, accessed 13 November 2023).

Water utilities performance review report for financial year 2021/22. Energy and Water Utilities Regulatory Authority, Ministry of Energy, United Republic of Tanzania; 2023 (https://www.ewura.go.tz/wp-content/uploads/2023/03/District-and-Township-WSSAs-Performance-Review-Report-FY-2021-22.pdf, accessed 13 November 2023).

Case A3.58 ▶ Systematic use of data on water safety risks to support routine funding allocations in Vanuatu

In 2016, the Government of Vanuatu launched the National Sustainable Development Plan 2016 to 2030, with one of the policy objectives being to ensure all people have reliable access to safe drinking-water and sanitation infrastructure. To support the achievement of this objective, in 2018 the Department of Water Resources launched the Vanuatu National Implementation Plan for Safe and Secure Community Drinking Water: A Guide to the Plan. This guide sets out a transparent process for the government to prioritize communities for water infrastructure upgrades that is based on a systematic review of improvement needs identified through drinking-water safety and security plans. As explained in Case A3.39, drinking-water safety and security plan improvement needs are routinely reviewed by advisory committees at provincial and national levels to determine the communities most at risk, and to determine annual budget allocations accordingly.

Sources:

Vanuatu national implementation plan for safe and secure community drinking water: a guide to the plan. Vanuatu; 2018 (https://www.nab.vu/sites/default/files/documents/Vanuatu%20National%20Implementation%20Plan%20for%20Safe%20and%20Secure%20Community%20Drinking%20Water.pdf, accessed 13 November 2023).

Vanuatu: national sustainable development plan 2016 to 2030 (Vanuatu 2030 the people's plan). Vanuatu; 2016 (https://policy.asiapacificenergy.org/node/2987, accessed 13 November 2023).

Case A3.59 ▶ Annual planning and budgeting processes informed by rural water supply monitoring data in Myanmar

In Myanmar in 2019, the Department of Rural Development (with support from partners) designed, piloted and adopted an electronic system for rural drinking-water services using a free, publicly accessible platform to manage, analyse and visualize data. Priority indicators reflected in the platform include water supply functionality, availability, continuity of supply, water quality, management details and user payments. Further, all water supply assets from source to public tapstands were included in monitoring efforts to support asset management. Monitoring indicators, which align with national targets and Sustainable Development Goal 6 indicators, were agreed upon in consultation with a wide range of stakeholders. (See Cases A3.53 and A3.54 for other examples of electronic data management systems for rural supplies.)

The electronic system has been designed for local government staff to update data regularly for use at local and national levels. This electronic system, combined with improved microbial monitoring practices, aims to provide an evidence base to support improved local and national annual planning and budgeting processes. The decision-making processes supported focus on maintenance and extension of water supply service delivery. (The process of data collection has partially continued despite the political changes of 2021 that limited the possibility of external support.)

***Sources*:**

Greggio E, formerly of WaterAid, personal communication, 2023.

Kimbugwe C, Davis T, Goff F, Greggio E, Chanthet S, Kiap B. Strengthening country-led water and sanitation services monitoring and data use for decision-making: lessons from WaterAid experience in four countries. H2Open J. 2022;5(2):348–64. doi:10.2166/h2oj.2022.028.

Annex 4: Sanitary inspection packages

A4.1 Introduction

A sanitary inspection (SI) is a rapid, on-site evaluation, traditionally using a checklist, to help identify and support the management of priority risk factors that may lead to contamination of a water supply. A simple but powerful risk assessment tool, SIs consider the physical structure of the water supply, its operation and external environmental factors related to drinking-water safety to determine both existing sources of contamination and water supply inadequacies that could lead to contamination.

SIs should be conducted through a field visit by a trained individual (see Box A4.1) to identify risk factors that may lead to the contamination of the water supply, including:

- potential sources of contamination (e.g. presence of a latrine close to the water source);
- observable contaminant pathways (e.g. inadequate drainage, standing water); and
- breakdowns in the barriers that prevent contamination (e.g. dug well apron with deep cracks) *(1)*.

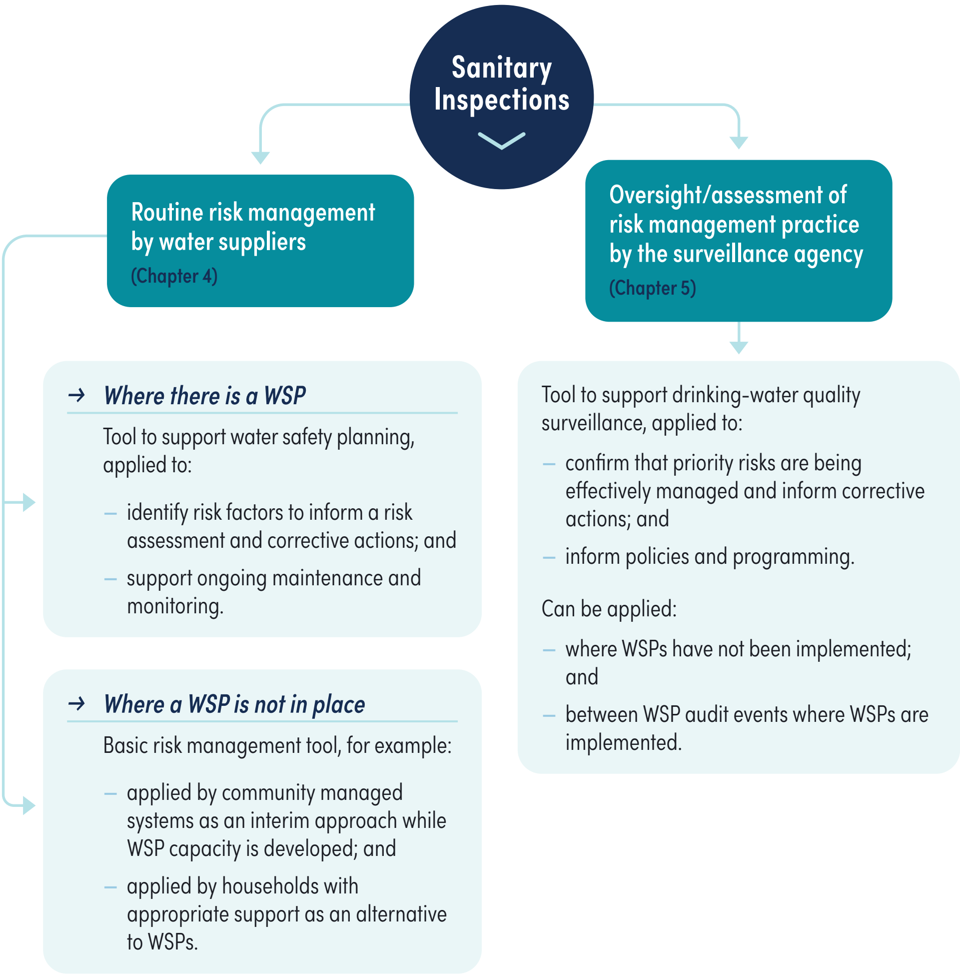
Box A4.1 ▸ SI training needs

SI should be conducted by a water supplier or surveillance officer who has been appropriately trained. Effective training will help to reduce inherent differences between individuals' perceptions of risk and improve the consistency of responses between inspectors *(2)*. Training may include operational definitions (e.g. definition of a "deep crack" versus a superficial crack in an apron), which can be supported by photographs taken in the local context to limit subjectivity.

SI forms typically consist of a checklist of equally weighted yes/no questions in which a "yes" response indicates the presence of a risk factor that may compromise the safety of the drinking-water supply. The number of "yes" responses (i.e. risk factors) may then be totalled to provide a sanitary risk score that can be used to prioritize action. Where multiple SI forms apply to a single water supply (e.g. for a non-piped system that includes a spring with household collection and storage, or a piped system with a surface water source, storage tank, distribution network and tapstands), it may be useful to combine the "yes" responses from the various forms to determine an overall sanitary risk score for the full water supply. The sanitary risk score should ideally be combined with water quality testing data to form part of an overall risk assessment of the drinking-water supply (see section 5.3.5). If there are insufficient resources to conduct water quality monitoring, SIs can still provide valuable information that can support safe water supply management.

SIs provide a low-cost, easy-to-use approach that can be applied in many settings, especially for small drinking-water supplies where resources and capacity may be limited. SIs support routine risk management by water suppliers (including as part of water safety plans (WSPs); see Chapter 4) as well as surveillance practice (see Chapter 5). SI applications are summarized in Fig. A4.1.

Fig. A4.1 • Applications of SIs for safe drinking-water management



A4.2 SI package overview

SIs provide a simple and rapid means of identifying risk factors in water supplies and prompting corrective actions to support safe drinking-water management. The World Health Organization (WHO) has developed 13 SI packages[1] for common water supply technologies and scenarios found in small supplies, which are summarized in Fig. A4.2. These SI packages are published separately in *Sanitary inspection packages – a supporting tool for the Guidelines for drinking-water quality: small water supplies* (or *Sanitary inspection packages*) *(3)* and can be downloaded in both PDF and editable formats from: https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/water-safety-and-quality/water-safety-planning/sanitary-inspection-packages. Links to the individual SI packages are also embedded in Fig. A4.2.

Each SI package includes the following three components (for details, see Fig. A4.3):

1. SI form
2. technical fact sheet
3. management advice sheet.

These packages may be applied in the format provided, or they can be adapted as needed where capacity and resources permit (see section A4.3).

1 For information on the development of the WHO SI packages, see Annex 1 in *Sanitary inspection packages (3)*.

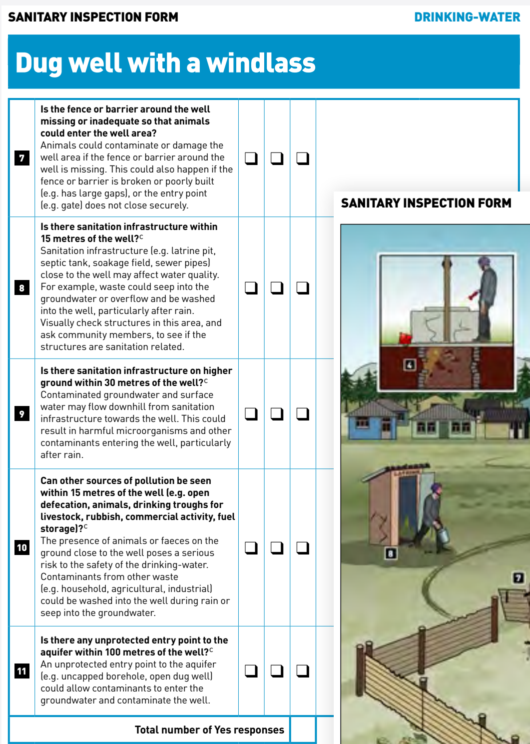
Fig. A4.2. • List of WHO SI packages for small water supplies

Source: adapted from *Sanitary inspection packages (3)*.

Fig. A4.3 • Contents of the WHO SI packages[a]

a. SI form

- A checklist of yes/no questions to support the identification of common risk factors and prompt corrective action
- Includes explanatory notes to clarify the sanitary significance of each question, and help consistency between form users
- Includes illustrations depicting the risk factors to assist with the completion of the form
- Includes a section to capture key water supply data (including water quality testing data where obtained) that may provide context for completion of the SI, aid risk assessment, and support the development or updating of water supply inventories



SANITARY INSPECTION FORM **DRINKING-WATER**

Dug well with a windlass

7	**Is the fence or barrier around the well missing or inadequate so that animals could enter the well area?** Animals could contaminate or damage the well area if the fence or barrier around the well is missing. This could also happen if the fence or barrier is broken or poorly built (e.g. has large gaps), or the entry point (e.g. gate) does not close securely.	❑	❑	❑
8	**Is there sanitation infrastructure within 15 metres of the well?**[c] Sanitation infrastructure (e.g. latrine pit, septic tank, soakage field, sewer pipes) close to the well may affect water quality. For example, waste could seep into the groundwater or overflow and be washed into the well, particularly after rain. Visually check structures in this area, and ask community members, to see if the structures are sanitation related.	❑	❑	❑
9	**Is there sanitation infrastructure on higher ground within 30 metres of the well?**[c] Contaminated groundwater and surface water may flow downhill from sanitation infrastructure towards the well. This could result in harmful microorganisms and other contaminants entering the well, particularly after rain.	❑	❑	❑
10	**Can other sources of pollution be seen within 15 metres of the well (e.g. open defecation, animals, drinking troughs for livestock, rubbish, commercial activity, fuel storage)?**[c] The presence of animals or faeces on the ground close to the well poses a serious risk to the safety of the drinking-water. Contaminants from other waste (e.g. household, agricultural, industrial) could be washed into the well during rain or seep into the groundwater.	❑	❑	❑
11	**Is there any unprotected entry point to the aquifer within 100 metres of the well?**[c] An unprotected entry point to the aquifer (e.g. uncapped borehole, open dug well) could allow contaminants to enter the groundwater and contaminate the well.	❑	❑	❑
	Total number of Yes responses			

a Images shown are extracts from the individual components of the full SI package for a *Dug well with a windlass*. All SI packages provided follow the format shown.

Fig. A4.3 continued • Contents of the WHO SI packages

b. Technical fact sheet

- Provides basic technical information on the water supply technology or scenario to support the completion of the SI form
- Includes illustrations depicting the water supply in a "sanitary condition", which can be compared against the SI form illustration to help identify the presence of risk factors

TECHNICAL FACT SHEET DRINKING-WATER

Dug well with a windlass

This technical fact sheet provides background information on a dug well with a windlass, which supports the sanitary inspection of this drinking-water source.[a]

A dug well consists of an excavated hole in the ground with a water-lifting device (e.g. hand pump, windlass) that is used to bring groundwater to the surface.

Groundwater is considered to be better quality than surface water in many places. However, appropriate treatment/disinfection are required for groundwater sources that are vulnerable to contamination.

Improved dug wells are lined, covered and fitted with a secure water-lifting device to provide safe drinking-water. **Unimproved dug wells** are open or uncovered wells. These are more likely to become contaminated, and should be improved where possible.

Dug wells can be excavated by hand or with a machine. The diameter of a dug well is often more than 1 metre. This means that dug wells can typically be accessed by a person for inspection, operations and maintenance or improvement works (e.g. repairing the well wall, removing sediment, deepening the well).

Dug wells should have adequate capacity (i.e. have an appropriate depth below the water table and width) to meet the needs of users at all times of the year. Limited capacity could result in users seeking alternative drinking-water sources that could be less safe.

The water collection area should be built so it is accessible for all users.[b]

Figure 1 shows a common type of dug well with a windlass. A section view of the belowground elements of the well is shown in Figure 2. These figures show a typical design. Other designs can also provide safe drinking-water.

Typical risk factors associated with a dug well with a windlass are presented in the corresponding *Sanitary inspection form.*

Figure 1. A common dug well with a windlas

[a] This fact sheet is not intended to serve as a guide to construction. For de dug well, refer to Hand-dug shallow wells: series of manuals on drinkin

[b] For guidance on designing accessible facilities, refer to Water and sanita groups: designing services to improve accessibility (Jones & Reed, 2005

TECHNICAL FACT SHEET: Dug well with a windlass

TECHNICAL FACT SHEET DRINKING-WATER

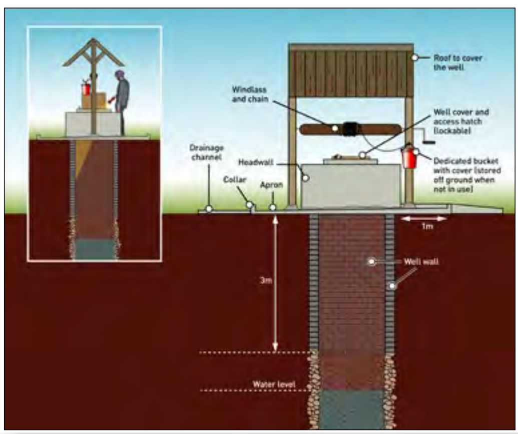


Fig. A4.3 continued • Contents of the WHO SI packages

c. Management advice sheet

- Provides general guidance on developing an operations and maintenance schedule to support the safe management of the water supply
- Suggests basic corrective actions for each risk factor included in the SI form

MANAGEMENT ADVICE SHEET **DRINKING-WATER**

Dug well with a windlass

This management advice sheet provides guidance for the safe management of a dug well with a windlass, which supports the sanitary inspection of this drinking-water source.

Guidance for typical operations and maintenance (O&M) activities is provided in Table 1, including suggested frequencies for each activity. These activities are important for keeping the dug well and windlass in good working condition and protecting drinking-water quality.

Table 2 lists potential problems that may be identified during a sanitary inspection, and provides basic corrective actions to consider for each problem.

This management advice sheet can also support routine management and monitoring practices, which are required to help ensure the ongoing safety of the water supply.

A. OPERATIONS AND MAINTENANCE

Basic O&M can usually be carried out by a trained owner, user or caretaker/operator (e.g. simple maintenance tasks such as cleaning the well area). Larger repairs and maintenance tasks (e.g. repairing the well wall, windlass maintenance) may need skilled labour which can be provided by local craftspeople, or with support from outside of the local area.

The condition of the dug well and windlass should be inspected routinely to help prevent contaminants entering the well. Any damage or faults should be repaired immediately (e.g. deep cracks in the headwall, broken fence, soil erosion around the apron). Standard operating procedures (SOPs) should be developed for important O&M tasks (e.g. entering the well to inspect the well wall). These should be followed by trained individuals so the work is carried out safely and the well is not contaminated during the work.

Consultation with the relevant authorities may be required to ensure that sanitation infrastructure (e.g. latrine pits, septic tanks, sewers, soakage fields) is not built near the well unless hydrogeological studies show that it is safe to do so. Consideration should also be given to catchment activities that extract groundwater (e.g. for irrigation, mining, power) to ensure an adequate quantity of drinking-water to meet the needs of users.

Activities other than the collection of drinking-water (e.g. laundry, washing, bathing) should not be permitted at the dug well area. These should be carried out at a safe distance downhill from the well.

Adequate treatment/disinfection are required before consuming the drinking-water if the dug well is vulnerable to contamination, or if the water could be contaminated due to unhygienic storage and handling by the user during transport or in the home.

Table 1. Guidance for developing an operations and maintenance schedule

Frequency	Activity
Daily to weekly	• Check and clean the dug well facility. Remove any polluting materials (e.g. faeces, rubbish). • Check and clean the bucket and chain (or rope). Store in a sanitary manner (e.g. in a clean/dry area, off the ground). • Check that the windlass is working. Repair or replace damaged parts as needed. • Check that the well cover and access hatch lid are in place and in good condition, and can be closed and latched shut/locked securely. Repair or replace damaged parts, or lock as needed. • Check that the drainage channel is clear and in good condition. Remove debris or repair as needed. • Check that the fence or barrier is in good condition and that the entry point (e.g. gate) can be closed securely and latched shut/locked. Repair as needed.

MANAGEMENT ADVICE SHEET: Dug well with a windlass (Version March 2023) 1

DRINKING-WATER

...ith a dug well with a windlass, and suggested corrective actions

		Corrective actions to consider
		• If the bucket and chain (or rope) are dirty, clean and disinfect them (e.g. with chlorine). • If there is no dedicated sanitary storage place for the bucket and chain (or rope), install a storage space for them (e.g. a hook or shelf raised off the ground). • Communicate the importance of routine cleaning/maintenance, and returning the bucket and chain (or rope) to the dedicated storage location after each use. Consider installing information signs at the well to remind users of the risk.
		• Ensure there is a bucket present that is dedicated for drawing drinking-water from the well. • Communicate the importance of using only the dedicated bucket for drawing water from the well. Consider installing information signs at the well to remind users of the risk.
		• If the well cover or access hatch lid is absent or damaged (e.g. deep cracks, severely corroded, does not fit tightly when closed), provide a temporary cover (e.g. impermeable plastic sheeting) to minimize the entry of contaminants. Install or repair the cover and/or lid as soon as possible.
		• Repair the headwall to ensure that the well is adequately sealed (e.g. repair mortar and brickwork). • For the belowground well wall, seek skilled help as needed to repair and seal the well wall. Pay special attention to the health and safety risks to workers when entering the well, and the potential to contaminate the well during the work. • Clean and disinfect (e.g. with chlorine) the well once finished.[c]
5	The apron around the well is absent or in poor condition (e.g. with gaps, deep cracks; signs of erosion under the apron), which could allow contaminants to enter the well (e.g. from contaminated surface water).	• If the apron is absent, construct an apron at least 1 metre around the headwall, ensuring that it slopes downward to a defined collar. • If the apron is damaged or has deep cracks, repair it to ensure that it is adequately sealed. • If the area around or under the apron shows signs of erosion, replace any eroded earth to ensure that it is adequately sealed. (Where the erosion is caused by poor drainage, see row 6.)
6	The drainage is inadequate (e.g. absent, damaged or blocked drainage channel or soakaway), which could result in stagnant water contaminating the well.	• If a drainage channel or soakaway is absent, dig a temporary channel to divert water away from the well site. Construct a permanent solution as soon as possible. • If a drainage channel or soakaway is not working, consider whether maintenance is needed (e.g. repairing, cleaning), or if deepening, widening or extending is required.

MANAGEMENT ADVICE SHEET: Dug well with a windlass 3

A4.3 Adapting SI packages

Although SI forms can be used directly in the format provided in the WHO SI packages, small water supplies vary widely and some aspects of the forms may not be relevant in all contexts, or additional risk factors may be important in some settings. If needed, and as capacity and resources permit, authorities should adapt the material to the local context. Adaptation to ensure SI forms are context appropriate and relevant may encourage their acceptance and uptake.

Where adaptation of the SI packages is deemed to be of benefit, simplicity should be maintained as an overarching principle. Language should be unambiguous and appropriate for the intended users.

The format should be clear and user friendly for the inspector (e.g. surveillance officer or water supplier). The intended users of the SI findings should be able to easily understand and act on any issues identified. This includes ensuring:

- key water supply information can be captured in a user-friendly way;[2]
- easy identification of potential sources of water supply contamination; and
- a clear, ideally graphical, means to communicate to the water supplier the nature of the risk factors.

The design of SI forms can range from basic pictures and a brief checklist to more comprehensive and detailed checklists with explanatory notes and guidance. The forms can be paper based or adapted for mobile platforms (e.g. mobile applications or "apps").

The forms should allow a total numeric score to be generated that can be attributed to the water supply and which may be analysed in combination with water quality testing results (see section 5.3.5). This will provide a more comprehensive indication of the level of risk to better support prioritization of improvement actions (e.g. identify support needs and inform strategic planning).

To assist inspectors, supporting guidance should be considered on the key technical features of the water supply as they relate to the SI form questions. Guidance should also be provided to help inspectors identify appropriate corrective actions to consider for issues identified during the inspection. Basic information should be provided to inform key operations and maintenance activities that protect water quality and help to ensure reliable functioning of the water supply. (This proposed guidance is in line with that offered in the technical fact sheet and management advice sheet in each of the WHO SI packages.)

2 The water supply information can assist with interpretation of the SI results, and also help to generate or maintain up-to-date water supply inventories at national or subnational levels.

Guidance on factors to consider when adapting the WHO SI packages is provided in Boxes A4.2 and A4.3.

Box A4.2 ▸ Factors to consider when adapting the WHO SI packages

Where adaptation of the WHO SI packages is deemed to be of benefit, the following questions should be considered.

Who should lead and contribute to the adaptation? In many cases, adaptation of SI packages will be led by the relevant health or surveillance authority. Input from those closest to the water supplies, such as local health representatives and water suppliers, is important to help ensure the materials are appropriate to the context. This may also contribute to a sense of ownership among stakeholders, potentially supporting future uptake *(4)*. In some cases, support from academic or research institutions and other experts (e.g. those representing the fields of drinking-water quality, health and catchment management) may be advantageous.

What to consider when adapting? Several elements of the SI packages may require adaptation, including the following.

- *Language:* Translation into local languages may be critical to support uptake and effective application of SI packages.
- *Risk factors:* The SI form questions in the WHO SI packages represent common risk factors related to the specific water supply technology or scenario in question. This list is not exhaustive, however, and consideration should be given to which risk factors are known to influence drinking-water safety in the given context. Questions that are not relevant should be removed, and additional questions should be included where needed. Further, the questions in the WHO SI forms may require simplification for ease of comprehension by users or in advance of translation into local languages.
- *Graphical representations:* Illustrations should ideally reflect local variations in water supply design (e.g. the technology type and associated components), risk factors, ethnicity, cultural habits and religious customs, as this can contribute to user acceptance and uptake of the forms. Where literacy levels are low, consider greater emphasis on graphical representations over text.
- *Weighting of risk factors:* The WHO SI form questions carry equal weighting for all risk factors, which is unlikely to be accurate in every context. For example, the presence of an unlocked gate is unlikely to carry the same risk to the water supply as the presence of a latrine uphill of the water source where the soil profile is sandy. Consideration should be given to the need for differential weighting of the risk factors for local conditions to better inform prioritized action.[a]
- *Minimum safe distances (MSDs) for contaminating activities:* It is important to consider local hydrological characteristics and other conditions to determine an MSD between water sources and all potential sources of contamination (also referred to as the "set-back" distance). See Box A4.3 for guidance.
- *Technical guidance and management advice:* The supporting technical guidance to help the inspector complete the activity should be customized to ensure the guidance is appropriate for the local technology in question. Operations, maintenance and troubleshooting advice provided should be pragmatic and in line with the available resources and capacity.

How to field test the adapted SI packages? Field testing should ideally be conducted to ensure that the adapted SI packages are fit for purpose. This may involve piloting in select areas, comparing inspection site photos against completed inspection reports, and interviews with SI package users. This information should be used to inform further revision and strengthening of the SI packages where needed. As additional experience is gained over time, further updates should be made as needed to reflect lessons learned.

[a] Some factors to consider in weighting risk factors are included in *How we assess water safety: a critical review of sanitary inspection and water quality analysis (1)* and *Sanitary inspection, microbial water quality analysis, and water safety in handpumps in rural sub-Saharan Africa (5).*

Box A4.3 ▶ Guidance on determining MSDs for potentially polluting activities from drinking-water sources

An MSD for potential sources of contamination should be determined in the local context if resources allow, especially for faecal contamination. The MSD is based on an estimate of the time taken by contaminants to travel from their source to the drinking-water supply.

For microbial pathogens, this travel time depends largely on local hydrogeological conditions, in particular the hydraulic conductivity or permeability of the soil and rock in the unsaturated and saturated zones. Travel time will also be affected by the volume and initial concentration of contamination introduced into an area, the pathogen death rate and degree of dispersion within the waterbody *(6)*. Given that many of these and other factors vary significantly on a site-by-site basis (and potentially even within a given water supply), it is difficult to set MSD values that are globally applicable.

The rate of movement of groundwater varies greatly depending on the permeability. This means that the MSD for impermeable clays may be as low as a few metres, but this may increase significantly in the dry season if the clay is subject to cracking. For sands, this may increase to 100 m. In permeable gravel beds or areas where there are shallow aquifers in fissures, the MSD may reach as much as several kilometres.

Where groundwater is used as a drinking-water source, site-specific factors should be considered as part of the risk assessment to determine the MSD, including (adapted from *Protecting groundwater for health (7)*):

- the type of sanitation containment technology(ies) in the area and their degree of pathogen removal;
- the hydraulic groundwater loading from these technologies;
- the soil and subsoil type, and the depth to the groundwater table; and
- catchment activities or events that may affect the subsurface (e.g. mining, quarrying, water extraction, drought, seismic activity).

Hydrogeological information may be available from water authorities and/or authorities responsible for catchment activities, such as mining. In the absence of sound hydrogeological information, an indication of the local conditions can be gained through test drilling around the water source, recording the changes in soil and rock type and conducting infiltration tests in the area. The infiltration capacity of the soil in the area should be assessed when the water table is at its highest. Information on the geology of the area where infiltration capacity is being evaluated should be obtained, particularly on whether any fissures or joints underlie the area, given these may dramatically increase the hydraulic conductivity and therefore the MSD.[a]

As an approximate guide, in the absence of the above information, any drinking-water source should be located upgradient and at least 15 m horizontal distance from permeable sanitation containers and soak pit or leach fields *(7–10)*.[b] However, unless detailed investigations of the area have been carried out under all conditions, it is preferable to increase these distances.

If these distances cannot be achieved because of population density or geographical conditions, alternative approaches should be considered to reduce risk (e.g. relocating the water source or abstraction point; relocation of sanitation infrastructure; or alternative sanitation designs such as elevated pits or pits sealed with impermeable concrete linings).

a For more information on conducting risk assessments for groundwater from polluting activities, see *Guidelines for assessing the risk to groundwater from on-site sanitation (6)* and *Protecting groundwater for health (7)*.

b Additionally, the bottom of permeable containers and soak pits or leach fields should be no less than 1.5 m to 2.0 m above the water table at its highest level during the year *(10)*.

A4.4 References

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