National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Tools for the implementation of **integrated Water and Sanitation Safety Planning** in small systems

RIVM report 2024-0022

H. van den Berg et al.

Tools for the implementation of integrated Water and Sanitation Safety Planning in small systems

RIVM report 2024-0022

Colophon

DOI 10.21945/RIVM-2024-0022

H. van den Berg (author), RIVM
B. Rickert (author), UBA
L. Huber (author), UBA
J. Lock-Wah-Hoon (author), RIVM
A.M. de Roda Husman (author), RIVM

RIVM National Institute for Public Health and the Environment, the Netherlands
UBA German Environment Agency, Germany

Contact:
Harold van den Berg
Centre for Infectious Disease Control
harold.van.den.berg@rivm.nl

This project was funded by the German Federal Environment Ministry's Advisory Assistance Programme (AAP) for environmental protection in the countries of Central and Eastern Europe, the Caucasus and Central Asia and other countries neighbouring the European Union. It was supervised by the German Environment Agency (UBA). The responsibility for the content of this publication lies with the authors. This project was co-funded by the Dutch Ministry of Infrastructure and Water Management.

National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport
Umwelt Bundesamt
Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

Published by:
National Institute for Public Health and the Environment, RIVM
P.O. Box 1 | 3720 BA Bilthoven
The Netherlands
www.rivm.nl/en

Synopsis

Tools for the implementation of integrated water and sanitation safety planning in small systems

Globally, many small villages and communities receive their drinking water from various water sources. It is not certain that the drinking water will be clean. Furthermore, sanitation facilities are often less well managed in this places, which may lead microbial contamination of the drinking water sources or the environment. These can also happen in Europe. People can become ill if they come into contact with these pathogens, for example through drinking water or contaminated crops. Safe management is important to minimize the risk of becoming ill via drinking water and sanitation.

In 2021, the National Institute for Public Health and the Environment (RIVM, the Netherlands) and the German Environment Agency (UBA) developed an approach that integrates safe management of small-scale drinking water supply and sanitation services. This method, called integrated Water and Sanitation Safety Planning (iWSSP), identifies contamination routes of drinking water and sanitation. In this way, measures can be taken to prevent infections. This approach contributes to clean drinking water and safe sanitation.

In this report, RIVM and UBA provide tools for people who are operating within small rural systems and seeking to implement iWSSP for the benefit of their communities. The combined method is particularly desirable when villages or communities have limited resources. The approach can be used worldwide. For iWSSP, the approaches developed separately by the World Health Organization (WHO) for both drinking water and sanitation systems have been merged. iWSSP consists of six steps to assess and manage potential risks of drinking water and sanitation. The six steps of iWSSP are briefly explained. Further, the report provides practical tips and ready-to-use documents to support implementing the approach in small drinking water and sanitation systems. All six steps must be completed to implement iWSSP fully in small systems.

Keywords: small supplies, drinking water, sanitation systems, safe management, risk management

Publiekssamenvatting

Ondersteuning geïntegreerde aanpak voor kleinschalige drinkwater en sanitaire voorzieningen

Wereldwijd halen veel kleine dorpen en gemeenschappen hun drinkwater uit verschillende waterbronnen. Het is niet zeker dat het drinkwater dan schoon is. Verder zijn hier sanitaire voorzieningen die vaak minder goed worden beheerd, waardoor ziekteverwekkers in drinkwaterbronnen of de omgeving kunnen terechtkomen. Dat kan ook in Nederland of Europa het geval zijn. Mensen kunnen ziek worden als zij bijvoorbeeld via drinkwater, of gewassen in contact komen met deze ziekteverwekkers Goed en veilig beheer is dan ook belangrijk om de kans via water ziek te worden zo klein mogelijk te maken.

Daarom hebben het RIVM en de Duitse organisatie UBA in 2021 een werkwijze ontwikkeld die veilig beheer van kleinschalig drinkwater en sanitaire voorzieningen combineert. Deze werkwijze, integrated Water and Sanitation Safety Planning (iWSSP) geheten, brengt besmettingsroutes van drinkwater in kaart. Zo kunnen maatregelen worden genomen om besmettingen te voorkomen. Deze aanpak draagt bij aan zowel schoon drinkwater als veilige sanitaire voorzieningen.

In dit rapport geven het RIVM en UBA handvatten voor mensen die werken met kleine systemen en de werkwijze voor hun gemeenschap willen invoeren. De gecombineerde werkwijze is vooral gewenst wanneer dorpen of gemeenschappen weinig geld of kennis hebben. De aanpak kan wereldwijd worden gebruikt. Voor de iWSSP zijn de aanpakken samengevoegd die de Wereldgezondheidsorganisatie (WHO) voor beide systemen apart heeft ontwikkeld. iWSSP bestaat uit zes stappen om de mogelijke risico's van drinkwater en sanitaire voorzieningen te herkennen en te beperken. De zes stappen van iWSSP worden kort uitgelegd. Verder geeft het rapport ondersteunen praktische tips en kant-en-klare documenten de invoering van de aanpak in kleine drinkwater- en sanitaire systemen. Alle zes stappen moeten worden doorlopen om iWSSP in kleine systemen in te voeren.

Kernwoorden: kleine systemen; drinkwater; sanitaire voorzieningen; risicoanalyse

Contents

Summary

Tools for the implementation of integrated water and sanitation safety planning in small systems

Poorly managed drinking water and sanitation have adverse negative health effects for the served population. Safe management is particularly challenging in small rural systems. The World Health Organization (WHO) has developed water and sanitation safety plans as a way to contribute to safe services from drinking water and sanitation systems in order to minimize waterborne diseases. Integrated water and sanitation safety planning (iWSSP) is a desirable approach, especially for small systems with limited resources and support.

iWSSP consists of six steps to identify and manage the potential risks. All six steps must be completed to implement iWSSP fully in small systems.

This practical tool has been written on the basis of the latest knowledge on integrated water and sanitation safety plans. It combines theoretical knowledge, practical tips and ready-to-use templates designed for implementation in the field. The information and tools presented in this document are useful for teams operating within small rural systems and seeking to implement iWSSP for the benefit of their communities.

Keywords: small supplies, drinking water, sanitation systems, safe management, risk management

Zusammenfassung (summary in German)

Arbeitshilfen für die Umsetzung von integrierten Trinkwasser- und Abwassersicherheitsplänen in kleinen Systemen

Schlecht betriebene Trinkwasserversorgung und Abwasserentsorgung kann zu gesundheitlichen Auswirkungen in der lokalen Bevölkerung führen. Ein sicheres Management ist vor allem in kleinen, ländlichen Systemen eine Herausforderung. Die Weltgesundheitsorganisation (WHO) hat die Ansätze der Sicherheitspläne für Trinkwasserver- und Abwasserentsorgung, *Water Safety Planning* und *Sanitation Safety Planning,* entwickelt als Mittel, sichere Trinkwasser- und Abwasserleistungen zur Verfügung zu stellen, und damit zusammenhängende Krankheiten zu minimieren. *Integrated Water and Sanitation Safety Plan (iWSSP)* ist ein gut umsetzbarer, wichtiger Ansatz für ländliche Regionen mit begrenzten Ressourcen und Unterstützungsmöglichkeiten.

iWSSP besteht aus sechs Schritten zur Identifizierung und Beherrschung möglicher Risiken. Alle sechs Schritte müssen durchgeführt werden, um eine vollständige Umsetzung von iWSSP in kleinen Systemen zu erreichen.

Dieses praktische Hilfsmittel wurde auf Grundlage der neuesten Erkenntnisse über die Integration von Trinkwasser- und Abwasser-Sicherheitsplänen entwickelt. Es bietet theoretisches Hintergrundwissen, praktische Tipps und einfach anzuwendende Vorlagen für die Umsetzung vor Ort. Die in diesem Dokument enthaltenen Informationen und Ressourcen sind hilfreich für Teams, die in kleinen ländlichen Systemen arbeiten, und die iWSSP zum Wohl ihrer Gemeinden umsetzen wollen.

Schlüsselwörter: kleine Versorgungen, Trinkwasser, Abwasser, sicheres Management, Risikomanagement

Samenvatting (summary in Dutch)

Ondersteuning geïntegreerde aanpak voor kleinschalige drinkwater en sanitaire voorzieningen

Slecht beheerde drinkwater en sanitaire voorzieningen hebben nadelige gevolgen voor de volksgezondheid. Veilig beheer is vooral een uitdaging voor kleinschalige systemen. De Wereldgezondheidsorganisatie (WHO) heeft veiligheidsplannen voor drinkwater en sanitaire voorzieningen ontwikkeld om bij te dragen aan het goed beheersen van mogelijke risico's voor veilig drinkwater- en sanitaire voorzieningen. Hierdoor kunnen door water overgedragen infectieziekten tot een minimum beperkt worden. Geïntegreerde veiligheidsplanning voor drinkwater en sanitaire voorzieningen (iWSSP) is een wenselijke aanpak, vooral voor kleine systemen met beperkte middelen en ondersteuning.

iWSSP bestaat uit zes stappen om de potentiële risico's te identificeren en te beheersen. Alle zes stappen moeten worden voltooid om iWSSP volledig in kleine systemen te implementeren.

Dit document is geschreven op basis van de nieuwste kennis over geïntegreerde water- en sanitatieveiligheidsplannen. Het combineert theoretische kennis, praktische tips en formulieren die de implementatie in het veld ondersteunen. De informatie en hulpmiddelen die in dit document worden gepresenteerd, zijn nuttig voor teams die kleine systemen beheren en iWSSP willen implementeren voor hun systeem.

Kernwoorden: kleine systemin, drinkwater, sanitaire voorzieningen, risicoanalyse en management

1 Introduction

The World Health Organization (WHO) recommends the use of comprehensive risk assessment and risk management frameworks for safe drinking water and safe sanitation (WHO 2022c, 2023). Water Safety Planning (WSP) (WHO 2017b) and Sanitation Safety Planning (SSP) (WHO 2018) are systematic approaches that are appropriate in a wide range of circumstances, including small systems, and in changing conditions, caused by, for example, climate-related challenges and demographic changes.

While WSP has been implemented in more than 93 countries (WHO 2017a), SSP uptake is slower, highlighting the need for a more substantial focus on sanitation safety (WHO 2022a). In rural communities, human and financial resources as well as administrative capabilities are often limited, hampering the adoption of these risk-based approaches. In such contexts, the implementation of WSP and SSP is not straightforward and support is required (Herschan et al. 2020). To aid WSP implementation in small supplies, WHO developed a field guide specifically tailored to WSP in these settings (WHO 2022b). No similar support currently exists for SSP in rural small sanitation systems.

What are WSP and SSP?

WSP and SSP are systematic processes that are widely recognized as reliable methods to manage drinking water supply and sanitation services for the protection of public health. These approaches are oriented towards gradual, incremental improvements that ultimately lead to the provision of safe drinking water and sanitation services for all. They consist of a thorough system assessment, complemented by effective operational monitoring and management and communication activities.

Why implement WSP and SSP?

Implementing WSP has demonstrated significant success in reducing health risks associated with contaminated drinking water, as exemplified by its positive impact in Iceland on a reduction of diarrhoeal diseases (Gunnarsdottir et al. 2012). The benefits of the SSP approach include its potential to positively influence public health by reducing pollution, eradicating improper waste disposal practices such as dumping, and minimizing the release of hazardous chemicals and materials (Winkler et al. 2017). However, no further information regarding the specific health benefits of SSP implementation has been published.

iWSSP: Integrating WSP and SSP

In smaller and more local contexts, drinking water and sanitation management are naturally interlinked, as sources of drinking water can be contaminated by faeces from poorly managed sanitation systems. This interconnectedness has sparked interest in exploring the potential of an integrated Water and Sanitation Safety Planning (iWSSP) approach, which can be highly relevant as a tailored solution for specific contexts (Friederichs *et al.*, 2017). Information on integrated approaches and the specifics of their implementation is limited: Clavijo *et al.* (2020) described water and sanitation safety planning in a metropolitan area in Latin America, while another study in South Africa conducted by Murei *et al.* (2022) described the barriers of water and sanitation safety planning implementation in rural areas. However, these accounts do not clearly describe how water and sanitation safety planning were integrated or how they can be implemented in small systems.

To shed more light on this critical aspect, a study conducted in rural areas of Serbia on the development and piloting of an integrated approach for water and sanitation safety planning for small systems was described by Van den Berg *et al*. (2023). The study introduced the six-step iWSSP approach to small supplies (see Figure 1 for a visual representation). The iWSSP approach describes the process of seamlessly integrating water and sanitation safety planning, a crucial step towards ensuring the safety and efficiency of these essential systems.

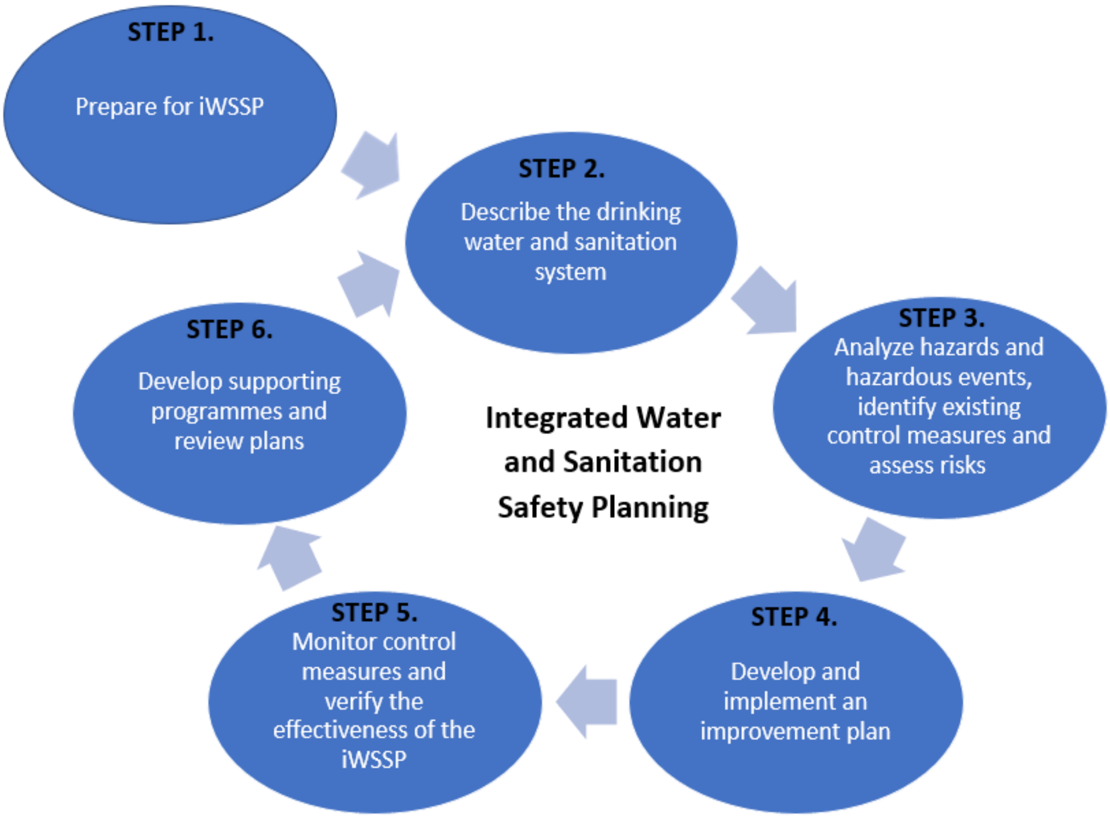

Figure 1 Six steps of iWSSP for small supplies (Van den Berg et al., 2023)

Description of the six steps of iWSSP for small supplies

Step 1 – Prepare for iWSSP
Define the objectives and scope of iWSSP, identify stakeholders and assemble a team. In this step, both drinking water supply and sanitation should be covered in the objectives and scope. The iWSSP team should be a multidisciplinary team including experts in the field of drinking water supply and sanitation as well as external stakeholders, such as representatives of health authorities, environmental agencies, and users.

Step 2 – Describe the drinking water supply and sanitation system
Accurately describe both the drinking water supply system and the sanitation system and compare both with the real situation during a site visit. In addition to WSP and SSP, available and newly collected data on drinking water supply and sanitation is combined to provide insights into interconnections between the systems. Develop combined information documentation, such as maps of the drinking water supply and sanitation system.

Step 3 – Analyse hazards and hazardous events, identify existing control measures and assess risks
Identify microbial, chemical, physical, and radiological hazards and hazardous events for both drinking water supply and sanitation and assess the risks on the basis of severity and likelihood of occurrence, considering the effectiveness of existing control measures. Combined information from step 2, such as maps of the drinking water supply and sanitation system, also allows teams to identify vulnerabilities and risks on the basis of interconnections. A risk assessment is conducted in such a way that the risk levels of both systems can be compared.

Step 4 – Develop and implement an incremental improvement plan
Develop a detailed improvement plan to address all significant risks requiring additional control. The improvement plan focuses on new or improved control measures that prevent, reduce, or eliminate the identified risks of both drinking water supply and sanitation. Those measures can foster positive interactions across both the drinking water supply and the sanitation system.

Step 5 – Monitor control measures and verify the effectiveness of iWSSP
Define an operational monitoring plan for important control measures and obtain evidence that iWSSP as a whole is working effectively at any given point in time. Compliance monitoring or customer satisfaction surveys can be used to verify the effectiveness of iWSSP. The operational plan includes actions to eliminate the cause of non-conformity or non-fulfilment of an operational target and to prevent recurrence in both the drinking water supply and the sanitation system.

Step 6 – Develop supporting programmes and review plans
Develop supporting programmes that contribute to achieving the iWSSP objectives and review iWSSP on a regular basis.

Target audience: Who is this document meant for?

- **Drinking water suppliers:** To public utilities or private entities responsible for drinking water supply, this document provides the knowledge and tools needed to enhance the safety and reliability of services.
- **Sanitation service providers:** To public utilities or private entities responsible for sanitation services, this document provides the knowledge and tools needed to enhance the safety and reliability of services.
- **Small communities:** Recognizing the central role that communities play in safeguarding drinking water and sanitation services, this document offers actionable insights and materials for community members who are committed to ensuring the safety of their drinking water and sanitation systems.
- **Facilitators:** For those tasked with guiding, coordinating, and overseeing the iWSSP implementation process, this document serves as an essential resource. It provides the necessary materials and support to excel in this pivotal role.

Scaling up and expanding the adoption of iWSSP in countries across the WHO European region and other regions around the world can be facilitated by sharing this document.

2 How to use this document

This document serves as a repository of fourteen templates to guide the implementation of iWSSP in small systems. It equips users with the tools needed for effective iWSSP implementation.

The core of this document is the "Templates" section, containing the necessary tools for implementing iWSSP. These can also be downloaded as editable versions and can be used separately for each step that is being implemented. Note that implementing all templates at the same time is not intended, as iWSSP is based on a step-by-step approach.

How these templates were developed

These templates originated from a project conducted from 2020 to 2023 titled "Integrated Water and Sanitation Safety Plans in Small Supplies in Serbia". The project received financial support from the German Federal Environment Ministry's Advisory Assistance Programme (AAP), which specifically focuses on environmental protection in Central and Eastern European countries, the Caucasus, Central Asia, and neighbouring European Union countries. Funding was also received from the Dutch Ministry of Infrastructure and Water Management.

The templates were developed and refined through collaboration between the Dutch National Institute for Public Health and the Environment (RIVM) and the German Environment Agency (UBA). These templates underwent revisions based on insights gained during a pilot project in rural Serbia. A crucial step in their development was a comprehensive review by an international group of experts specialized in water and sanitation planning, ensuring the applicability, validity, and relevance of the templates.

Intended use of the templates

These templates are useful tools if you are embarking on the implementation of iWSSP in small systems. The templates are designed to facilitate the iWSSP process. Given the unique nature of each locality, you may need to adapt the templates to align with your specific drinking water supply and sanitation services. We strongly recommend an evaluation of each template's applicability to your context prior to their use and deployment. Table 1 provides an overview of the templates, serving as a useful reference point.

Table 1 Overview of templates developed to support iWSSP implementation in small supplies

iWSSP Step	**Template**	**Content**
Step 1	Objectives	Provide a selection of possible objectives
	Stakeholders	Document possible stakeholders, their roles, and ideas about how to involve them
	Team list	Provide details of team members
Step 2	Narrative system description	Identify systems and system characteristics
Step 3	List of hazardous events	Detailed list of possible hazardous events
	Control measures	Document control measures and their validation
	Risk assessment definitions	Aligned definitions for likelihood, severity, and risk
Step 4	Improvement plan	Document suggested improvements, responsibilities, resources, timelines, and status
Steps 3 and 4	Risk assessment master table	Document details on the risk assessment, control measures, and improvements (for steps 3 and 4)
Step 5	Operational monitoring plan	Document details on operational monitoring and corrective action
	Verification monitoring plan	Document details on verification
Step 6	Supporting programmes	Document supporting activities
	Operations and maintenance	Provide instructions for operational and maintenance tasks
	Emergency response	Document emergency response actions and communication

3 iWSSP templates

3.1 Step 1. Prepare for iWSSP

Step 1 contains three main activities: 1/ define the objectives and scope of iWSSP; 2/ identify stakeholders; and 3/ assemble a team. For all three activities, templates are provided.

3.1.1 Objectives

Setting specific iWSSP objectives helps to define the purpose of the iWSSP approach in small systems. Ensure that the objectives cover both drinking water and sanitation. Examples of iWSSP objectives are:

- To ensure the safety of a drinking water supply by minimizing contamination of source water, reducing, or removing contamination by treatment and preventing contamination during storage, distribution, and handling;
- To improve public health outcomes from the collection, treatment, reuse and/or disposal of human waste in both formal and informal settings;
- To safeguard human health, promote the safety of workers and users, and enhance environmental protection;
- To promote local discussion and policy and regulatory changes for risk assessment and management approaches such as iWSSP.

The template on **"Objectives" (Annex 1)** supports the iWSSP team in selecting objectives.

Practical tip:

The specific objectives can vary, depending on the setting and context in which iWSSP is implemented, and also on the type and complexity of drinking water supply and sanitation services. The resources, or lack thereof, may also determine what the objectives may be. It is important to consider these circumstances when defining objectives.

3.1.2 Stakeholders

Involving people with the appropriate skills at the right time ensures that the required expertise, political support, and financial resources are available to implement iWSSP. Stakeholders are individuals or representatives of organizations. They might be people who have direct control over the drinking water supply or sanitation system or have influence over practices that affect water safety, water quantity and sanitation safety in the catchment. Also, people who are affected by actions taken in the drinking water supply or sanitation system to protect water quality (e.g. representatives of the local community) could be involved. The template on **"Stakeholders" (Annex 2)** supports the iWSSP team in identifying and documenting stakeholders.

Practical tip:

To define stakeholder involvement, consider the system and steps they control, are affected by, or are involved in, such as drinking water supply, sanitation, or both. For sanitation, consider waste generation, transport, conveyance, treatment, and disposal. For drinking water supply, consider catchment, abstraction, treatment, distribution, and consumers. Collect stakeholder information, including their names and contact details, and define their roles. Finally, determine how to involve the stakeholders in the process.

3.1.3 *iWSSP team*

The aim of this task is to establish a team representing a range of useful skills across the sanitation chain and drinking water supply system. Besides organizations and/or stakeholders for all steps of the sanitation chain and drinking water supply, external technical support might be needed in the team (e.g. facilitators). The **"iWSSP team"** template **(Annex 3)** supports establishing and documenting the iWSSP team.

Practical tip:

These are examples of team members who may be involved in an iWSSP team:

- staff from the municipality's drinking water and sanitation department,
- municipal environmental health practitioners,
- representatives from the local council,
- operators,
- technical staff,
- external experts, and
- facilitators.

Each of these team members may bring a unique set of skills and expertise.

3.2 Step 2 – Describe the drinking water supply and sanitation system

Step 2 involves describing the drinking water and sanitation system. It allows for a better understanding of how the small systems operate, how they serve the community, and forms an important basis for the following iWSSP steps. To describe the system, it is important that the iWSSP team considers various aspects of the drinking water and sanitation system.

A general overview of the system would provide useful information on drinking water supplier and sanitation entity (name, area of intervention, number of staff, governance model), population served, number of connections (by type), service level(s) and types of drinking water sources and sanitation.

The system description should summarize problems relating to water quality and sanitation, continuity, and quantity (reliability), accessibility, and management and operation. To collect information on drinking water supply and sanitation services, you can use existing documents, descriptions, maps, or flowcharts.

The provided template on **"System description" (Annex 4)** provides a set of questions that can help you collect relevant information. It is important to note that this template is not an exhaustive list, and the questions may need to be adapted for application in your local context. This can include the selection of relevant questions, depending on the drinking water supply and sanitation services in the area.

Available and newly collected data on drinking water supply and sanitation is combined to provide insights on interconnections between the systems. It is recommended to develop combined documentation, such as maps of the drinking water supply and sanitation system.

Practical tip:

To collect information on drinking water supply and sanitation services, you can use existing documents, descriptions, maps, or flowcharts. Examples include: Supply plans, regional and sub-regional maps, process maps, list of standard operating procedures.

Conduct field visits to confirm the accuracy of information about the drinking water supply and sanitation services. This would also identify important threats within the system that may be overlooked when this step is exclusively performed at the desk.

3.3 Step 3 – Analyse hazards and hazardous events, identify existing control measures and assess risks

Step 3 contains three main activities: identify microbial, chemical, physical, and radiological hazards and related hazardous events, identify existing control measures, and assess the risk on the basis of severity and likelihood of occurrence.

3.3.1 Identify hazards and hazardous events

In this step, each microbial, chemical, physical, and radiological hazard, quantity, reliability and consumer acceptance, or effects on the health of workers, as well as each event through which this could be introduced to the drinking water supply and sanitation system should be assessed. This is an important basis for assessing the resulting risk for each of the combinations of hazards and hazardous events in the subsequent risk assessment. The **"List of hazardous events"** template **(Annex 5)** provides a list of examples of hazardous events related to the drinking water supply and sanitation system that can be used as a basis for the hazard analysis.

Practical tip:

For identifying hazardous events, you may use existing lists of hazardous events or documents describing hazardous events, such as Annex 5 or the following additional information sources: sanitary inspection forms (https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/water-safety-and-quality/water-safety-planning/sanitary-inspection-packages), sanitation inspection forms (https://www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health/sanitation-safety/sanitation-inspection-packages), a compilation of potential hazardous events and their causes (https://www.rivm.nl/en/documenten/compilation-of-potential-hazardous-events-and-their-causes), a project on ensuring safely managed on-site sanitation systems (https://washdata.org/report/jmp-2021-smoss-synthesis-report).

A ***hazard*** is a microbial (e.g. pathogens), chemical (e.g. arsenic), physical (e.g. turbidity) or radiological agent in, or condition of water and wastewater, with the potential to cause harm to public health.

A ***hazardous event*** is an event that introduces hazards to, or fails to remove them from, the drinking water supply or sanitation system. The hazardous event can occur from source (catchment) to consumer (household) or from capture to end-use/disposal, for water supply and sanitation system respectively.

X-Y formula. Hazardous events should clearly describe the impact and the cause, i.e. "X happens (to the water supply or sanitation system) because of Y".

Example: Source water is contaminated by agricultural fertilizers (X) due to poor application practices in the immediate vicinity of the extraction point (Y).

All identified hazardous events can be documented in a master sheet, and information from the next steps can be easily added to this document, ensuring that all information is captured in one place. The **"Risk assessment master table"** template **(Annex 6)** supports the iWSSP team to better prioritize and document hazardous events, control measures and possible improvements.

3.3.2 Identify existing control measures

A control measure is any action or activity that can be used to prevent, eliminate a risk, or reduce it to an acceptable level. The iWSSP team identifies what control measures are already in place to mitigate these specific risks.

For the identified control measures, determine how effective the existing control measure is at reducing the risk. Consider how effective the existing control measure could be (assuming it was working well at all times) and how effective the existing control measure is in practice. Information gathered on the control measures can be added to **Annex 6 "Risk assessment master table"**. Alternatively, the iWSSP team can use the separate template on **"Control measures" (Annex 7)** that also supports identifying existing control measures and documenting their effectiveness.

Practical tip:

Some sanitation control measures may include: the application of technical standards on material, dimensions, and location of toilets, training of masons for correct installation of toilets, and the use of personal protective equipment. Standard operating procedures for general handling precautions, installation of sealed and impermeable septic tanks, and sewer systems are also important.

Drinking water control measures may include: restricted access to catchments, industrial effluent standards and volume controls, validated treatment processes, and purchasing policies and procedures. Pressure monitoring and recording, consumer education, fencing stock from catchment streams and watercourses, and cessation of source water abstraction during high contamination periods are also important.

Both drinking water and sanitation control measures may include: registration of on-site facilities and small drinking water supplies and consideration of climate change and climate variability.

3.3.3 Assess risks

Risks are a combination of the likelihood of an identified hazard and hazardous event occurring within a specified timeframe and the severity of its impact to the exposed population.

- Likelihood: How often or likely will a hazardous event occur?
- Severity: What are the consequences for public health or for the exposed group?

Risk assessment can be very subjective, therefore teamwork (with staff from different steps in the water supply and sanitation systems and with different expertise) is essential. Good and clear definitions are important to get a more objective risk assessment.

Definitions of likelihood, severity, and risk appropriate for drinking water and sanitation are given in **"Risk assessment definitions iWSSP" (Annex 8)**. The iWSSP team assesses likelihood and severity on the basis of predefined criteria found in the risk assessment definition template. To document the risk assessment for all identified hazardous events and hazards, the definitions can be used as-is, or adapted. A risk matrix is a widely used tool for assessing and prioritizing risks. The risk assessment can be carried out by using a risk matrix, as shown in **Annex 8.**

To prioritize risks, the iWSSP team determines a risk score by multiplying the scores for likelihood and severity. If the score falls between 1 and 2, it is considered a low-risk scenario. A score between 3 and 5 is categorized as medium risk, while a score between 6 and 9 indicates a high-risk situation. These risk categories are detailed in Annex 8, which provides guidance on the appropriate actions or attention needed for each category. By understanding the likelihood, severity, and risk score, you can make informed decisions to address and mitigate potential risks effectively. This helps to ensure the safety and reliability of the system.

3.4 Step 4 – Develop and implement an incremental improvement plan

Step 4 involves the development of a detailed improvement plan to address all significant risks requiring additional control, which are identified in iWSSP step 3. The improvement plan focuses on new or improved control measures that prevent, reduce, or eliminate the identified risks to both drinking water supply and sanitation. Those measures can promote positive interactions within and between both the drinking water supply system and the sanitation system. iWSSP should keep track of whether improvements are carried out within the implementation dates set in the improvement plan.

This process helps ensure that funding and effort target the highest risks with the greatest urgency. The **"Improvement plan"** template **(Annex 9)** provides information on how to develop an incremental improvement plan and can be used for documentation. In the **"Risk assessment master table"** template **(Annex 6)**, the team can document the improvement plan in combination with the hazardous events.

Practical tip:

Some examples of control measures may include:

- licensing of emptying service providers for sanitation,
- construction or improvement of a faecal sludge treatment plant for sanitation, and
- developing standard operating procedures for operating and maintaining both sanitation and drinking water.

Additionally, a communication campaign can be launched to encourage the correct use and maintenance of the toilet and drinking water supplies for both sanitation and drinking water.

3.5 Step 5 – Monitor control measures and verify the effectiveness of iWSSP

Step 5 involves defining an operational monitoring plan for important control measures and obtaining evidence, through verification, that iWSSP as a whole is working effectively.

3.5.1 Operational monitoring

In this step, operational monitoring covers both the drinking water supply system and the sanitation system. It determines if the systems are operating as intended at any given point in time. The operational monitoring plan includes actions to eliminate the cause of any non-conformity (non-fulfilment of an operational target) and to prevent recurrence.

The operational monitoring procedures that are used may, for example, include measurements (e.g. water analysis), visual inspection and/or organizational control. The operational monitoring plan describes regular monitoring of control measures to give simple and rapid feedback on how effectively the control measures are operating, so that corrections can be made quickly, if required.

An operational monitoring plan should include the following information:

- Process steps in drinking water supply or sanitation system;

- Control measure: any action and activity that can be used to prevent or eliminate the risk caused by a hazard / hazardous event or reduce it to an acceptable level;
- What to monitor: the parameter / feature monitored;
- Where: location in the drinking water supply or sanitation system (as specific as possible);
- When: frequency of monitoring;
- How: which method is used for monitoring (e.g. standard operating procedure, visual inspection);
- Who: person carrying out the monitoring;
- Critical limit (or target condition): maximum and/or minimum values set for a parameter that are considered “critical” as they define the bounds between which a control measure can be considered to be effective;
- Corrective action: action to eliminate the cause of a non-conformity (non-fulfilment of an operational target) and to prevent recurrence.

The **“Operational monitoring plan”** template **(Annex 10)** can be used for developing an operational monitoring plan.

Practical tip:

Operational monitoring parameters and features can be categorized into visual inspections and measurements.

- Examples of visual inspections include: checking the availability and access to toilet facilities and the use of personal protective equipment by sanitation workers for sanitation purposes, as well as the integrity of the well head, condition of fence, and insect screens for drinking water.
- Examples of measurements include: flow rates, retention time, chemical oxygen demand, and frequency of waste collection for sanitation, and chlorine concentration and turbidity for drinking water.

3.5.2 Verification monitoring

Verification is achieved by the routine confirmation, through the provision of objective evidence, that the drinking water supply and the sanitation system are in accordance with the set objectives and that the risk management approach is effective. This includes compliance monitoring, which may be undertaken by the operator or oversight agency. Verification may consist of compliance monitoring and consumer satisfaction surveys.

The compliance monitoring procedures that are used may, for example, include measurements (e.g. water analysis), visual inspection and/or organizational control, and the **“Verification plan”** template **(Annex 11)** can be used for documentation.

Practical tip:

Verification monitoring parameters and features can be categorized into measurements and consumer satisfaction.

- Examples of measurements include: chemical parameters for drinking water, nutrient load for sanitation, number of incidents for both sanitation and drinking water, and effluent quality testing or drinking water quality testing for *E.coli*.
- Examples of consumer satisfaction for both sanitation and drinking water include: surveys, feedback on overall satisfaction and complaints received from community members for both drinking water and sanitation, as well as follow-up measures and the level of resolving the issues.

3.6 Step 6 – Develop supporting programmes and review plans

In step 6, activities are undertaken to support the ongoing iWSSP approach. For the following three activities: supporting programmes, operations and maintenance and emergency response, templates are available to help the iWSSP team develop these programmes.

3.6.1 Supporting programmes

Supporting programmes play an important role in achieving the goals and objectives of iWSSP as do regular iWSSP reviews. Supporting programmes address actions or activities that contribute to drinking water or sanitation safety, but do not directly affect the water quality or water quality parameters. Examples of supporting programmes and review plans include programmes that support the development of skills and knowledge of staff, programmes that strengthen relationships with consumers and stakeholders, and those that create enthusiasm and improve attitudes of staff.

The template on **"Supporting programmes" (Annex 12)** can be used for identifying existing supporting activities (Annex 12.1) as well as new and additional supporting activities (Annex 12.2).

Practical tip:

Supporting programmes for iWSSP may include the following examples.

- Developing staff skills and knowledge: Implementing behaviour change programmes, providing iWSSP awareness training for staff and offering training in both business and technical skills.
- Effective management programmes: Engaging in demand management activities, such as leak detection and water efficiency programmes, and seeking external assistance for equipment.
- Programmes for enhancing communication: Building partnerships with farming communities, creating associations of service providers (e.g. faecal sludge emptying trucks and sanitation workers), and facilitating dialogue between service providers and authorities.

3.6.2 Operations and maintenance

For each important operations or maintenance task, documenting step-by-step instructions (standard operating procedure) for carrying out the task. These instructions will give the caretaker confidence that he or she always knows what to do and when. The instructions will also be very useful when new caretakers need to be trained. The template on **"Operations and maintenance" (Annex 13)** can be used to document step-by-step instructions.

> ***Practical tip:***
> As you develop your instructions for operations and maintenance, you should bear in mind the following tips.
> - It is valuable to post copies of the instructions on site for easy reference by the caretaker. For example, detailed instructions on chlorine mixing should be posted at the treatment site.
> - It can be very helpful to include drawings or photographs in the instructions to ensure that the steps are clear and easy to understand. If you decide to use drawings or photographs, you may wish to modify this template.

3.6.3 *Emergency response*

An emergency is a serious situation or occurrence for which no standard operating procedure is in place. Emergencies usually happen unexpectedly, requiring immediate and extensive action. An emergency response plan could guide responses to an emergency considering the needs of different groups (e.g. those with limited access to communication systems). The template on **"Emergency response" (Annex 14)** can be used for developing emergency response plans.

> ***Practical tip:***
> Examples of emergency situations for which an emergency response plan may be developed:
> - Flooding;
> - Prolonged drought;
> - Catastrophic failure of treatment (e.g. following an earthquake);
> - Extended power outage;
> - Spill (chemical, radiological or microbial) in the catchment;
> - Acts of vandalism or sabotage.
>
> Conduct regular emergency response exercises and drills to ensure that key personnel understand their roles and responsibilities. Furthermore, check whether all relevant details are still up to date.

3.6.4 *Review iWSSP*

The iWSSP outputs should be periodically reviewed and updated to respond to dynamic environments, and adapted as new controls are implemented, or new hazards and hazardous events emerge.

The iWSSP team should meet regularly to review all aspects of iWSSP to ensure that it is up to date and effective and reacts to changes (see changes in Figure 2). In the estimate of meeting frequency, the team should be realistic and consider the availability of team members. For instance, the iWSSP team could meet every month / 2 months / 3 months / 6 months.

The topics that can be discussed are shown in Figure 2. The WSP-team should periodically revise iWSSP during their meetings.

Figure 2 Revise iWSSP

Acknowledgements

The authors thank staff from Institute of Public Health of Serbia (IPH), PUC Backa Palanka, local communities of Sokolovica, Pivnice and Mladenovo and iWSSP facilitators for collaboration and support regarding the implementation of iWSSP by using the draft templates. The authors thank Dragana Jovanovic (IPH), Oliver Schmoll (WHO Regional Office for Europe) and Enkhtsetseg Shinee (formerly WHO Regional Office for Europe) for their contribution and support to the project in Serbia. The authors would like to thank Claire Furlong (IHE Delft) and Raquel Mendes (Vista Water) for reviewing the templates. Finally, the authors thank Rob de Jonge and Matthijs de Winter for critically reviewing this report.

Literature

Clavijo A, Iribarnegaray MA, Rodriguez-Alvarez MS, and Lucas Seghezzo. 2020. 'Closing the cycle? Potential and limitations of Water and Sanitation Safety Plans (WSSPs) for Latin American metropolitan areas', Journal of Water, Sanitation and Hygiene for Development, 10: 490-501.

Friederichs L, Van den Berg HHJL, De Roda Husman AM. 2018. Towards integrated climate resilient water and sanitation planning. Summary report of the pan European Symposium on Water and Sanitation Safety Planning and Extreme Weather Events, April 6-7, 2017. RIVM report 2018-0169. DOi 10.21945/RIVM-2018-0169.

Gunnarsdottir MJ, Gardarsson SM, Elliott M, Sigmundsdottir G, and Bartram J. 2012. 'Benefits of Water Safety Plans: Microbiology, Compliance, and Public Health', Environmental Science & Technology, 46: 7782-89.

Herschan J, Rickert B, Mkandawire T, Okurut K, King R, Hughes SJ, Lapworth DJ, and Pond K. 2020. "Success Factors for Water Safety Plan Implementation in Small Drinking Water Supplies in Low- and Middle-Income Countries." In Resources.

Murei A, Mogane B, Mothiba DP, Mochware OTW, Sekgobela JM, Mudau M, Musumuvhi N, Khabo-Mmekoa CM, Moropeng RC, and Momba MNB. 2022. 'Barriers to Water and Sanitation Safety Plans in Rural Areas of South Africa—A Case Study in the Vhembe District, Limpopo Province', Water, 14: 1244.

Van den Berg H, Rickert B, Lock-Wah-Hoon J, Jovanovic D, Bijelovic S, Gligorijevic S, Karadzic V, Vasic M, De Roda Husman AM. 2023. Experiences from piloting integrated water and sanitation safety planning in small rural systems in Serbia. Journal of Water and Health (2023), 21 (12): 1772–1783.

WHO. 2017a. "Global status report on water safety plans: A review of proactive risk assessment and risk management practices to ensure the safety of drinking-water." In.: World Health Organization, Geneva.

WHO. 2017b. "Guidelines for drinking-water quality: fourth edition incorporating the first addendum." In.: World Health Organization, Geneva.

WHO. 2018. "Guidelines on sanitation and health." In. Geneva: World Health Organization.

WHO. 2022a. "Delivering safe sanitation for all: areas for action to improve the situation in the pan-European region." In.: World Health Organization. Regional Office for Europe, Copenhagen.

WHO. 2022b. "A field guide to improving small drinking-water supplies: water safety planning for rural communities." In.: WHO Regional Office for Europe, Copenhagen. Licence: CC BY-NC-SA 3.0 IGO.

WHO. 2022c. "Sanitation safety planning: step-by-step risk management for safely managed sanitation systems." In. Geneva: World Health Organization.

WHO. 2023. "Water safety plan manual: Step-by-step risk management for drinking-water suppliers." In. Geneva: World Health Organization.

Winkler MS, Jackson D, Sutherland D, Lim JMU, Srikantaiah V, Fuhrimann S, and Medlicott K. 2017. 'Sanitation safety planning as a tool for achieving safely managed sanitation systems and safe use of wastewater', WHO South East Asia J Public Health, 6: 34-40.

Annex 1 Template iWSSP step 1 – Objectives

Date: ___________ Version: ___________

Select one or more objectives that are relevant for your site(s). Also include, if applicable, any other objectives that are not described in the spaces below.

1. To ensure the safety of a drinking water supply by minimizing contamination of source water, reducing, or removing contamination by treatment, and preventing contamination during storage, distribution, and handling.

2. To improve public health outcomes from the collection, treatment, reuse, and/or disposal of human waste in both formal and informal settings.

3. To safeguard human health and promote the safety of workers and users.

4. To promote national discussion, and policy and regulatory changes, for risk assessment and management approaches such as integrated water and sanitation plan (iWSSP).

5. Other (please specify): ………

6. Other (please specify): ………

7. Other (please specify): ………

Annex 2 Template iWSSP step 1 – Stakeholders

Date: ____________ Version: ____________

Sanitation system or drinking water supply system or both	**Step in the system** **(e.g. catchment or treatment)**	**Stakeholder**	**Role of the stakeholder**	**How to involve the stakeholder**	**Contact details**

Annex 3 Template iWSSP step 1 – Team

Date: ____________ Version: ____________

Name *First and last name*	**Job title**	**Organization / representing**	**Role within the iWSSP team**	**Contact details** *Work address; email; phone*

Annex 4 Template iWSSP step 2 – System description

1. General information

Date of this document: ....
Version: ....

What is the name of your village or town ....
What is the name of your district? ....
What is the name of your region? ....

How many people live in your community? ....

What is your community mostly formed of?

☐ Rural or low-density settlements

☐ Sub-urban or peri-urban neighbourhoods, small towns or village centres

☐ Urban areas

---

2. Information on sanitation system and drinking water supply

2.1 Type of sanitation

1. What types of sanitation systems are present in your community (please select all that apply)?

   ☐ Centralized wastewater collection and treatment (off-site sanitation)

   ☐ Decentralized sanitation (on-site sanitation)

   ☐ Open defecation

   ☐ Other type (please specify): ....

2. How many people are using the different types of sanitation?

   ☐ Centralized wastewater collection and treatment, specify the number of people or percentage of people using a centralized system:
   ....
   ....

   ☐ Decentralized sanitation, specify the number of people or percentage of people using:
   ....
   ....

☐ Open defecation, specify the number of people or percentage of people using:

....
....

☐ Other type of sanitation (please specify):
....
....

3. What is the volume of wastewater and faecal sludge collected [m³/year]?

   Wastewater: ....

   Faecal sludge: ....

2.2 Type of drinking water supply

4. What is the source of the primary drinking water supply? (please select all that apply.)

   ☐ Groundwater

   ☐ Spring water

   ☐ Surface water (e.g. river, lake, reservoir, dam)

   ☐ Other source *(please specify)* ....

5. What is the population served by your supply (number of citizens / households)? ....

6. What is the volume of drinking water supplied [m³/year]? ......

7. Are any alternative drinking water sources present and used by community members (e.g. private wells, rainwater)?

   ☐ Yes ☐ No

   If yes, please include details here.

   ....
   ....

3. Management

3.1 Management of the sanitation system

Centralized system (only complete if centralized systems are in place)

1. Is the centralized sanitation system managed by the community?

   ☐ Yes ☐ No

If yes, has your community formally established a group of people responsible for this?
☐ Yes ☐ No

If no, who or which entity is responsible for management and operation of the sanitation system?
....
....

2. What is the total number of staff or community members involved in the operation and management of the sanitation system?

   ....
   ....

3. Who is responsible for the overall operation and management of the system?

Name: ....

Profession / level of training: ....

4. What other staff are involved in the operation and management of the sanitation system?

Name: ....

Specific responsibilities: ....

Profession / level of training: ....

Name: ....

Specific responsibilities: ....

Profession / level of training: ....

5. Do you collect sanitation service fees from community members?

   ☐ Yes ☐ No

If yes, how much is charged per month on average?...

Decentralized system (only complete if decentralised systems are in place)

6. Is the decentralized system (storage, emptying and transport, treatment or disposal) managed by the community?

   ☐ Yes ☐ No

If yes, has your community formally established a group of people responsible for this?
☐ Yes ☐ No

If no, who or which entity/entities is/are responsible for management and operation of the sanitation system?
....
....

3.2 Management of the drinking water supply system

7. Is your drinking water supply managed by the community?

   ☐ Yes ☐ No

   If yes, has your community formally established a group of people (e.g. a water association or water user group) responsible for this?

   ☐ Yes ☐ No

   If no, who or which entity is responsible for management and operation of the drinking water supply?

   ....
   ....

8. What is the total number of staff or community members involved in the operation and management of the drinking water supply? ....

9. Who is responsible for the overall operation and management of the drinking water supply?

   Name: ....

   Profession / level of training: ....

10. What other staff are involved in the operation and management of the drinking water supply?

    Name: ....

    Specific responsibilities: ....

    Profession / level of training: ....

    Name: ....

    Specific responsibilities: ....

    Profession / level of training: ....

11. Who is/are the contact(s) at your local health office and/or environmental agency?

    Local health office:

    Name: ....

    Contact details: ....

    Environmental agency:

    Name: ....

    Contact details: ....

12. Do you collect drinking water supply service fees from community members?

☐ Yes ☐ No

If yes, how much is charged in total per month on average?

....

---

4. Specific questions per sanitation or drinking water supply step

4.1 The sanitation system

4.1.1. Toilets / open defecation

1. Are people using private toilets and/or public toilets?

☐ Yes ☐ No (open defecation)

If yes, please specify:

☐ Household, ___%

☐ Shared, ___%

☐ Public – community, ___%

☐ Private, paid for, ___%

2. What type of interfaces are in place?

☐ Dry technologies
  ☐ Dry toilet
  ☐ Urine-diverting dry toilet
  ☐ Urinal
☐ Water based technologies
  ☐ Pour flush toilet
  ☐ Cistern flush toilet
  ☐ Urine-diverting flush toilet

3. Do people have problems with toilets? If yes, what problems are experienced?

☐ No water available for flushing
☐ Toilets not in use, reason: ....
☐ Toilets broken
☐ Toilets unsafe
☐ Other (please specify) ....

4. Are there specific places for open defecation?

☐ No ☐ Yes, where: ....

If yes, are these places located
- Nearby abstraction points for drinking water (e.g. wells)? ☐ No ☐ Yes
- Nearby drinking water pipes? ☐ No ☐ Yes
- Nearby storage tanks? ☐ No ☐ Yes
- Other: ....

4.1.2 Collection and storage

5. How is excreta collected and stored?
   - ☐ Open defecation
   - ☐ Bucket latrine
   - ☐ Single pit latrine
   - ☐ Single ventilated improved pit latrine
   - ☐ Double alternating dry pits
   - ☐ Double dehydration vaults
   - ☐ Composting chambers
   - ☐ Urine storage tank
   - ☐ Twin pits pour with flush
   - ☐ Septic tanks
   - ☐ Anaerobic biogas reactor
   - ☐ Centralized (sewer system)

6. Do you have information on the construction of the pit latrine(s) or septic tank(s)? Provide an estimate if specific values are not available.

   Age: ....
   Material: ....
   Method of construction: ....
   Lifespan (how many year useable): ....

7. What is the depth of the storage container (e.g. septic tank)? .... meter(s)

8. What is the minimum relative distance of the storage container (e.g. septic tank) to water supply pipes? .... meter(s)

9. Are pit latrines, septic tanks, or other excreta storage containments and their discharge located near parts of the water supply?

   ☐ No ☐ Yes, where? (specify what part of the water supply): ....

   If yes, are these places located
   - Nearby abstraction points for drinking water (e.g. wells)? ☐ No ☐ Yes
   - Nearby drinking water pipes? ☐ No ☐ Yes
   - Nearby storage tanks? ☐ No ☐ Yes
   - Other: ....

10. Does the containment (e.g. pit latrine or septic tank) sometimes overflow (e.g. during a rainy season)?

    ☐ No ☐ Yes, how often? : ....

4.1.3 Emptying, conveyance and transport

Decentralized systems

11. Is the containment (storage container e.g. pit latrine or septic tank) ever emptied?

☐ No ☐ Yes, how often: ....

If yes, who empties the containment (pit latrine or septic tanks)?

☐ Owners

☐ Municipality

☐ Private companies

☐ Others, specify: ....

12. What happens when a storage container is not emptied?

☐ Abandoned
☐ Empties by non-human processes (e.g. during rainy season)
☐ Other, specify: ....

13. How often is the storage container (e.g. pit latrine or septic tank) emptied? .... every ....

14. How is the storage container (e.g. pit latrine or septic tank) emptied?

☐ Human powered emptying and transport
☐ Motorized emptying and transport
☐ Other, specify: ....

15. Is personal protective equipment (PPE) used during emptying? (select all that apply)

☐ No ☐ Yes, which and do they use them consistently according to procedures?

☐ Gloves, used consistently ☐ No ☐ Yes
☐ Facemask, used consistently ☐ No ☐ Yes
☐ Overalls, used consistently ☐ No ☐ Yes
☐ Boots, used consistently ☐ No ☐ Yes
☐ Other, specify: ....

16. Have spills with faecal sludge occurred during emptying?

☐ No ☐ Yes, is the spill removed or cleaned and how?
....

17. Is personal protective equipment used for discharging the waste? (select all that apply)

☐ No ☐ Yes, which and do they use them consistently according to procedures?

☐ Gloves, used consistently ☐ No ☐ Yes

☐ Facemask, used consistently ☐ No ☐ Yes
☐ Overall, used consistently ☐ No ☐ Yes
☐ Boots, used consistently ☐ No ☐ Yes
☐ Other, specify: ....

18. Is faecal sludge (raw sewage) spilt during transport (e.g. leaking tank)?

☐ No ☐ Yes, how is this cleaned:
....

19. Where is the collected waste / faecal sludge taken to?

☐ Informal disposal site: ....
☐ Formal dumpsite: ....
☐ Treatment plant: ....
☐ Transfer station: ....
☐ Other: ....

Centralized systems (sewer system)

20. Is a sewer system present?

☐ No ☐ Yes:

☐ Simplified and solids-free sewer technologies
☐ Conventional gravity sewer technologies
☐ Transfer and sewer discharge station technologies

21. Does the sewer system receive rain / stormwater (combined sewer system) or is rain / stormwater collected separately?

☐ Combined sewer system
☐ Separate sewer system
☐ Other: ....

22. What is the approximate length of the sewer network? ..... kilometers

23. Do you have construction information about the sewer network? Provide an estimate if specific values are not available.

Age: ....

Material: ....

24. What is the depth of the sewer pipes? .... meter

And relative depth to drinking water supply pipes? .... meter

Are the sewer pipes located above or below the drinking water pipes?

☐ Sewer pipe above drinking water pipe
☐ Sewer pipe below drinking water pipe
☐ Sewer pipe at the same height as drinking water pipe

25. Do you have information on grading of materials surrounding the pipe? ....

26. Are the sewer pipes sometimes blocked (obstructed)?

☐ No ☐ Yes, how often: ....

27. Do sewer pipe breaks occur?

☐ No ☐ Yes, how often: ....

28. Are sewer leakage rates known?

☐ No ☐ Yes, what is this rate:
....

4.1.4 Treatment

(Semi)Centralized systems

29. What kind of treatment is used (please select all that apply)?

- ☐ Settler
- ☐ Anaerobic baffled reactor
- ☐ Anaerobic filter
- ☐ Waste stabilization ponds
- ☐ Aerated pond
- ☐ Constructed wetlands
    - ☐ Free-water surface constructed wetland
    - ☐ Horizontal subsurface flow constructed wetland
    - ☐ Vertical flow constructed wetland
- ☐ Conventional treatment
    - ☐ Primary treatment
        - ☐ Sedimentation
    - ☐ Secondary treatment
        - ☐ Trickling filter
        - ☐ Upflow Anaerobic Sludge Blanket Reactor (UASB)
        - ☐ Activated sludge
        - ☐ Sedimentation/thickening ponds
    - ☐ Tertiary treatment
        - ☐ Coagulation / flocculation
        - ☐ Slow sand filtration
        - ☐ Membranes
    - ☐ Disinfection
        - ☐ Chlorination
- ☐ Sludge treatment technologies
        - ☐ Unplanted drying beds
        - ☐ Planted drying beds
        - ☐ Co-composting
        - ☐ Biogas reactor
- ☐ Other, specify: ....

30. Monitoring of the treated sewage water (effluent):

- ☐ Observations, specify ....
- ☐ Measurements
    - ☐ Flow rate
    - ☐ Chemicals
        - ☐ COD
        - ☐ BOD

- ☐ solids
- ☐ other, specify ....

☐ Microbiological
- ☐ *E. coli*
- ☐ faecal coliforms
- ☐ total coliforms
- ☐ other, specify ....

☐ Physical parameters)
- ☐ pH
- ☐ temperature
- ☐ other, specify ....

31. Is it possible that raw sewage water (influent) is not treated (e.g. due to process overflow in case of heavy rainfall)?

☐ No ☐ Yes, how often? ....

32. Do sanitation workers use personal protective equipment (PPE)?

☐ No ☐ Yes, which and do they use them consistently according to procedures?

☐ Gloves, used consistently	☐ No	☐ Yes
☐ Facemask, used consistently	☐ No	☐ Yes
☐ Overall, used consistently	☐ No	☐ Yes
☐ Boots, used consistently	☐ No	☐ Yes
☐ Other, specify:		

33. Do you have bypasses and overflows from your sewage works?

☐ No ☐ Yes, how often: ....

34. Has the quantity or quality of raw sewage water and treated sewage water changed in the last years (e.g. increase of raw sewage, higher turbidity of treated sewage)?

☐ No ☐ Yes: specify, ...
....

In answering this question, you should consider:
- Has there been a change in industrial processes or a new process introduced?

  ☐ No ☐ Yes
- Has the facility started accepting offsite sewage such as leachate?

  ☐ No ☐ Yes
- Has the discharge volume increased?

  ☐ No ☐ Yes

- Has the rate of discharge increased?

☐ No ☐ Yes

35. Do you have clear, adequate functioning operation and maintenance programmes in place at your facility?

☐ No ☐ Yes

If yes, do you have an adequate functioning operation and maintenance manual?

☐ No ☐ Yes

36. Are procedures in place to deal with an emergency (e.g. contingency plans)?

☐ No ☐ Yes

37. Are procedures in place to deal with complaints from the public or external parties?

☐ No ☐ Yes

4.1.5 Disposal

Decentralized system

38. Is faecal sludge dumped?

☐ No ☐ Yes, specify where: ....

39. Where is untreated wastewater or faecal sludge discharged or dumped? Specify for different decentralized sanitation systems present.

....
....

40. Are waste is discharge sites located near parts of the drinking water supply?

☐ No ☐ Yes, where: ....

If yes, are these places located

Nearby abstraction points for drinking water? ☐ No ☐ Yes

Nearby drinking water pipes? ☐ No ☐ Yes

Nearby storage tanks? ☐ No ☐ Yes

Other, specify: ....

41. Does legislation regarding discharge / disposal of wastewater exist? If so, list them below.

....
....

Centralized system

42. Where is treated wastewater discharged?

 ....
 ....

43. Is faecal or wastewater sludge dumped or disposed?

 ☐ No ☐ Yes, specify where: ....

44. Does legislation regarding discharge / disposal of wastewater and / or wastewater sludge exist? If so, list them below.

 ....
 ....

45. Are wastewater or wastewater sludge discharge sites located near parts of the water supply?

 ☐ No ☐ Yes, where: ....

 If yes, are these places located

Nearby abstraction points for drinking water?	☐ No ☐ Yes
Nearby drinking water pipes?	☐ No ☐ Yes
Nearby tanks?	☐ No ☐ Yes
Other, specify:	

 ____

4.2 Drinking water supply

Specific questions related to the different steps in the drinking water supply can be found in Template 2-B Description of water supply from "A field guide to improving small drinking-water supplies: water safety planning for rural communities. Copenhagen: WHO Regional Office for Europe; 2022. Licence: CC BY-NC-SA 3.0 IGO."
Link: A field guide to improving small drinking-water supplies: water safety planning for rural communities (who.int)

Annex 5 Template iWSSP step 3 – List of hazardous events

Date: ___________ Version: ___________

Sanitation safety planning

Sanitation and health are interlinked through multiple possible hazardous events that can occur along the sanitation service chain.

Open defecation / in absence of containment

Open defecation can lead to pathogens discharged

- onto fields, infecting new hosts through feet or crops (e.g. soil-transmitted helminths);
- into water bodies, infecting new hosts through water contact (e.g. schistosomiasis from urination/ defecation in surface water) or consumption; and
- overall spread within the environment by insects or animals acting as mechanical vectors.

Hazardous event related to open defecation	**Could happen in our system**	
	yes	**no**
Waste (liquid, solid, urine and faeces) including pathogens reaching surface water body/groundwater after rain events along with contaminants on the surface		
Open urination by people in surface water bodies promoting vector breeding which may lead to vector borne diseases		
Direct contact with human faeces leading to sickness / infection		
Solid human waste is dumped in the open without any treatment leading to contamination of the environment		
Solid human waste is dumped in the open by the households leading to contamination of the environment		

Toilet

The user interface must guarantee that human excreta is hygienically separated from human contact to prevent exposure to faecal contamination. Toilets are the user interface for urination and defecation. **Unsafe or not used toilets** can lead to pathogens discharged:

- infecting new hosts through feet (e.g. soil-transmitted helminths);
- into water bodies, infecting new hosts through water contact or consumption; and
- overall spread within the household environment by insects or animals acting as mechanical vectors.

Hazardous event related to toilet	Could happen in our system	
	yes	no
Poorly-constructed user interfaces (toilets) and containment (pit latrines), can lead to flies and other insects breeding in excreta or spreading faecal pathogens to food, fingers and surfaces.		
If the slab or toilet floor is not stable or well built (containment), it may collapse or crack, exposing the user to hazards or leading to injury		
Areas inside the toilet or outside the toilet contaminated with faeces may transmit hookworm or pathogens to subsequent individuals if they use the facility bare footed		
Wrong design and/or construction of the toilets (e.g. lack of water seal or lid) leading to vector-borne transmission of pathogens to users		
Sickness / infection of users due to contact with unclean toilets that are not well constructed		
Decreasing water supply impeding function of water-reliant sanitation systems (e.g. flush toilets, sewerage, treatment) leading to no water seal, insect vectors having contact with the faeces and people reverting to open defecation		
Flooding of containment, such as septic systems, due to increasing groundwater levels leading to contamination of the environment		
The water seal may not function leading to contamination of the environment and enabling direct contact with contaminated waste		
Breakage in the exposed pipe between the toilet and containment leading to contamination of the environment and enabling direct contact with waste		
The containment (toilet superstructure) absent or damaged, allowing rainwater to cause the pit to fill up and overflow		
Toilet superstructure the containment absent or damaged, allowing for animals, rodents or insects to enter the containment (e.g. toilet and pit), damage the facility and carry excreta to the community		
Sickness / infection of users due to contact with unclean toilets that are made of a non-durable material that prevents cleaning of the slab (or pedestal).		
Sickness / infection of users due to contact with toilets that are not kept clean and where excreta remain on user interface (toilet) and superstructure surfaces of the room housing the toilet		
Sickness / infection after contact with faecal materials at user interface (e.g. toilets) due to the lack of handwashing facilities		

Hazardous event related to toilet	Could happen in our system	
	yes	no
Practice of improper handling of child faeces or nappies leading to sickness / infection		
Accidental contact with faecal matter after defecation / no handwash leading to sickness / infection		
Access route to the toilet is blocked or not manageable for some intended users leading to open defecation		
Exposure to (microbial) hazards through ingestion or inhalation during flush through aerosols formed (e.g. no lid in place or not closed)		

Storage/containment
Unsafe containment (storage): poor containment such as poorly-constructed latrine pits or septic tanks can cause leakage into groundwater and thereby into water consumed; and lead to overflow into the household environment.

Hazardous event related to storage / containment	Could happen in our system	
	yes	no
Leachate from cracked / damaged containment leads to contamination of groundwater		
Pit or tank overflows lead to contamination of local area and enabling direct contact with contaminated waste		
Poorly-constructed containment systems can lead to flies and other insects breeding in excreta or spreading faecal pathogens to food, fingers and surfaces		
Poorly-constructed containment systems can leak into the soil and contaminate soil and groundwater		
Contamination of watercourses / land due to blockage or overflowing of containment systems, such as septic tanks, reaching the water bodies via the surface		
Effluent outlet leads to contamination of the environment (open drain or water body)		
Containment systems, such as septic tank inadequately sized for the load received leading to contamination of receiving environment due to blockage or overflowing		
Containment systems, such as septic tank inadequately sized for the load received leading to exposure to septic tank contents may lead to sickness/infection		
Containment systems not accessible for emptying leading to overflow to contaminate the soil and groundwater		
High water table slowing down leaching causing water coming out of pan/ failure of water seal		

Hazardous event related to storage / containment	Could happen in our system	
	yes	no
Blackwater flows out of the containment, such as septic tanks, to the open ground causing contamination of soil and water		
Flooding of on-site systems causing spillage and contamination and enabling direct contact with faecal sludge and/or excreta		
Flooding and collapse of containment systems leading to contamination of the environment and enabling direct contact with faeces		
Overflow and/or obstruction of sewerage and septic systems leading to contamination of the environment and enabling direct contact with faeces		
Unsafe emptying of containment system leading to sickness / infection		
Users damaging containment, such as pit latrine or septic tanks, in order to avoid costs for emptying cause contamination of the groundwater		
Users damaging containment, such as pit latrine or septic tanks, in order to avoid costs for emptying cause direct exposure		
Groundwater contaminated via leachate percolating from containment, such as pits, septic tanks or infiltration wells		
Ingestion of groundwater contaminated via leakage from cracked/damaged septic tanks		
Dermal contact with pathogens due to effluent discharging into open drains or water bodies		
Trauma or asphyxiation caused by falling into collapsed pits as a result of reduced soil stability or structural failure of containment structure		

Emptying / conveyance / transport
Unsafe conveyance/transportation: poor emptying practices can lead to

- direct exposure of sanitation workers or others involved in emptying activities to pathogens, as well as
- untreated excreta discharged into water bodies, drains fields and other surfaces can potentially lead to transmission; and
- unsafe sewers can cause exposure through leakage, overflow and unsafe discharge into drains, water bodies, groundwater and open surfaces**.**

Hazardous event related to emptying / conveyance / transport	Could happen in our system	
	yes	no
Discharge without treatment leading to contamination of the environment (open drains, water bodies or open ground)		

Hazardous event related to emptying / conveyance / transport	**Could happen in our system**	
	yes	**no**
Overflow of sewers due to blockage leading to contamination of the environment		
Overflow of sewers due to failure (e.g. pipe breaks) leading to contamination of the environment		
Overflow of sewers during high flows leading to contamination of the environment		
Leakage from cracked/damaged sewer pipes or joints leading to contamination of the groundwater		
Damage to other infrastructure/systems on which sanitation systems rely (e.g. electricity networks for pumping; road networks used by sludge vehicles) due to heavy rainfall / flooding leading to disruption of the transport and conveyance		
Damage to other infrastructure/systems on which sanitation systems rely (e.g. electricity networks for pumping; road networks used by sludge vehicles) due to earthquakes leading to disruption of the transport and conveyance		
Increased corrosion of piped sewers leads to contamination of the groundwater or drinking water in underlying pipes		
Damage to underground infrastructure from e.g. rising groundwater levels, earthquakes or poor construction, leading to broken pipes and joints resulting in contamination of the groundwater or drinking water in underlying pipes		
Spillage during emptying or transport from equipment malfunction leading to contamination of the environment		
Spillage during emptying or transport from unsafe handling leading to contamination of the environment		
Worker contact during sewer cleaning and other maintenance leading to injury / sickness / infection		
Worker exposed to hazards (airborne particles) when emptying dried faeces from double vault latrines		
Blockage due to sand and/or oils and fats and/or other improper materials discarded to sewer leading to contamination of the environment		
Higher pollution concentration in wastewater and reduced capacity of receiving water bodies to dilute wastewater in case of drought / decreased rainfall		
Ground movement in soils with high clay content leading to broken pipes and joints resulting in contamination of the environment and eventually groundwater		
Decreases water supply due to droughts impeding function of water-reliant sanitation systems		

Hazardous event related to emptying / conveyance / transport	Could happen in our system	
	yes	no
Truck operators may be sprayed with sludge, leading to sickness, and the surrounding may accidentally be contaminated due to unsafe handling / operation		
Direct contact to sewage during emptying by opening and closing the collection chambers, connecting hoses and/or pumps		
Contamination of watercourses / land due to spillage of sludge		
Contamination of receiving environment due to flooding or heavy rain from stormwater systems contaminated with sewage or from combined sewers		
Uncontrolled and unknown discharges (e.g. from animal farms, industrial, septic tanks or pollutants resulting road traffic accidents) to stormwater system and water bodies contaminating the environment		
Exposure to untreated sludge from containment due to unsafe removal leading to sickness / infection		
Ingestion of pathogens after contact with excreta during manual emptying of pits using buckets		
Ingestion of pathogens after contact with contaminated soil, caused by discharge of faecal sludge without treatment to open grounds		
Dermal contact with pathogens in open channels and surface waters caused by discharge of untreated faecal sludge		
Ingestion of pathogens after contact with wastewater during sewer cleaning and maintenance		
Ingestion of pathogens after contact with faecal sludge during cleaning sludge beds		

Wastewater and faecal sludge treatment
Unsafe off-site treatment: inadequate treatment can lead to insufficient pathogen removal from faecal sludge, and into water bodies through runoff or by purposeful discharge, contaminating water for human consumption. Poorly-managed treatment processes can also allow animal contact with untreated excreta, contributing to further exposure.

Hazardous event related to treatment	Could happen in our system	
	yes	no
Treatment technology (the whole treatment plant or part of the treatment plant) is dysfunctional leading to contamination of the environment		
Design deficiencies or inadequate construction specifications leading to discharge of untreated wastewater		

Hazardous event related to treatment	Could happen in our system	
	yes	no
Destruction and damage to sanitation infrastructure due to heavy rainfall / flooding leading to contamination of the environment.		
Damage to other infrastructure/systems on which sanitation systems rely (e.g. electricity networks for pumping; road networks used by FSM vehicles) due to heavy rainfall / flooding		
Damage to wastewater treatment works (which are often low lying/coastal) from exposure to saltwater leading to contamination of the environment		
Discharge of untreated wastewater due to operator's failure resulting in environmental pollution		
Discharge of untreated wastewater due to overflow of combined sewers resulting in environmental pollution		
Discharge of wastewater that does not meet quality standards resulting in environmental pollution		
Reduced efficiency of biological wastewater treatment (if temperature exceeds or falls below operational limits) leading to contamination of the environment		
Reduced effectiveness of biological treatment processes due to saltwater exposure from saline intrusion into wastewater influent leading to contamination of the environment		
Obstruction creating reduced capacity in rivers or ponds that receive wastewater		
Reduced capacity of receiving water bodies to dilute wastewater leading to contamination of the environment		
Acts of vandalism or sabotage due to poor infrastructure security leading to discharge of untreated wastewater		
Inadequate treatment due to operators lack of proper technical knowledge		
Inadequate treatment due to non-availability or low quality and irregular supply of chemicals		
Ingestion of surface water contaminated with effluents from treatment plants that have not been designed based on pathogen removal, reduction or inactivation		
Inhalation of aerosols while manual handling of the dried faecal sludge		
Ingestion of pathogens in incompletely treated effluent, resulting from discharge of fresh faecal sludge in wastewater treatment ponds, causing overload and failure		
Inadequate treatment due to general lack of electricity supply for treatment processes		

Sanitation workers
Unsafe working environment: inadequate protection of sanitation workers can lead to exposure to untreated excreta and related hazards.

Hazardous event related to sanitation workers	**Could happen in our system**	
	yes	**no**
Direct contact with faecal sludge or raw sewage due to personal protective equipment failure - breakage or mis-use/non-compliance leading to sickness / infection		
Direct contact with faecal sludge or raw sewage due to lack of personal protective equipment leading to sickness / infection		
Contact with sharps by entering or emptying containment systems, e.g. septic tanks or pit latrines leading to injury / sickness / infection		
Contact with sharps from preliminary treatment e.g. screening leading to injury / sickness / infection		
Contact with faecal sludge or raw sewage via contaminated tools and equipment leading to sickness / infection		
Lack of proper hand hygiene after contact with faecal sludge or raw sewage leading to sickness / infection		
Lack of proper handwashing practice with soap and water after contact with human faeces or raw sewage in all critical occasions leading to sickness / infection		

Disposal
Unsafe disposal: discharge of untreated faecal sludge into the environment can lead to hazardous events through multiple pathways

Hazardous event related to disposal	**Could happen in our system**	
	yes	**no**
Direct contact with faecal sludge or raw sewage due to lack personal protective equipment, particularly where disposing of wastewater and, faecal sludge		
Direct contact with faecal sludge or raw sewage due to lack of training on the risks of handling effluents or faecal sludges and on standard operating procedures		
Discharge of effluent from onsite systems into the soil may lead to contamination of groundwater		
Discharge of untreated wastewater resulting in environmental pollution		
Discharge of wastewater that does not meet quality standards resulting in environmental pollution		
Dumping used waste, such as napkins, sanitary towels or toilet paper, into the water bodies/other places causing water/environmental pollution		
Unsafe or illegal offsite disposal of sludge may lead to contamination of watercourses / land		

Hazardous event related to disposal	Could happen in our system	
	yes	no
Dumping faecal sludge or septage from the septic tank in an unsafe manner leading to contamination of the environment		
Contact with sharps at dumpsite or landfills place leading to injury / sickness / infection		
Ingestion of pathogens in surface waters due to discharge of partially treated or untreated wastewater		

Hygiene
Unsafe hygiene: can lead to hazardous events through multiple pathways

Hazardous event related to hygiene	Could happen in our system	
	yes	no
Lack of proper hand hygiene leading to sickness / infection		
Lack of proper handwashing practice with soap and water leading to sickness / infection		
Lack of proper hygiene while cooking/ serving food at home leading to sickness / infection (community)		
Lack of proper hygiene while cooking & serving food in commercial establishments leading to sickness / infection (community)		

Water Safety Planning

Catchment
The catchment is the first step of the water supply in which hazards can reach the abstraction point due to direct introduction of hazards into the groundwater body, direct introduction of hazards into surface water body, or via surface runoff and / or groundwater feeding the surface water body. This is also the step where unsafe sanitation may have the largest impact on drinking water safety.

Hazardous event related to catchment	Could happen in our system	
	yes	no
Discharges from untreated or poorly treated domestic wastewater / faecal matter from on-site systems or open defecation reach source water (directly or indirectly via overland flow), e.g. caused by not removing retained solids on time, causing overflowing of effluents, or poor maintenance of the systems		
Discharges from untreated or poorly treated domestic wastewater / faecal matter from centralized wastewater collection reach source water (directly or indirectly via overland flow)		

Hazardous event related to catchment	**Could happen in our system**	
	yes	**no**
Domestic solid wastes or solid waste site leachate reaches surface water body via groundwater feeding the surface water body		
Inadequate re-use of human or animal faeces / wastewater leads to introduction of pathogens and nutrients into catchment and subsequently surface water		
Discharges from untreated or poorly treated industrial discharges and wastewater reach source water (directly or indirectly via overland flow)		
Agricultural chemicals (e.g. fertilizers and agricultural pesticides/ algaecides), manure or faecal material from application or storage reach surface water through overland flow and / or via groundwater		
Agricultural activities near the dam (flowers production) cause deforestation and may introduce agrochemicals via surface water runoff or via groundwater contamination		
Nutrients (e.g. from agricultural activities) reach surface water directly or through overland flow, leading to algal blooms		
Lack of Best Management Practices (BMP) for pesticide control, irrigation / drainage / match irrigation to crop needs, nutrient management, design and operation of industrial activities etc. leads to increased contamination		
Aquacultural activities lead to direct discharge of human pathogens from systems using wastewater and from fish excreta, flow of fishpond water into the surface waterbody, particularly during flooding		
Spills or leakages from major spills or continuous small spills, both accidental and deliberate, reach source water (directly or indirectly via overland flow)		
Salinization of river water as a consequence of mining activities, especially of salt mining		
Mining causing acidic water with low pH, reaching the surface water via groundwater flow		
Mining, energy generation or other empoundments causing changes in the hydraulic regime, potentially leading to reduced water quantity		
Faecal matter from intensive animal practices, manure application, livestock and other animals contaminates source water		
Discharges / leachate from e.g. extractive mining, waste disposal or other current or former hazardous waste sites reach source water via groundwater		
Traffic, including waterway transportation and vehicle maintenance activities, contaminates waterbody directly or via overland flow		

Hazardous event related to catchment	Could happen in our system	
	yes	no
Human pathogens reach surface water body through human activities (e.g. swimming, washing of clothes)		
Increased concentration of pollutants when conditions become drier and there is less recharge, particularly in groundwater sources that are already of low quality		
Increased concentration of pollutants in case of increased abstraction / overabstraction with less inflow, particularly in groundwater sources that are already of low quality		
Reduced quantity available if increased winter precipitation is compensated with higher evaporation due to higher summer temperatures		
Higher levels of hazards as long-term rainfall increases, causing rising groundwater levels which decrease the efficiency of natural purification processes		
Transport of contaminants is increased, particularly in shallow aquifers, with increased lateral flow in soils after large rainfall events		
Contamination sources are mobilised or lower quality water intrudes due to increased pumping in times of drought		
Hazards are introduced from surrounding soil to groundwater (e.g. humic material, arsenic, fluoride, manganese, iron, sulphate, radiological agents		
Nonavailability or shortage of water due to incorrect placement of intake point		
Improper choice of water source because of lack of detailed assessment or reliable survey data		

Abstraction from groundwater

Hazardous event related to abstraction from groundwater	Could happen in our system	
	yes	no
Reduced quantity due to drying up of wells caused by to reduced groundwater tables		
Reduced quantity due to failure (e.g. due to flood, slips or earthquake-related damage) causing infrastructure to become dysfunctional		
Hazards reach the source water with contaminated water from the surface entering well heads after intense runoff / flooding events		
Contamination enters dug well, borehole or spring source during construction due to contaminated equipment		
Contamination enters borehole during construction due to residual substances used in drilling		

Hazardous event related to abstraction from groundwater	**Could happen in our system**	
	yes	**no**
Contamination of the borehole due to poor quality of the bore casing (joints, cracks or corrosion) in the bore casing		
Contamination enters borehole through well head or casing which is damaged due to inappropriate wellhead design or construction		
Contamination of the groundwater due to cracked lining representing a pathway for introducing hazards		
Contamination of the groundwater due to lack of seal on rising main representing a pathway for introducing hazards		
Contamination of the groundwater due to lack of or damaged cover on well representing a pathway for introducing hazards		
Contamination of the groundwater due to cracked or damaged apron or pump-house floor representing a pathway for introducing hazards		
Contamination of the groundwater due to faulty masonry on spring protection representing a pathway for introducing hazards		
Quantity is reduced by break down of pumps (defect, power failure, lack of standby pumps, spare parts, back-up generator)		
Contamination of the groundwater due to eroded backfill on spring source representing a pathway for introducing hazards		
Contamination of the groundwater due to ropes and buckets used to withdraw water from dug well or spring source representing a pathway for introducing hazards		
Hazards are introduced due to vandalism as access to unfenced dug well, borehole or spring source makes it a target		
Contamination is introduced through stagnant water uphill or in the direct vicinity of the dug well, borehole or spring source and absence of drainage channel / diversion ditch		
Available quantity is reduced when sediments, iron or manganese cause the well to clog		
Hazards are introduced during repair and maintenance by untrained staff, e.g. with contaminated tools		
Available quantity is reduced by too high velocity due to poor design causing premature breakages of channels or pipes of the borehole		
Available quantity is reduced in case of breakdown of well pump (defect, power failure)		
Contamination may be introduced through lack or damage to cover of wells in the vicinity of the abstraction point		

Drinking water treatment
Inadequate treatment can lead to insufficient removal of hazards, leading to unsafe drinking water for human consumption. Poorly-managed treatment processes can also lead to ingress of hazards.

Hazardous event related to drinking water treatment	**Could happen in our system**	
	yes	**no**
Inadequate back-up (infrastructure, human resources) leads to poor performance of the whole process in case of failure of the initial resources		
Interruption to the treatment process or poor water quality due to damage to treatment infrastructure in case of e.g. flooding, fire or other severe weather events		
Interruption to the treatment process or poor water quality due to failure of alarms and monitoring equipment which hinder quick response in case of treatment failure		
Interruption to the treatment process or poor water quality during accidents and recurring disasters, due to a lack of preparedness		
Introduction of hazards to incoming or treated water through cross- connection to contaminated water/wastewater, internal short circuiting		
Increased turbidity and affected treatment process caused by dust accumulation around the treatment area		
Hazards are insufficiently removed / reduced if the treatment is not well adapted to prevailing raw water quality and flow variations		
Hazards are insufficiently removed / reduced due to poor dose control, leading to poor functioning of treatment step		
Hazards are insufficiently removed / reduced due inadequate treatment as reliable water quality data is missing		
Introduction of hazards to incoming or treated water / hazards are insufficiently removed through operators' lack of proper technical knowledge and hygienic practices		

Sand filtration

Hazardous event related to sand filtration as treatment	**Could happen in our system**	
	yes	**no**
Compromised hazard removal due to poor source water quality or water of variable quality which compromises filter operation		
Compromised hazard removal if treatment steps (e.g. clarifiers) before the sand filter are not working well, and less particles can be removed before the filter		

Hazardous event related to sand filtration as treatment	**Could happen in our system**	
	yes	**no**
Compromised hazard removal and water quality if design of the filter and the operational requirements of the treatment plant do not match the raw water quality, leading to insufficient water treatment		
Compromised hazard removal due to sudden increases in the rate in which water passes through the filter which will shake loose particles that have already been trapped in the sand, causing "spikes" in the turbidity		
Reduced quantity in case of algal blooms with algae blocking the filters		
Insufficient hazard removal if filter design does not match operation flow rates		
Compromised removal of hazards if depth of the filter is insufficient		
Compromised functioning of treatment step due to inappropriate operation of the filter (i.e. how and how often the filter is backwashed, if the backwash water is returned to the head of the plant, how the filter is restarted, the management of the filter ripening and the procedures used in cleaning the filter sand, lack of proper valve lubrication and maintenance, media not inspected and/or cleaned, poor operator training and support)		
Compromised removal of hazards due to frequent filter backwashing which mixes filter layers, and affects particle size of filter particles, leading to reduced filtration capacity		
Compromised removal of particles if the filter bed is not completely fluidized during filter backwashing		
Insufficient backwashing water available to maintain removal of hazards in case of increased temperature, and higher frequency / flow rates may be needed to reach necessary flushing velocity		
Insufficient backwashing water available to maintain removal of hazards in times of higher turbidity, and higher frequency / flow rates may be needed to maintain removal of hazards		

Chlorination

Hazardous event related to chlorination as treatment	Could happen in our system	
	yes	no
Chlorine dose is too low to leave enough free available chlorine to disinfect the water effectively		
Free available chlorine is in contact with the water for an insufficient time (typical recommendation: 30 minutes) to efficiently reduce microbial contamination		
pH of the water is outside effective range (typically this means that pH is rather too high, resulting in a lower percentage of the free available chlorine existing in its more powerful disinfecting form), compromising disinfection (not enough chlorine is in a form which is good to kill pathogens) which may fail to remove / reduce microbial hazards		
Turbidity of the water is too high when the chlorine is added to it; which can hinder the access of chlorine to target pathogens		
Water temperature is too low to allow for efficient chlorination so that pathogens are insufficiently removed		
Chlorine dose is too low to leave enough free available chlorine to disinfect the water effectively		
Chlorination is not adapted to fluctuations in raw water quality and flow variations, leading to insufficient reduction of pathogens		
Insufficient availability of chlorine or reagent of poor quality / old solution / solution which has been exposed to the sunlight, unapproved or contaminated chemicals and materials may compromise treatment		
Poor dose control / dosing equipment (including calibration of dose controller's sensor, dose calculation) / insufficient chlorine reaching dosing point may lead to poor functioning of chlorination		
Wrong monitoring (e.g. incorrect sampling, incorrect recording of readings, incorrect method for measurement, incorrect calibration) of free available chlorine lead to insufficient dosing		
Power cuts may lead to failure of dosage pumps and / or mixing facilities		
Inadequate back-up (infrastructure, human resources) leads to poor performance of chlorination process		
Process control failure and malfunction and/or poor reliability of equipment compromises treatment		
Failure of alarms and monitoring equipment hinder quick response in case of chlorination failure		
Lack of preparedness for potential accidents and recurring disasters causes interruption to the process or poor water quality		
Cross-connection to contaminated water/waste water, internal short circuiting contaminates the incoming or treated water		

Drinking water distribution
Inadequate treatment in the distribution can lead to insufficient removal of hazards, leading to unsafe drinking water for human consumption. Poorly-managed operations and maintenance of the distribution network can also lead to ingress of hazards.

Distribution system

Hazardous event related to distribution system	**Could happen in our system**	
	yes	**no**
Negative, or fluctuating, pressure conditions (e.g. intermittent operation or the effect of a pressure wave within the system) allow for ingress of contamination from surrounding soil / surfaces / animal faeces / leaky sewer mains / drains / garbage / pit latrines / valve boxes / canals, especially in the first flush after water pressure is returned, and may carry deposited silt and / or rust with it in first flush		
Loose joints, pin-holes, loose connection, cracks, holes in the pipeline coupled with low internal pressures allow for ingress of contamination		
Lack of prevention device or failure of device leading to potentially contaminated backflow from residential / industrial / commercial customers due to (likelihood increased during low-pressure events)		
Accidental cross-connection (or illegal / unauthorized connections) between drinking water and non-drinking water assets or wastewater during construction or maintenance (e.g. opening of usually shut valves) allowing for contamination to enter		
Pipes located above ground are prone to damages, allowing for ingress of contamination from surrounding soil / surfaces		
Insufficient performance of valves may lead to compromised isolation, flushing and/or disinfection of potentially contaminated area		
Unhygienic construction, repair and maintenance methods may introduce contamination (e.g. debris, vermin, soil, groundwater or rainwater entering)		
Unsuitable construction materials may introduce hazards (e.g. impurities such as copper, iron, lead, plasticizers, bituminous lining)		
Inappropriate materials, such as metallic products, which are incompatible with the water quality and / or other materials in the system may cause corrosion and resulting loss of structural integrity, water colour and water quality issues		
Pipe slimes, sediment and deposited minerals such as silicates or oxidised manganese may be re-suspended in the distribution system during high-flow events or flow reversals		

Hazardous event related to distribution system	Could happen in our system	
	yes	no
Particles (e.g. floc after the treatment plant, sediments, manganese deposits) may accumulate, particularly at dead ends, due to long stagnation		
Biofilms in piped networks may lead to pathogen survival and growth of pathogens		

Post treatment storage

Hazardous event related to post treatment storage	Could happen in our system	
	yes	no
Damaged or lacking vent screens allow ingress of animals / vermin /faeces which may introduce contamination (particularly for consumers' premises storages)		
Damaged or lacking tank covers allow ingress of animals / vermin /faeces / roof drainage which may introduce contamination		
Insufficient cleaning of reservoirs may lead to build up of sediment or living organisms (including algal / biofilm growth)		
Lack of surface sealing which slopes away from storage may lead to contaminated water (including potentially animal faeces if access is not restricted) running towards storage and entering it through damages		
Roots of plants / trees in vicinity may damage reservoir and allow for ingress of contamination		
Dissolving or corroding tank materials may introduce hazards		
Unhygienic sampling procedures may introduce contamination		
Unauthorised access by humans may lead to vandalism and sabotage		
If water is disinfected at storage: Insufficient residence time of water does not allow for sufficient contact time to reduce pathogens (event related to post chlorination after treatment, but not in reservoir)		
For underground storage reservoirs: ingress of groundwater from unsealed joints and cracks leads to ingress of contamination		
Inadequate capacity of storage leads to insufficient quantity which is supplied to consumers' demand		
Power cuts leading to failure of booster stations and hence reduced quantity		

Drinking water consumers' premises / household
Unsafe hygienic practices can lead to hazardous events through multiple pathways

Public fountains

Hazardous event related to public fountains	**Could happen in our system**	
	yes	**no**
Leaking public fountains may through unsealed surfaces and / or cracks lead to ingress of contamination into pipes, especially if distribution system is operating intermittently		
Leaking public fountains may reduce quantity of available drinking water		
Insanitary taps or attachments (e.g. hoses) may introduce contamination to the water collected as well as to the distribution system		
Spilt water may be contaminated by runoff, especially if animals have access to the collection area, and collection containers may thus be contaminated when placed on the ground to collect water		
Animal faeces, garbage etc. may contaminate the collection area, and collection containers may thus be contaminated when placed on the ground to collect water		
If the collection area is not fenced, animals (including those used for collecting the water) can access the fountain area, damage the taps and pollute the area and / or collection containers		
Hose connection to tap may allow for potentially contaminated water backflow into the distribution system		

Household level

Hazardous event related to household level	Could happen in our system	
	yes	no
If water from different sources and with different qualities is used in the same household and collected and stored in the same containers, drinking water may get contaminated		
If collection- and storage containers are used for storing different liquids or materials, drinking water may get contaminated		
Cracked, leaking or insanitary collection- and storage containers may introduce contamination and reduce quantity		
If lid of collection- and storage containers is absent, damaged or not in place, contamination may enter and animals/insects may get into container		
Storage containers / jars kept at ground level allows for contamination to enter through e.g. animals or poor sanitation practices		
Faeces, garbage and other wastes in an insanitary area around the storage container / jar may introduce contamination		
Pump from ground level tank to roof tank draws may groundwater because storage is leaky and thus enter contamination		
Insufficient cleaning of storage tank may allow for contamination / sedimentation to accumulate		
Use of an inappropriate or insanitary tap or utensil to draw water from the storage, as well as poor hygiene practices (e.g. dirty hands) may introduce contamination		

Annex 6 Template iWSSP step 3 – Risk assessment table

Date: ____________ Version: ____________

	Sanitation step					Water supply step						Hazard			Hazardous event
Hazardous event number	**Capture / toilet**	**Containment**	**Transport**	**Treatment**	**Disposal**	**Catchment**	**Abstraction**	**Treatment**	**Distribution**	**Consumers**	**Specify**	**Microbial**	**Chemical**	**Physical**	**Specify**

Risk assessment table (continued)

Effectiveness				Risk assessment				Need for new control measures		
Effective	Not effective	Somewhat	Specify	Likelihood	Severity	Risk rating	Specify	Yes	No	Required action
						0				
						0				
						0				
						0				

Risk assessment table (continued)

Description of improvement				
Details on what needs to be done	**Who**	**Implementation due date**	**Resources (estimated budget, work time)**	**Implementation status (not started, in progress, or completed)**

Annex 7 Template iWSSP step 3 – Control measures

Date: ____________ Version: ____________

Sanitation or water supply system	Step in the system (e.g. catchment or treatment)	Exposure group	What can go wrong? Hazardous event	Hazardous event number	Existing control measure(s)	Is this event under control?			
						Yes	Somewhat	No	Validation notes

Annex 8 Template iWSSP step 3 – Definitions for likelihood, severity and risk level to be used in the risk assessment

Likelihood

	Description drinking water	Description sanitation
Likely	Will probably occur in most circumstances; has been observed regularly (e.g. daily to weekly).	Has often been observed in the past and / or is likely to occur in the next 12 months (or another reasonable period)
Possible	Might occur at some time; has been observed occasionally (e.g. monthly to quarterly or seasonally).	May have happened in the past and / or may occur under regular circumstances in the next 12 months (or another reasonable period)
Unlikely	Could occur at some time but has not been observed; may occur only in exceptional circumstances.	Has not happened in the past and is unlikely to happen in the next 12 months (or another reasonable period).

Severity / Consequence

	Description drinking water	Description sanitation
Major impact	Major water quality impact; illness in community associated with the water supply; large number of complaints; significant level of customer concern; significant breach of regulatory requirement.	Hazard or hazardous event potentially resulting in serious illness or injury, or even loss of life (e.g. severe poisoning, loss of extremities, malaria, schistosomiasis, chronic diarrhoea, chronic respiratory problems, neurological disorders); and / or may lead to legal complaints and concern and/ or major regulatory non-compliance
Moderate impact	Minor water quality impact (e.g. not health related, aesthetic impact) for a large percentage of customers; clear rise in complaints; community annoyance; minor breach of regulatory requirement.	Hazard or hazardous event potentially resulting in self-limited health effects or minor illness (e.g. acute diarrhoea, vomiting, minor trauma) and/ or moderate regulatory non-compliance
No/minor impact	Minor or negligible water quality impact (e.g. not health related, aesthetic impact) for a small percentage of customers; some manageable disruptions to operation; rise in complaints not significant.	Hazard or hazardous event resulting in no or minor health effects (e.g. temporary symptoms like irritation, nausea, headache) and/ or minor regulatory non-compliance

Risk matrix

Example of a 3x3 risk matrix:

Consequences			RISK MATRIX	
Major impact (Score: 3)	**Moderate impact** (Score: 2)	**No or minor impact** (Score: 1)		
3	2	1	**Unlikely** (Score: 1)	**Likelihood**
6	4	2	**Possible (Score: 2)**	
9	6	3	**Likely (Score: 3)**	

Risk categories

<table>
<tr><th></th><th>Description drinking water</th><th>Description sanitation</th></tr>
<tr><td rowspan="2">High – clearly a priority: requires urgent attention</td><td colspan="2">Actions need to be taken to minimize the risk.</td></tr>
<tr><td>Possible options should be documented (as part of the improvement plan developed in the next task) and implemented based on community priorities and available resources.</td><td>It is possible that the event results in injuries, acute and/ or chronic illness or loss of life.</td></tr>
<tr><td rowspan="2">Medium – medium- or long-term priority: requires attention</td><td colspan="2">Once the high priority risks are controlled, actions need to be taken to minimize the risk.</td></tr>
<tr><td>Possible options should be documented (as part of the improvement plan developed in the next task) and implemented based on community priorities and available resources.
Or where the likelihood of a hazard occurring is low because effective control measures are in place, but the consequences are major (e.g. microbial risks), special attention should be given to maintaining the control measures and their appropriate operational monitoring to ensure that the likelihood remains low.</td><td>It is possible that the event results in moderate health effects (e.g. fever, diarrhoea, small injuries) or unease (e.g. noise, malodours).</td></tr>
<tr><td rowspan="2">Low – clearly not a priority</td><td colspan="2">No action is needed at this time, but actions may need to be taken (not a priority). The risk should be revisited in the future as part of the review process.</td></tr>
<tr><td>Or control measures are effective, and attention should be given to ensure that the risk remains low.</td><td>No health effects anticipated.</td></tr>
</table>

Annex 9 Template iWSSP step 4 – Improvement plan

Date: ____________ Version: ____________

Hazardous event which needs further action	**Hazardous event number**	**Additional control measure** *What specific improvement action will be taken?*	**Who** *Person or organization responsible for the improvement*	**Resources** *Estimated budget / time required*	**Implementation date** *When should the improvement be implemented*	**Implementation status** *On hold/ ongoing/ finished*

Annex 10 Template iWSSP 5 – Operational monitoring plan

Date: ____________ Version: ____________

What *Parameter to be tested and target value*	**Where** *Location in the system / control measure*	**When** *Frequency*	**Who** *Person carrying out monitoring*	**Limit values or target conditions**	**How** *Methods of monitoring, laboratory / field test equipment*	**Corrective actions** *Actions to be taken when limit values or target conditions are not met*

Annex 11 Template iWSSP step 5 – Verification (compliance) monitoring plan

Date: ____________ Version: ____________

What *Parameter to be tested and target value*	**Where** *Location in the system*	**When** *Frequency*	**Who** *Person carrying out monitoring*	**Limit values**	**How** *Methods of monitoring, laboratory / field test equipment*	**Reporting** *WSSP team member to whom the results are reported and with whom to discuss remedial action*

Annex 12 Template iWSSP step 6 – Supporting activities

Annex 12.1 Activities in place

Date: ____________ Version: ____________

Type of supporting activity in place *E.g. quality, management, communication, maintenance, training*	**Drinking water supply**	**Sanitation system**

Annex 12.2 New activities

Date: ____________ Version: ____________

Type of additional supporting activity *E.g. quality, management, communication, maintenance, training*	**Drinking water supply**	**Sanitation system**

Annex 13 Template iWSSP Step 6 – Operation and maintenance

Date: ____________ Version: ____________

Operational or maintenance task *List important tasks here (e.g. tank cleaning, filter cleaning, chlorination).*	**Step-by-step instructions** *List all steps involved in completing these tasks.*	**Who?** *Who should implement the tasks?*	**When?** *When and how often should the tasks be implemented?*

Annex 14 Template iWSSP Step 6 – Emergency response plan

Emergency response plan	
Author	
Date and version	
Possible emergency situations (please list most likely emergencies that may affect the drinking water or sanitation system)	
Persons to be notified / involved	Persons within the drinking water utility, sanitation services, community: • Name: …………………… Telephone: ……………. • Name: …………………… Telephone: ……………. • Name: …………………… Telephone: ……………. • Name: …………………… Telephone: ……………. Persons outside the water utility, sanitation services, community: • Name: …………………… Telephone: ……………. • Name: …………………… Telephone: ……………. • Name: …………………… Telephone: …………….
Steps to follow in case of an emergency	• **Assess the emergency situation** • Based on the situation assessment, take a **decision of steps to take**, stakeholders / individuals to inform and to involve, and where to best invest your resources. • Implement the steps, and monitor their implementation. • **Follow up and review** the emergency response and adapt your emergency response approach if needed, considering lessons learned.
Method of notification and alerting the community (users and/or consumers)	
Alternative drinking water supply or sanitation services	

Published by:

National Institute for Public Health
and the Enviroment, RIVM
P.O. Box 1 | 3720 BA Bilthoven
The Netherlands
www.rivm.nl/en

April 2024

Committed to
health and sustainability