Risk-based management and monitoring for safer and more resilient water supply

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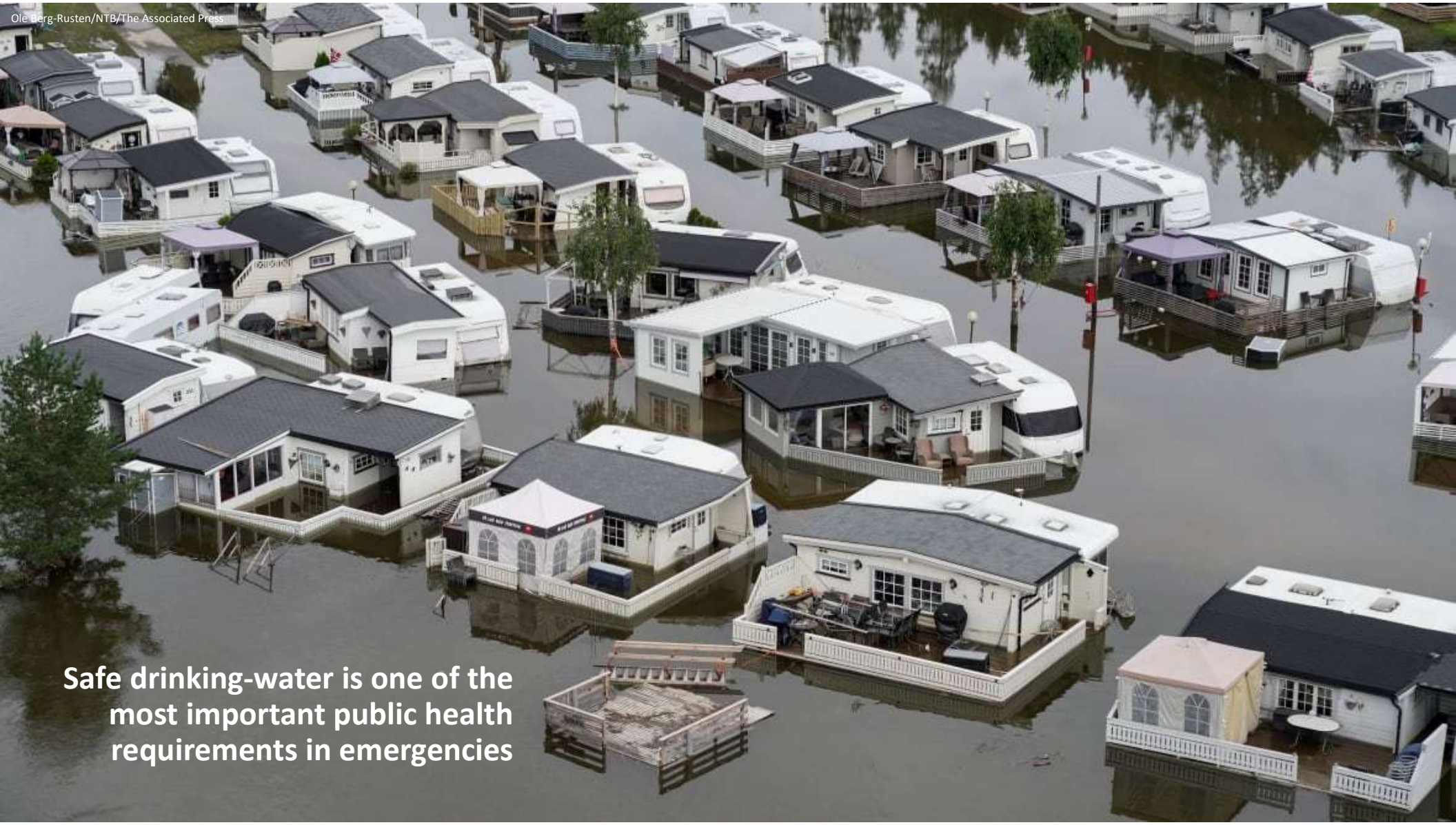
World Health Organization
European Region

NORDIC-BALTIC NETWORK ON WATER AND HEALTH

ICELAND, 23 OCTOBER 2025


Ole Berg-Rusten/NTB/The Associated Press
Safe drinking-water is one of the most important public health requirements in emergencies

OVERVIEW

Content and scope

1. Safe drinking-water in emergencies
2. Strengthening the resilience of water supplies through risk-based surveillance
3. Tools for enhancing emergency readiness in conflict contexts

Aim to provide an overview of risk-based approaches to enhance the safety and resilience of water supplies in emergencies and conflict settings

CONTENTS

1. Safe drinking-water in emergencies

2. Strengthening the resilience of water supplies through risk-based surveillance

3. Tools for enhancing emergency readiness in conflict contexts

1. Safe drinking-water emergencies

Types of emergencies

Unforeseen

Foreseen

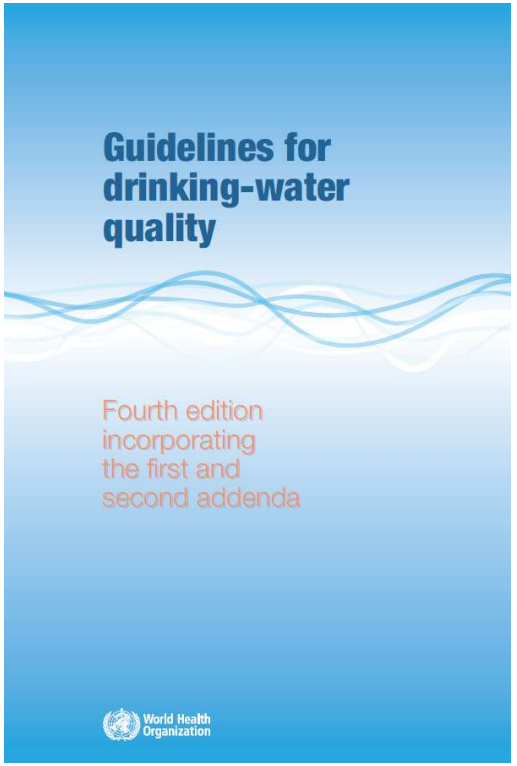
"Officials noted that the phenomenon was unexpected and that their system had not been designed to deal with such an intrusion."

1.1 Safe drinking-water in emergencies

WHO Guidelines for drinking-water quality (2022)

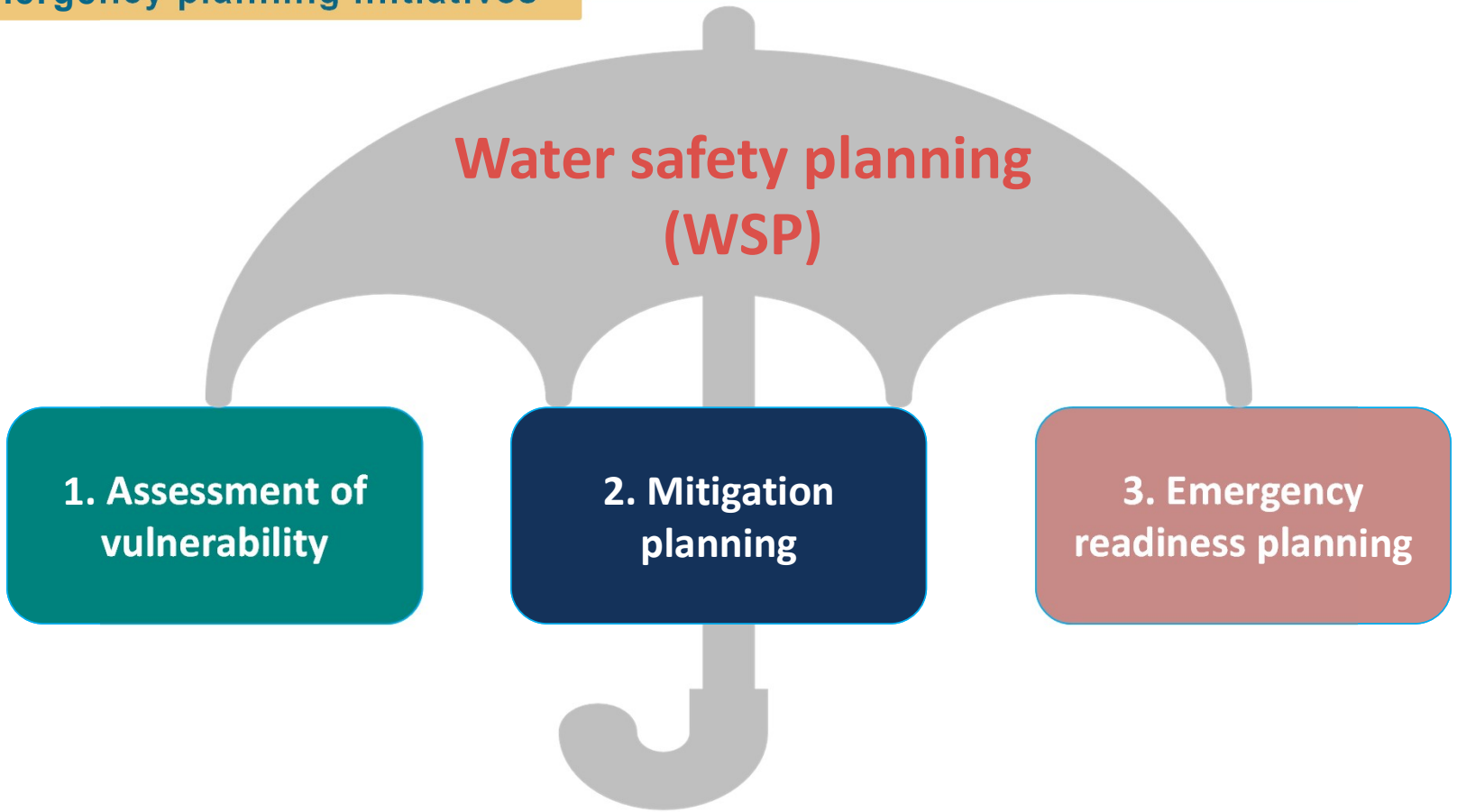
Outlines special considerations for safe drinking-water management in emergency situations

How can this be adapted to local-level emergency preparedness and response planning (i.e. "readiness")?



1. Safe drinking-water in emergencies

Emergency planning initiatives



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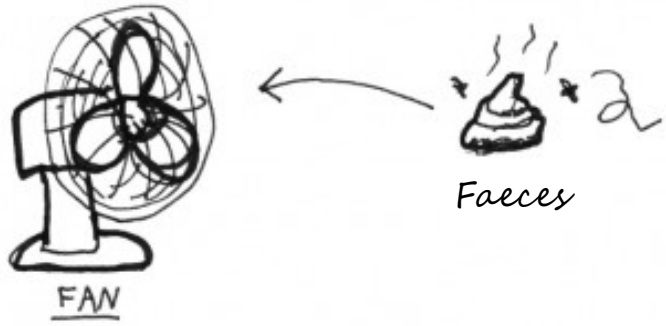
1. Safe drinking-water in emergencies

Emergency planning initiatives

Key to:

- ☑ Anticipate **probable *events***
- ☑ Ensure emergency management plans in place & be prepared to respond when needed
- ☑ Conduct regular simulations/drills
- ☑ Ensure back-up materials, resources, facilities
- ☑ Ensure good communication and coordination with agencies
- ☑ Consider how readiness can be applied to ***unforeseen events***



General emergency preparedness can support resilience to unforeseen events

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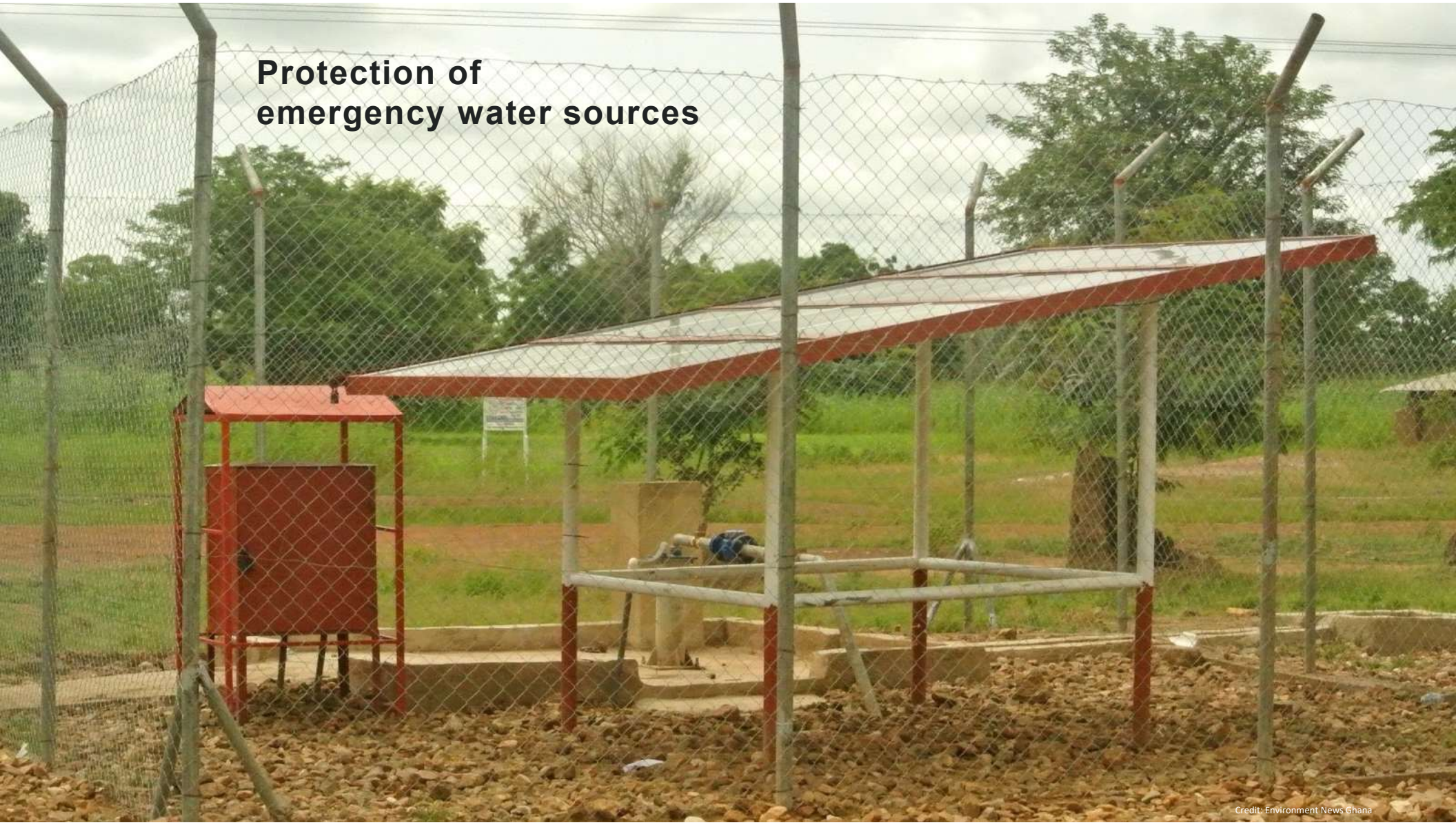
Water quantity
& reliability
Credit: Scott Macnamara/flickr.com

Protection of emergency water sources



Credit: Environment News Ghana


Provision of
adequate disinfection
Credit Colorado State University/flicker.com

Safety and acceptability of emergency water supplies

Home / Irish News

Tap water crisis spreads as emergency supply tainted

Danger on tap: Council workers fill water tanks in Galway


Availability of
packaged water
Credit:Marcel Burger, nordicreporter.com


Equitable access
to emergency
supplies
Credit: CDC

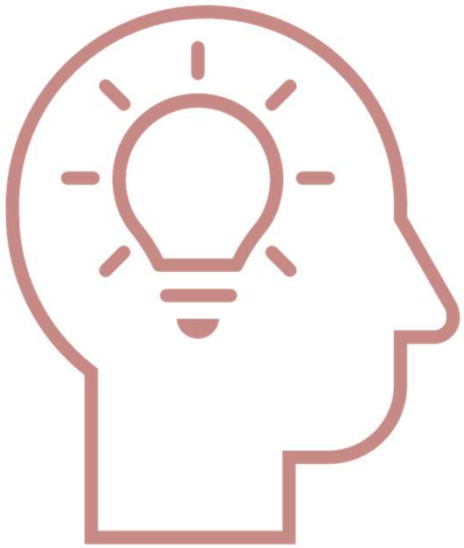
Safe household collection, storage, treatment & handling

Capacity to monitor water quality & take action

Credit: SGS Lithuania

PART 1 RECAP - Safe drinking-water in emergencies

- Safe, sufficient water is vital in emergencies - focus on preventing contamination and ensuring disinfection.
- Planning is central for effective for preparedness, with strong coordination and simulations.
- Ongoing monitoring and rapid response are key to detect issues and maintain safe supply.



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Mentime
What words come to mind when you think of "resilience"?
fast
bold
creative
leader
focus
transpiration

2.1 Resilience to change and uncertainty

Resilience in the context of water supply

- Anticipate
- Respond
- Cope
- Recover
- Adapt

2.1 Resilience to change and uncertainty

Risk-based surveillance supports anticipation of change

What does resilience to change and uncertainty mean?

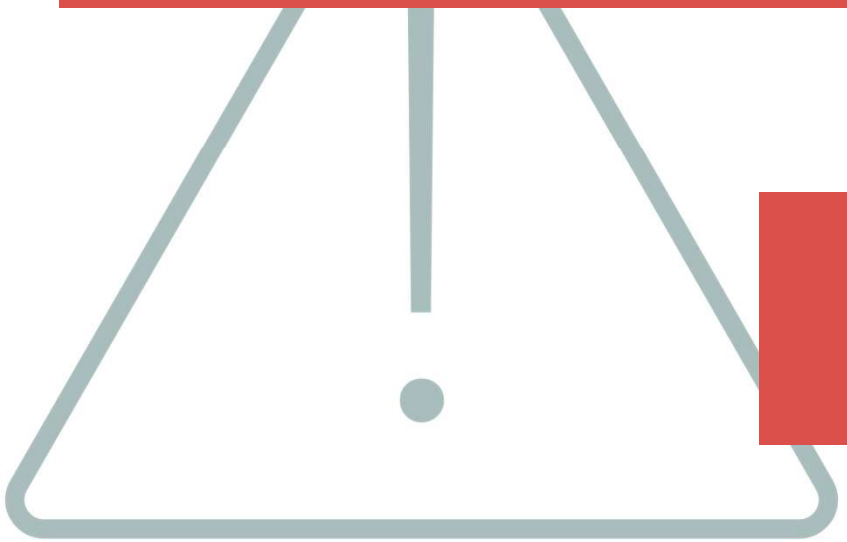
What role does risk-based drinking-water quality surveillance play in forward-thinking?

2.1 Resilience to change and uncertainty

Definitions

SURVEILLANCE

The continuous and vigilant
public health assessment and review of the
safety and acceptability of drinking-water supplies



RISK-BASED SURVEILLANCE

Assessing drinking-water safety on the basis of risk to inform targeted and progressive improvement action

2.1 Resilience to change and uncertainty

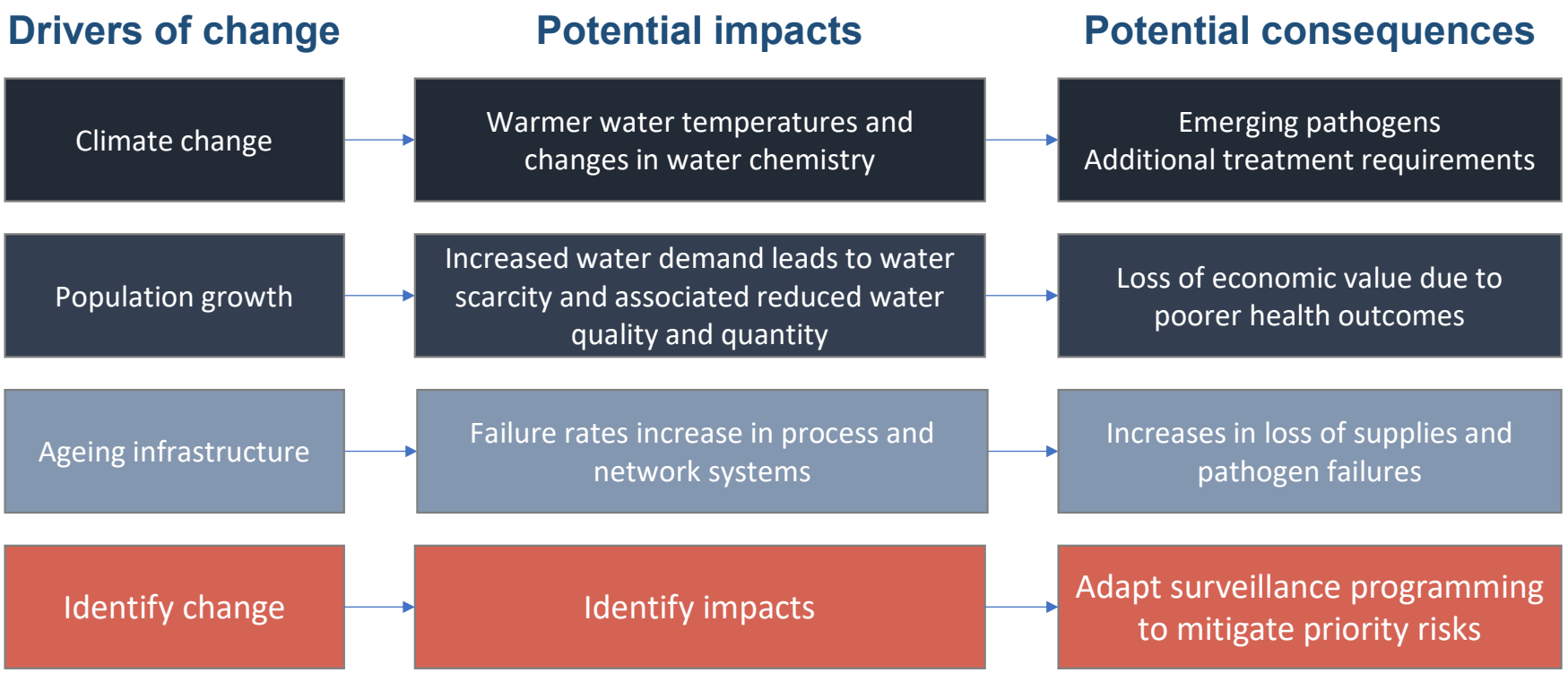
Resilience in the context of water supply

Resilience applies to a broad range of shocks, stressors and uncertainty, such as

- → Major essential service disruptions *(e.g. prolonged power/communications outage, transportation disruptions)*
- → Major contamination event *(e.g. waterborne disease outbreak, chemical spillage in catchment)*
- → Loss of critical infrastructure
- → Loss of critical human resources *(e.g. shelter-in-place restrictions, mass absenteeism)*
- → Conflict, war, sabotage, or cyberattack
- → Mass migration event
- → Epidemic or pandemic
- → Climate change
- → …

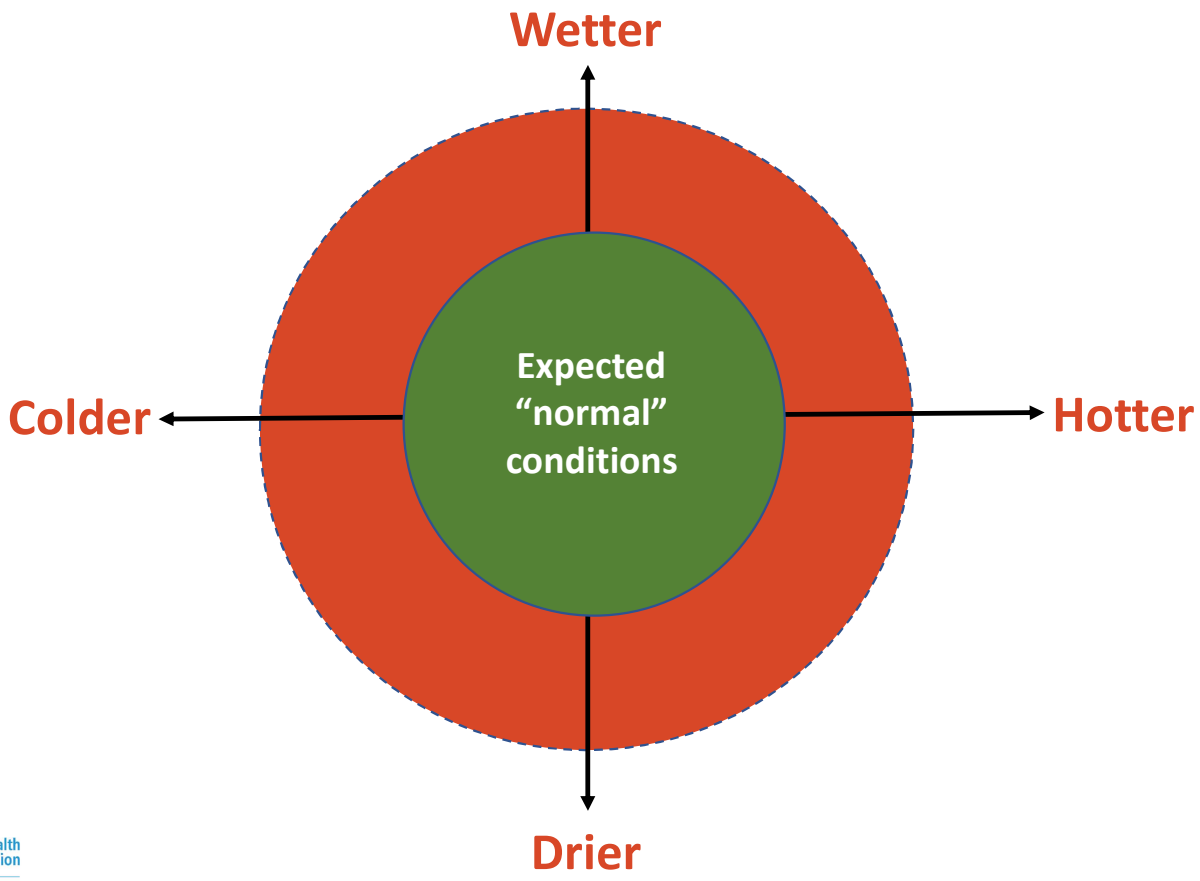
2.1 Resilience to change and uncertainty

Examples of future water supply system changes and uncertainty



2.1 Resilience to change and uncertainty

Climate change can cause hazards and risks to change over time



Future boundaries for extreme events are uncertain.

Risk-based surveillance can help monitor and anticipate these changes to help timely action.

2.1 Resilience to change and uncertainty

Risk-based surveillance anticipates future change

Surveillance agencies have an important supporting role in …

- Identifying and tracking longer-term changes and associated risks
- Supporting projection of locations and scale of risks to water quantity and quality
- Tracking progress on risk mitigation efforts to ensure timely adaptation

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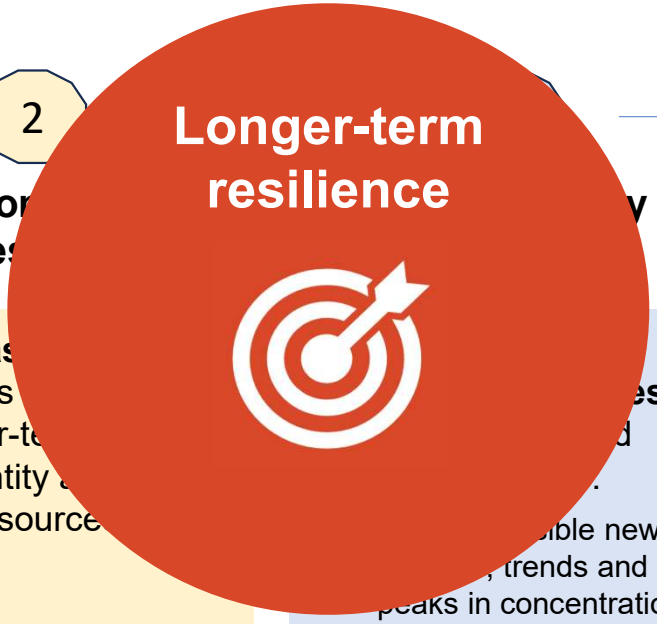
2.1 Resilience to change and uncertainty

Role of surveillance agencies in longer-term planning for change



1 **Proactively participate**

Proactively participate in processes to ensure drinking-water risks are considered in longer-term planning (e.g. water resource plans, drought management plans)

2 **Pro… asse…**

Promote as… the hazards … from longer-t… in the quantity … of water resource…

…es to …d …ible new …, trends and …eaks in concentrations

- share this information and its interpretation

4 **Advise**

Advise if regulations and drinking-water quality standards merit updates in response to concerns anticipated for new parameters or changes to parametric values

2.1 Resilience to change and uncertainty

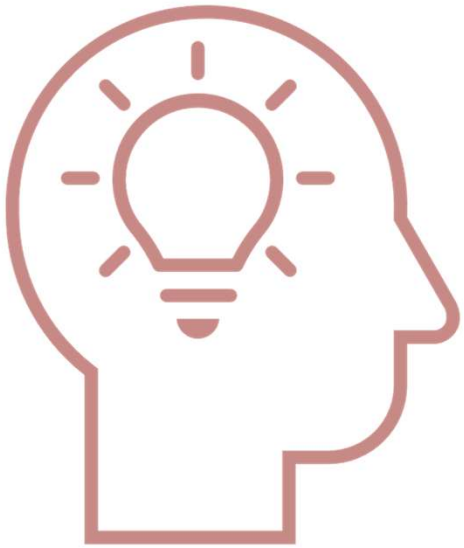
Role of surveillance agencies in longer-term planning for change

Surveillance agencies can build resilience through:

- → Adapting surveillance activities and monitoring as required based on anticipated threats
- → Undertaking investigative monitoring and research
- → Promoting consideration of health risks in the local-level WSP resulting from longer-term changes
- → Advising water suppliers on necessary actions to enhance resilience, including emergency preparedness and response

RECAP – Surveillance for enhanced resilience to change and uncertainty

- Risk-based surveillance strengthens resilience by tracking long-term and emerging risks
- Surveillance can help monitor and anticipate these changes to help timely action
- Collaboration and data sharing across sectors help identify trends and guide preparedness and response actions
- Surveillance findings inform updates to water quality standards and contingency planning



Forthcoming training package

Strengthening drinking-water quality surveillance using risk-based approaches

Strengthening drinking-water quality surveillance using risk-based approaches

Course overview

- → Introduces the principles and practice of risk-based drinking-water quality surveillance
- → Covers rationale, core components, and application
- → Includes a special focus on small supplies

Strengthening drinking-water quality surveillance using risk-based approaches

Learning objective

Strengthen understanding of risk-based surveillance and build capacity towards enhanced public health protection

Based on experiences at the Nordic-Baltic Network meeting, Estonia, 2024

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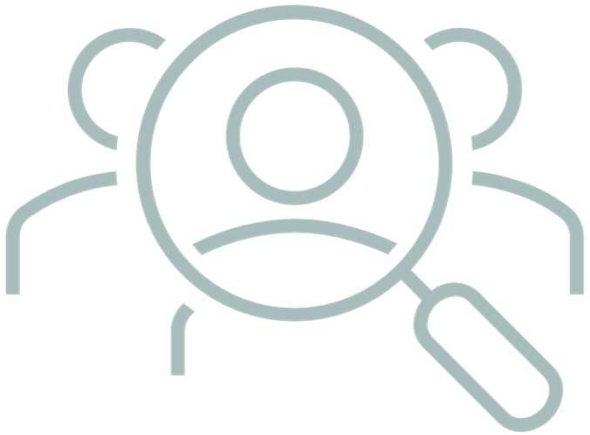
Strengthening drinking-water quality surveillance using risk-based approaches

Target audience

- → Surveillance officers and public health practitioners
- → Decision-makers and regulators setting priorities and strengthening surveillance
- → Those supporting implementation of risk-based surveillance



Strengthening drinking-water quality surveillance using risk-based approaches

Course outline

Module 1	Why do we need a risk-based approach?
Module 2	What is risk-based surveillance?
Module 3	How to link risk assessment outcomes to surveillance?
Module 4	What to monitor?
Module 5	Where to monitor and how often?
Module 6	How to assess risk management practices by the water supplier?
Module 7	How to use surveillance findings to take progressive action and build resilience?

Forthcoming training package

Strengthening drinking-water quality surveillance using risk-based approaches

→Launch: 6 November 2025

→Will be available on the WHO/Europe website

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Emergency preparedness in conflict contexts

Water suppliers could maintain safe and adequate water supply during complex emergencies. or conflict

Surveillance agencies could continue effective monitoring and reporting during complex emergencies/conflict situations to inform rapid action

There would be sufficient coordination between health, water and civil protection sectors for complex or conflict-related emergencies

Strongly disagree

Strongly agree

PUBLISHED MAY 2025

- → Presents checklists designed to strengthen emergency preparedness and response of WASH services at the local level
- → Prepared in the context of the war in Ukraine in consultation with national stakeholders
- → Can be adapted to support more resilient WASH service delivery in other countries

Many considerations are relevant to general emergency readiness, not just in conflict contexts!

3. Tool to support emergency readiness

Purpose and scope of the WASH emergency readiness checklists

- Support preparatory activities to minimize risks from potential future impacts of attacks on WASH services; and/or
- Response activities after an attack has occurred and normal service is disrupted.

3. Tool to support emergency readiness

Highlights impact of conflict on WASH services

Table 1. Examples of impacts from the war on WASH services in Ukraine

WASH service impacts from the war	Relative intensity of the impacts by situational group			
	Less frequently attacked areas	More targeted areas	Active combat areas	Areas not under Government control
Drinking-water quality deterioration • Damage/destruction from attacks causing leakage/runoff of c activities (e.g. industrial/manufacturing sites, military objects, f chemical storage facilities), contaminating water sources • Damage/destruction of wastewater/stormwater infrastructur sources • Damage/destruction of treatment and distribution infrastruct unsafe water supply (e.g. untreated or partially treated drinkin contamination into damaged distribution networks)				
Infrastructure damage • Combat operations directly damaging water and sewerage in treatment facilities, pipes, reservoirs, dams or pump stations), reductions in safe and adequate drinking-water and a lack of s safe faecal waste disposal • Corrosion of network assets due to emergency supply of non-p water • Challenges with repair/replacement of damaged infrastructur alternative arrangements, resulting in services remaining vuln breakdown				
Disruption of essential power supplies • Damage/destruction of essential infrastructure leading to disr (e.g. load shedding or blackouts) • Reduced treatment and pumping capacities during this time, delivery of safe and adequate WASH services (e.g. intermittent contamination due to depressurization of water networks) • Ongoing vulnerability due to challenges with implementing a arrangements due to high costs				
Disrupted logistics for materials • Supply chain disruption for WASH materials (including critical spare parts, treatment chemicals, disinfectants, testing equipment and reagents, hygiene products and delivery personnel) • Insufficient stockpiling and contingency planning due to staff attrition, and supply chain and financial constraints (see next row) • Delays in major ports and road crossings into Ukraine (due to blockades, attacks or mining), further complicating logistics and resource availability	++	+++	+++	Unknown
Reduced financing for services • Decreasing WASH service revenues due to a reduced population in affected areas and business closures, compounded by a moratorium on tariff increases, and rising costs to fund preparedness and response actions • Rising costs for repairing and restoring infrastructure in areas affected by military attacks, along with providing safe alternative and interim services • Rising costs for strengthening the resilience of WASH services against future attacks and procuring necessary materials (due to logistical challenges and the need to source materials from outside the country)	+	+++	+++	Unknown
Displaced populations and workforce availability • Significant population displacement altering demand for WASH services and affecting workforce availability, resulting in an impact on capacity to operate and maintain systems • Some areas (e.g. western Ukraine) facing demands on WASH systems that exceed their design capacity, while eastern regions and war zones experience reduced demand and personnel shortages	+++	+++	+++	Unknown
Negative societal impacts • Authorities forced to implement emergency-level WASH service targets, reducing service standards (e.g. having access at home to safe and adequate drinking-water when needed, functioning flushable toilets and solid waste collection), leading to populations being more vulnerable to serious health effects	+	+++	+++	Unknown

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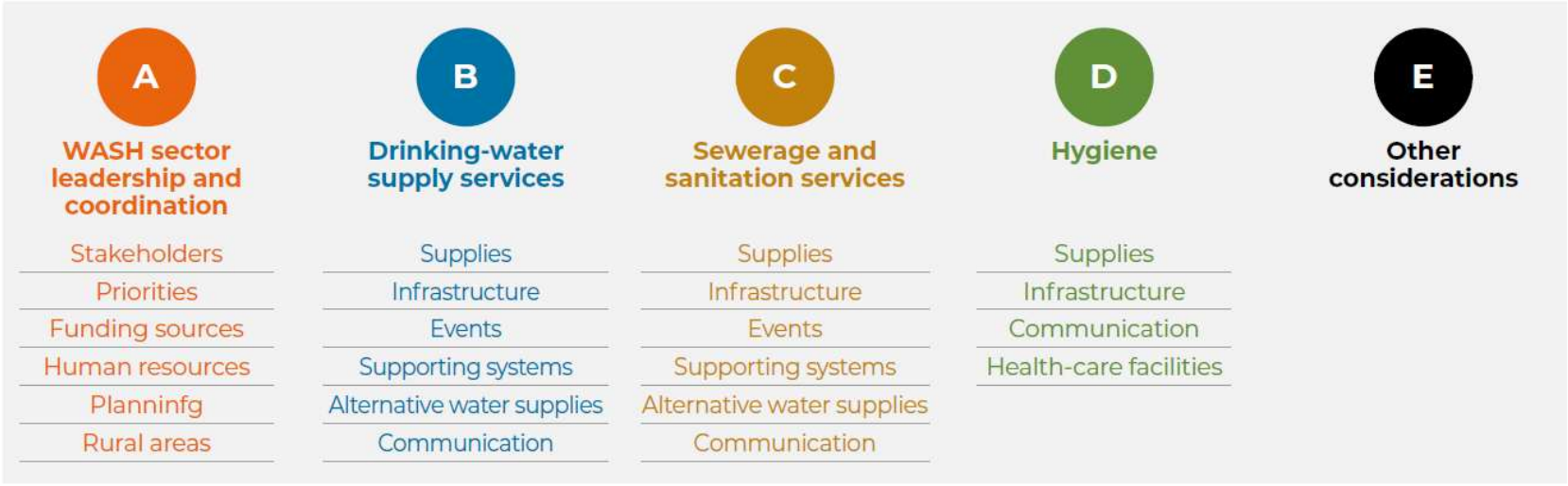
3. Tool to support emergency readiness

Checklist structure - categories and sub-categories

Fig. 1. Broad structure of the checklists



….structured according to individual service provision and enabling considerations

3. Tool to support emergency readiness

Organization of the checklist items and application

Fig. 2. Organization of checklist items

….questions posed alongside the health context, and checklist of key considerations

3. Tool to support emergency readiness

Example checklist questions and guidance

No.	Question on drinking-water supply	Relevance to health	Key considerations	Identified gaps *(example response)*	Actions *(example response)*	Stakeholders *(example response)*
7.	Are plans in place to prepare for, and respond to, **loss of access and isolation** of **centralized** water treatment works and other infrastructure (such as storage tanks and pumps) due to bridges or roads being impassable or mined?	Inability to access the water infrastructure to operate it can lead to inadequate quantities of microbiologically safe and acceptable drinking-water, and thus to illness.	• Are backup plans in place to access sites if roads or bridges are lost or made impassable, or are not safe to access?	*One of our treatment plants requires at least daily attendance via just one road.*	*We can station operators at the empty apartment next door to the treatment plant.*	*Vodokanals*

PRE-POPULATED

COMPLETED AS PART OF THE EXERCISE
(example response given)

3. Tool to support emergency readiness

Example checklist questions and guidance

3.B Drinking-water supply services checklist

No.	Question on drinking-water supply	Relevance to health	Key considerations	Identified gaps *(example response)*	Actions *(example response)*	Stakeholders *(example response)*
Supplies						
1.	Are plans in place to prepare for, and respond to, a ***temporary*** **loss of electrical power** supply to **centralized** systems for a few hours or days?	Power is often required for water treatment and disinfection, to maintain system pressure to stop contamination entering the distribution system, and to maintain a continuous supply of adequate quantities of safe and acceptable drinking-water. Thus, loss of power can lead to microbiologically unsafe drinking-water, or result in inadequate quantities of water for domestic needs (e.g. hydration and hygiene) and use of less safe alternative sources, which in turn can cause illness.	• What actions are undertaken in anticipation of possible power failure, such as keeping water storage facilities as full as possible, and reconfiguring the system to run off gravity where practicable? • What are the backup power supply options, such as batteries or generators; what is their capacity; and is this sufficient to meet critical power needs? • How long can the facility operate without power, based on available fuel supplies and/or system storage? • How sufficient is the generator fuel supply (including available funds, supply route/chain and safety/security of storage)? • What human resources are available to manage backup power supplies (including routine maintenance and testing)? • What communication protocols are available with energy generators and distribution system suppliers?	*We have generators but no spare fuel or safe place to store it.*	*We need to find a way to store fuel without it being a fire hazard.* *We need to build a protective shelter to shield fuel from direct hits.*	*Power generators, power distributors and vodokanals*

3. Tool to support emergency readiness

Example checklist questions and guidance

No.	Question on drinking-water supply	Relevance to health	Key considerations	Identified gaps *(example response)*	Actions *(example response)*	Stakeholders *(example response)*
Events						
10.	Are there means in place to monitor and ensure the supply of **safe drinking-water during an event**?	Microbiological and other forms of contamination of water can pose a threat to public health. Prevention of contamination is dependent on being able to monitor and control the system.	• Is there access to secure and reliable remote telemetry for monitoring and control of water treatment processes? • Is there access to basic field testing kits for monitoring critical treatment processes (e.g. pH of coagulant-dosed water, filtered water turbidity, treated water free chlorine residual and pH)? • Is it possible to undertake visual and manual operational checks (e.g. to check floc formation, filter height, filter bed distribution following backwash, pressure and flow rates, and perform visual checks on treated water storage covers)? • Is it possible to survey key water distribution assets, such as above ground storage tanks, underground storage tanks and buried transmission lines for signs of damage?	*We have a manual operational monitoring plan for the plant that we used to use before we got SCADA, but we have lost the skills.*	*We can update the manual operating manuals and practise operating in manual mode to allow supply to continue if we lose SCADA.*	*Vodokanals*

3. Tool to support emergency readiness

Guidance on setting priorities for action – simplified approach

Priority level	Priority descriptor	Example guiding definition for descriptor[a]
High	Clear priority: requires immediate action	Failure to implement the improvement action may result in an immediate and major threat to public health (e.g. illness in the community as a result of faeces contaminating water supplies, food or hands, or from acute or longer-term exposure to a priority chemical) and prolonged loss of safe and adequate WASH services (e.g. damage to service reservoir, loss of sewage treatment capacity, longer-term outage of a critical treatment chemical or ruptured main supply pipeline) for the majority of the local population.
Medium	Medium- or long-term priority: requires some attention	Failure to implement the improvement action may result in a moderate impact on adequate WASH service delivery (e.g. shorter-term power outage, medium-term outage of a non-critical consumable item or non-health-related aesthetic issues in the water supply) for some of the local population.
Low	Not a priority in the short term	Failure to implement the improvement action may result in a minor or negligible impact on adequate WASH service delivery (e.g. a non-health-related water quality issue or some manageable disruptions to operations or supply chains) for a small section of the local community.
Unsure	Additional information required to inform a priority level	Further data collection, information gathering and/or broader stakeholder consultation is required to ascertain the priority level. Some no- or low-cost actions can be taken in the interim, targeting improvements that are considered no-regret/low-regret options based on the current understanding of the situation.

….priority level assigned based on team judgement

3. Tool to support emergency readiness

Guidance on setting priorities for action – more sophisticated

Possible improvement actions identified to address a gap	Impact of improvement	Time frame to implementation	Practicality	Cost	Availability of partner support	Score	Priority
Three-category rating scale	*1 Low 2 Intermediate 3 High*	*1 Long 2 Intermediate 3 Short*	*1 Low 2 Intermediate 3 High*	*1 High 2 Intermediate 3 Low*	*1 Low 2 Intermediate 3 High*		
Weighting of criterion	*× 3*	*× 2*	*× 1*	*× 1*	*× 1*		
a. Install generator plug-in points at all critical powered infrastructure, and obtain backup generators on trailers to be located at short notice to key locations	3 High	3 Short	2 Intermediate	2 Intermediate	3 High	22	High
b. Construct sewage containment pondage in case of sewage treatment plant failure	2 Intermediate	1 Long	1 Low	1 High	1 Low	11	Low
c. Stockpile sanitation and hygiene products locally in case of areas becoming inaccessible	2 Intermediate	2 Intermediate	2 Intermediate	2 Intermediate	3 High	17	Medium

Priority ranking key:

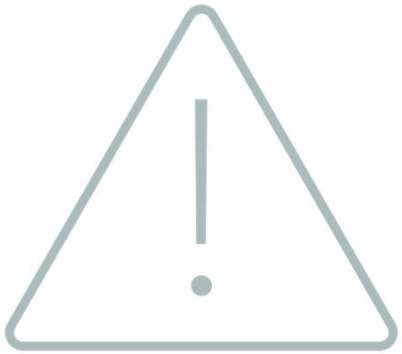
8–12 Low	12–18 Medium	19–24 High

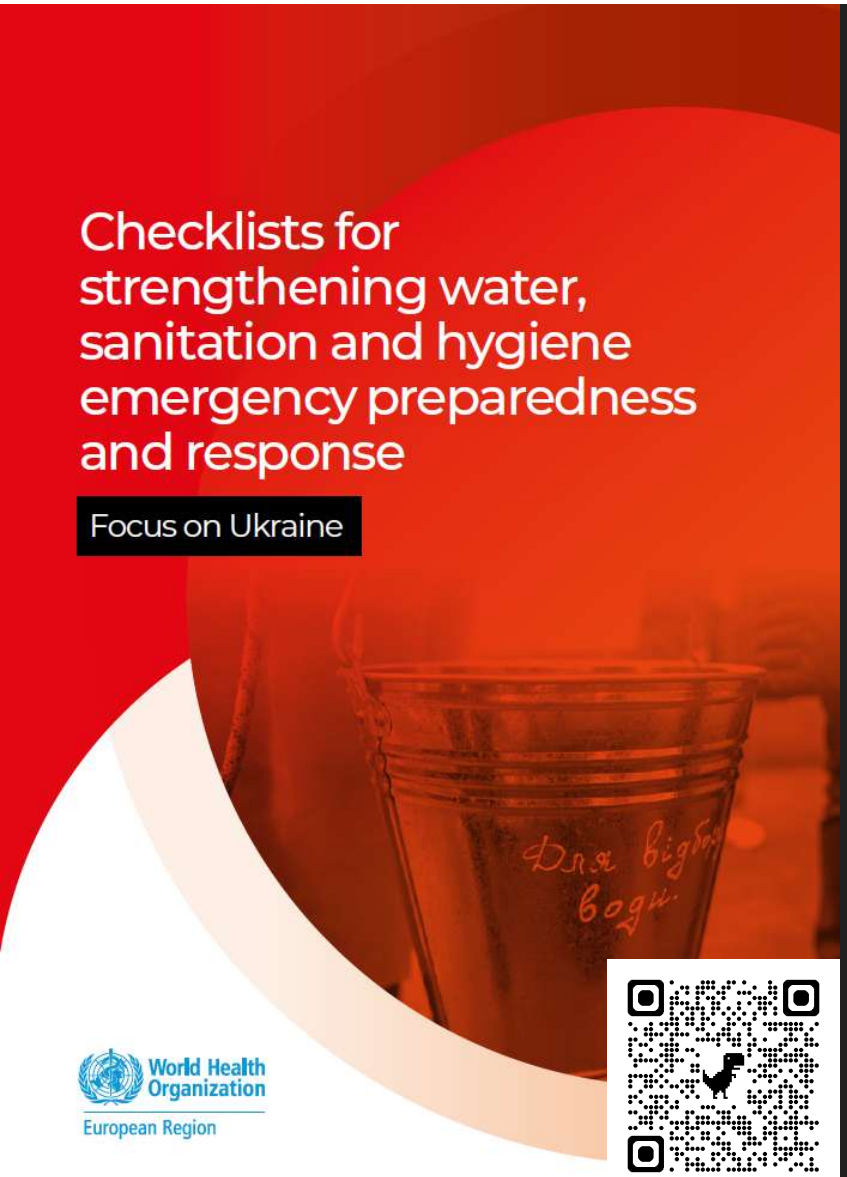
….prioritization based on scoring of weighted criteria relevant in the local context

3. Tool to support emergency readiness

Output – improvement action plan to address priority concerns

No.	Improvement action	Reason for the action	Responsible party/parties	Source(s) of funding	Due date	Status
Example	*Protect vulnerable lengths of pipe and infrastructure by burying them or covering them with sandbags*	*Most of the infrastructure is underground, but a few vulnerable points are above ground and vulnerable to strikes*	*Vodokanal employees and local government staff to coordinate, with community members and volunteers to help deliver*	*Vodokanal operational budget, to be supplemented with financial assistance from oblast level*	*Within three months*	*In progress: vulnerable single points of failure identified, and approximately 20% of those points now protected*





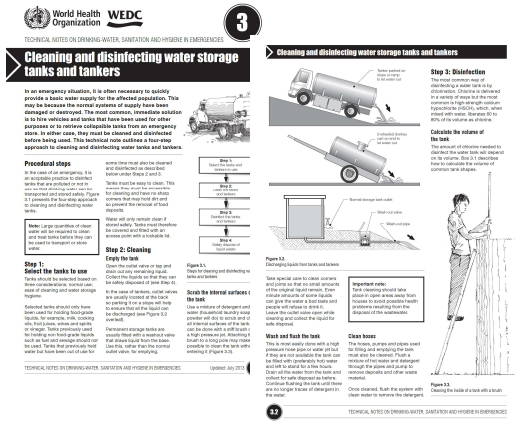
AVAILABLE FORMATS

PDF

W

→ *Supports adaptation to local contexts*

Additional WHO resources to support emergency readiness



WHO/WEDC Technical notes on emergencies (2013)

Strengthening surveillance using risk-based approaches (2019)

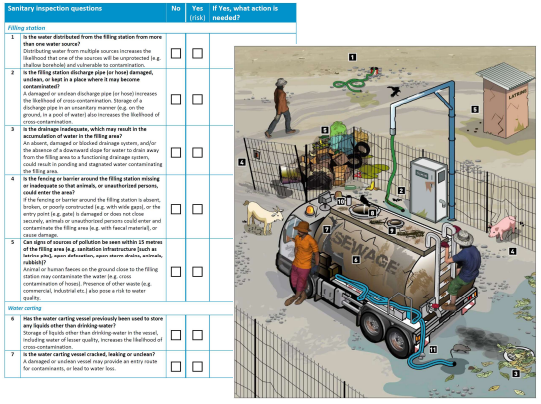
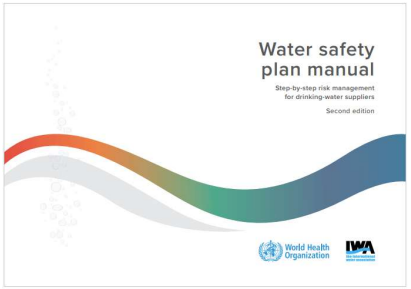


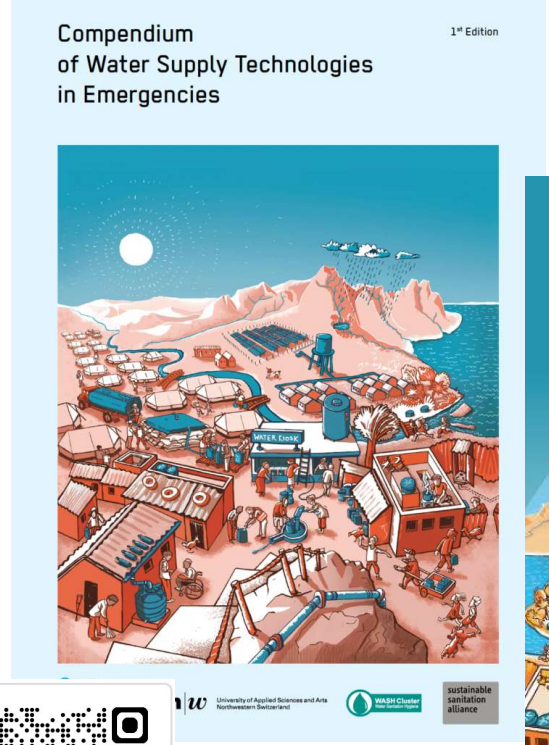
Figure 1. Typical risk factors associated with a filling station and water carting chain.

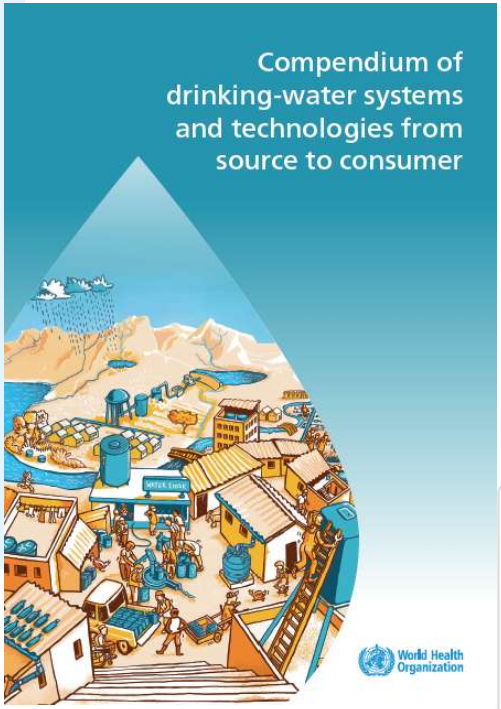
Sanitary inspection packages (2024)

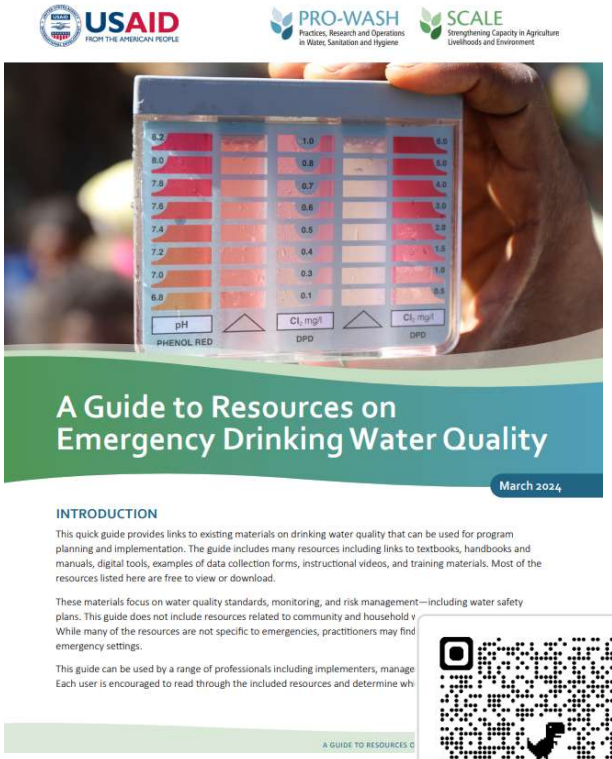


Water Safety Plan Manual, second edn. (2023)

Additional resources to support emergency readiness








thank YOU!
World Health Organization
European Region
Prepare for the worst.
Hope for the best.
EMERGENCY WATER
DISTRIBUTION UNIT
Credit: SCG Processes

Discussion starters ▶
Resilience building in your country context

What needs to be done to better prepare for emergencies and enhance resilience in your context?

What are the main barriers preventing stronger coordination between surveillance agencies and water suppliers with regards emergency planning and response?

What support or collaboration is needed to strengthen emergency preparedness and response planning? How can the Nordic-Baltic Network better support each other?