Water and sanitation safety planning for climate resilience

Overview and supporting resources

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World Health Organization

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#WaWF23


Climate change is having a profound impact on our ability
to provide access to safe and effective WASH services
Credit: Ian Paterson/flicker.com


Considerable uncertainty exists regarding the magnitude of climate impacts on WASH service delivery
Credit Job de Graff/flicker.com

How best to manage current and future risks from climate variability & change?

Credit: Simone D. McCourtie/World Bank

Overview

Explore tools to strengthen the resilience of water & sanitation systems

1. Water safety planning

2. Sanitation safety planning

Water & sanitation safety planning towards climate resilience

- WHO promotes a risk-based approach:
  - **Water safety planning (WSP)**
  - **Sanitation safety planning (SSP)**

- Frameworks for the **proactive management** of climate related-risks

- Desire for more resilient systems has been a recent driver for uptake of WSPs & SSPs

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Overview

Explore tools to strengthen the resilience of water & sanitation systems via

1. Water safety planning

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What is a *Water safety plan*?

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A comprehensive
risk assessment & risk management
approach that includes ***all steps*** *in the water supply*

"Most effective means of consistently ensuring the safety of drinking-water supply"[1]


Credit: Shutterstock

[1] WHO (2022). Guidelines for drinking-water quality

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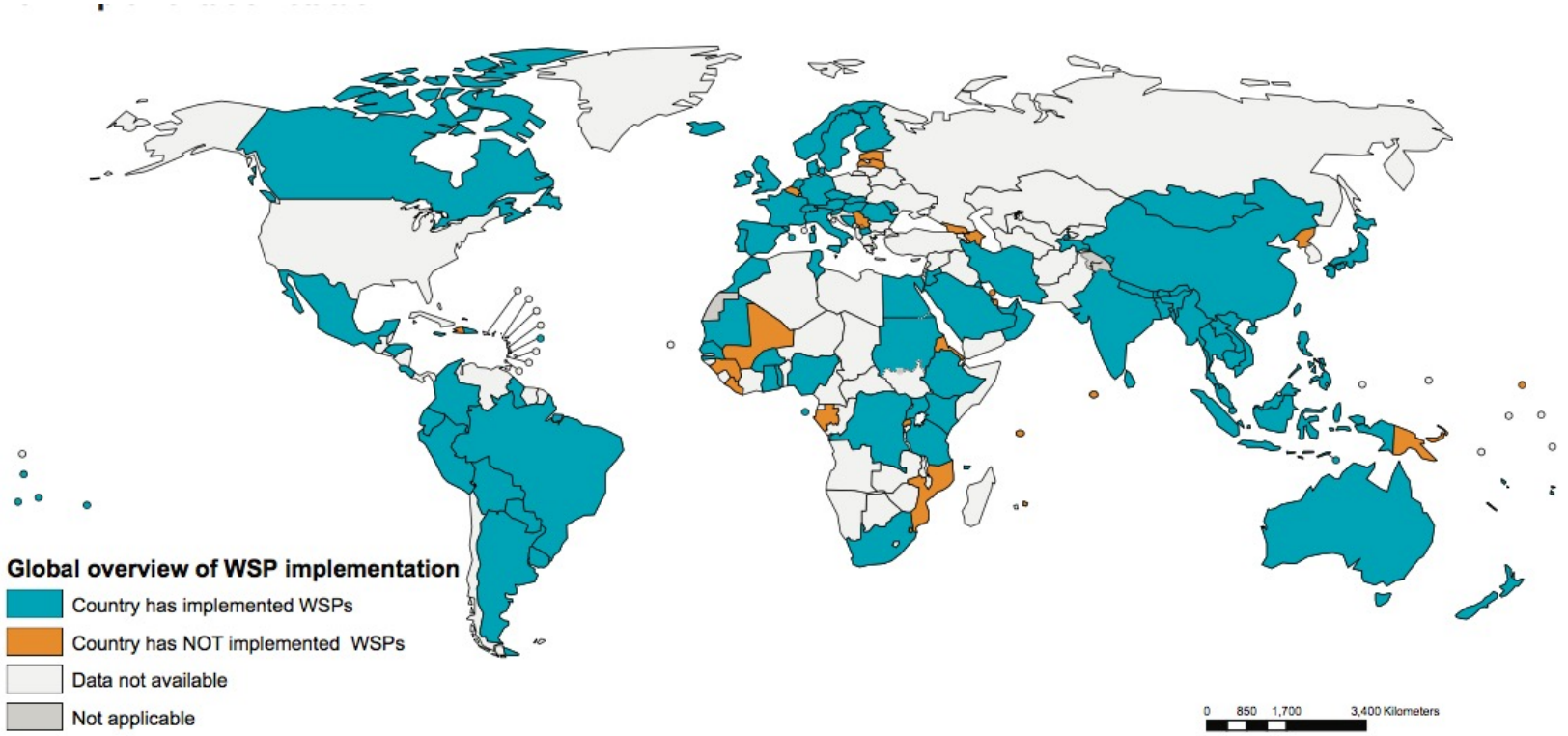
Water safety plans - Global perspective



93 *countries have implemented WSPs*

WHO & IWA (2017) Global status report on water safety plans. Geneva, Switzerland.

Benefits of water safety planning

World Health Organization

- ☑ **Improved staff awareness of critical processes & water safety** (e.g. Byleveld et al., 2016; WHO, 2018)
- ☑ **Enhanced proactive management of water supply hazards** (e.g. Curk et al., 2006; WHO, 2011; Mayr et al., 2012)
- ☑ **More effective management of emergency situations** (e.g. Byleveld et al., 2016)
- ☑ **Greater cost efficiency** (e.g. WHO, 2018; Kumpel et al., 2018)
- ☑ **Improved water quality & regulatory compliance** (e.g. Setty et al., 2017; WHO, 2018)
- ☑ **Improved public health outcomes** (e.g. Gunnarsdóttir et al., 2012; Setty et al., 2017)
- ☑ **Increased consumer confidence** (e.g. Samwel et al., 2010; Lucentini et al., 2016)

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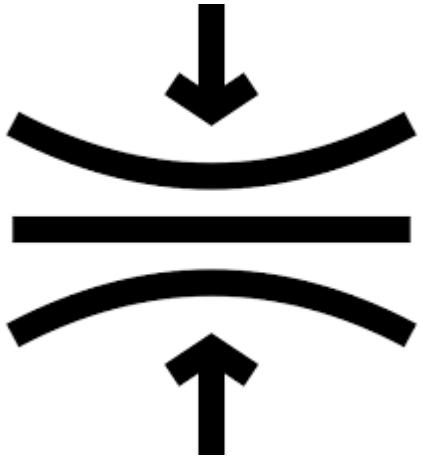
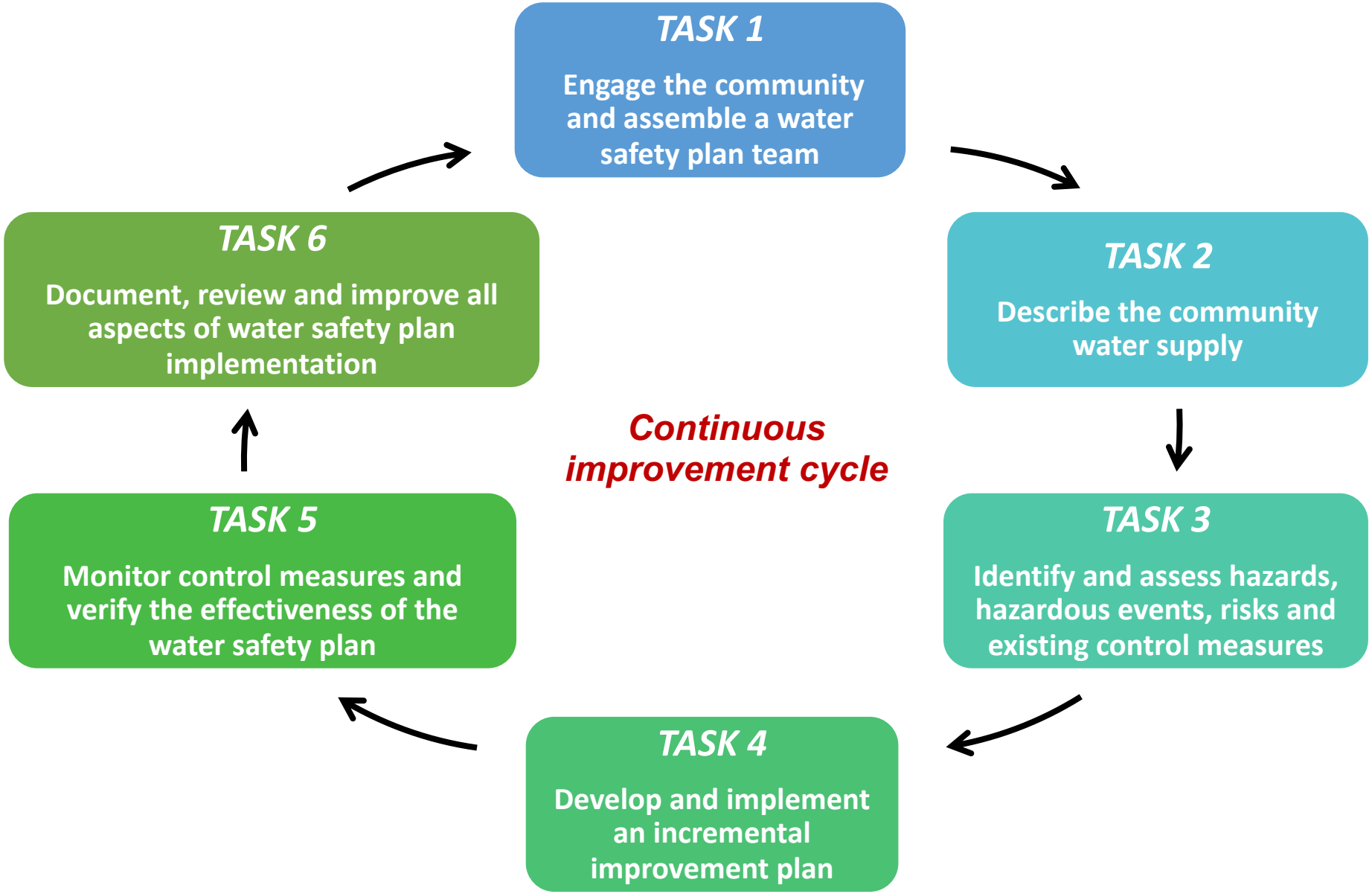
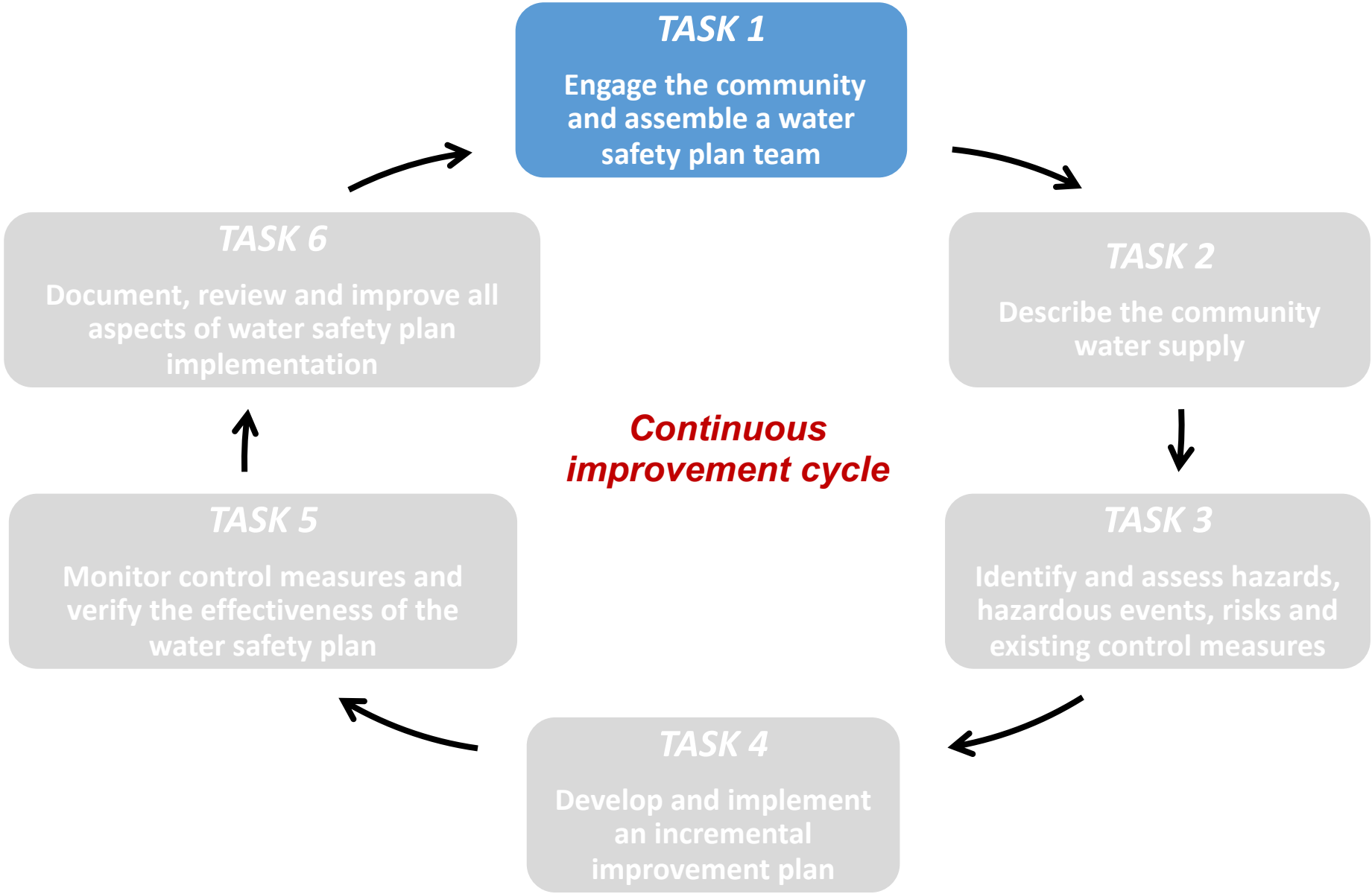
Water safety plans **provide a proactive risk management approach for** ***enhanced resilience***



Integrating CLIMATE RESILIENCE into the WSP approach



Integrating CLIMATE RESILIENCE into the WSP approach



Task 1: WSP team assembly

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Platform to engage necessary expertise to integrate climate considerations into WSP e.g.

- Local bureaus of meteorology, hydrology
- Community members with knowledge of catchment
- Adaptation/disaster/emergency planners
- Public health and climate change specialists
- Sanitation safety planning team…

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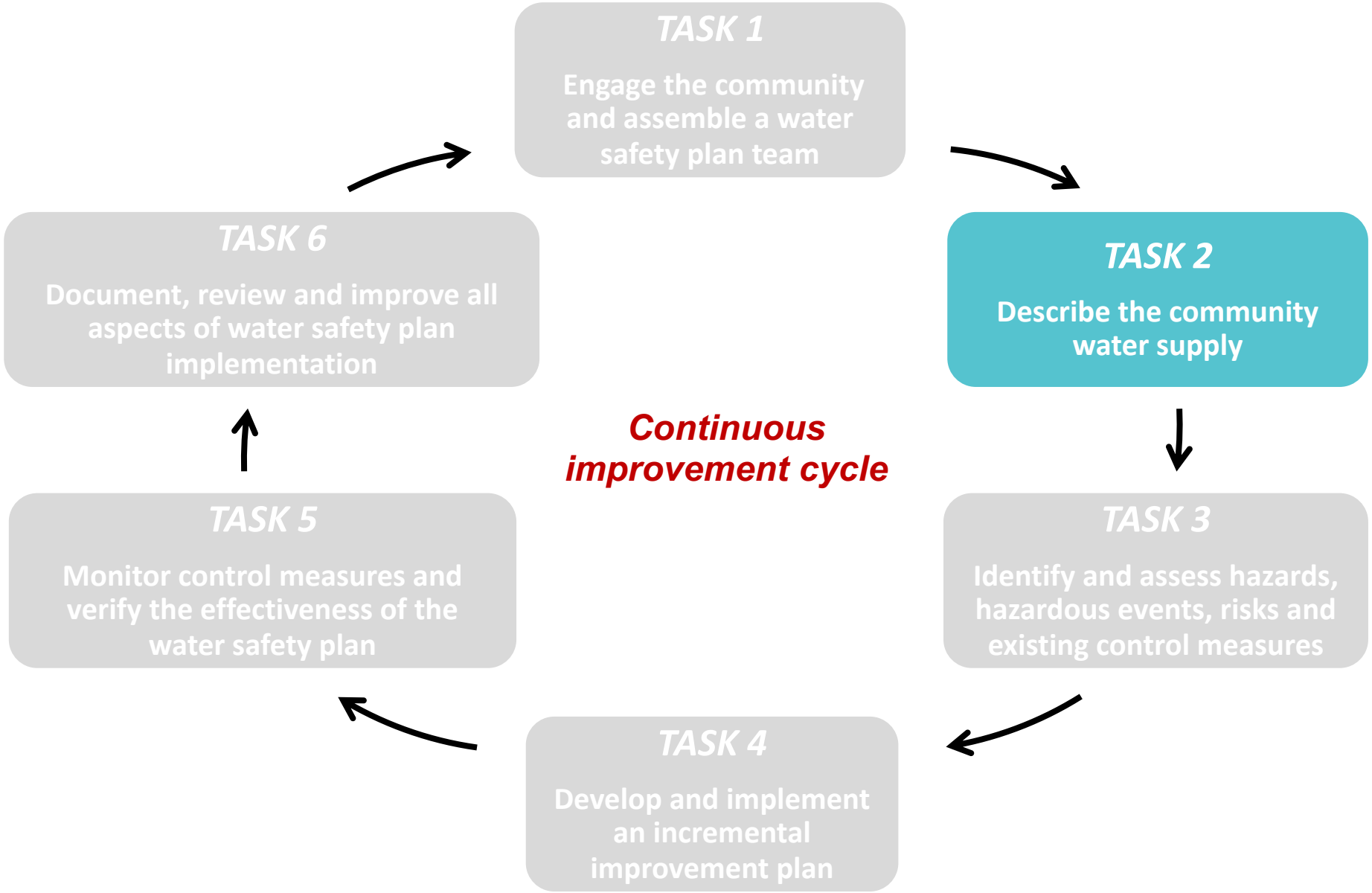
Integrating CLIMATE RESILIENCE into the WSP approach

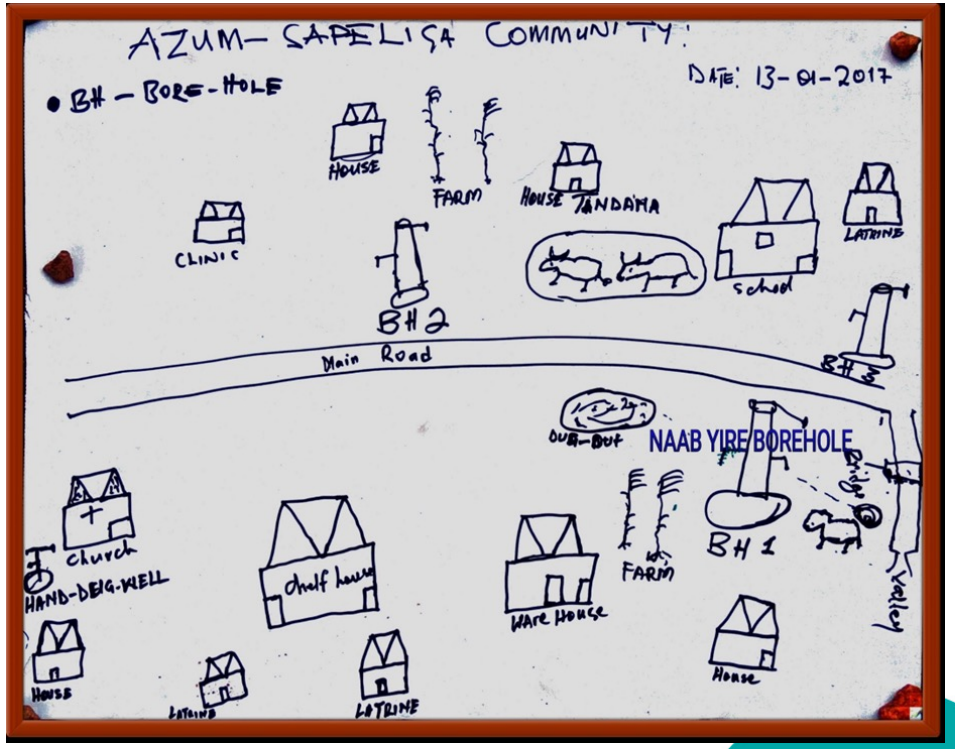


Task 2: Describe the water supply

Describe the entire water supply, capturing climate information that will support the identification of threats and assessment of risks…

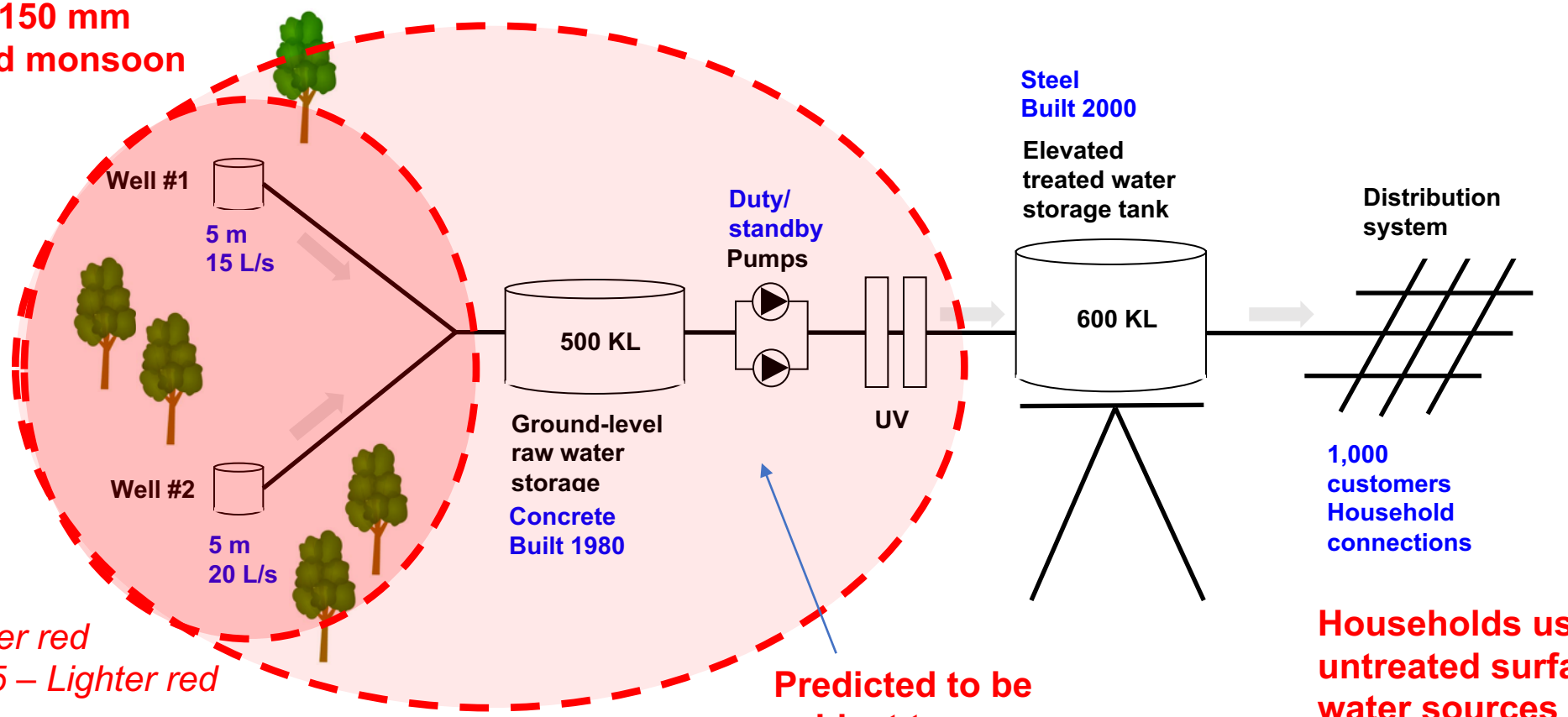
For example:

- ☑ History of seasonal and extreme weather events and future projections
- ☑ Current reliability of water sources, typical yields and future projections
- ☑ Trends in land use, water abstraction and population impacting water resource demand
- ☑ Potential new or alternative (including emergency) water sources
- ☑ Implications of projections on the water supply, inclusive of ***vulnerable or disadvantaged populations***



Climate considerations

Annual rainfall:
2023 – 75 mm
2033 – 150 mm
Delayed monsoon



Demand > supply by 2028

Flood zone:
Current – darker red
Projected 2025 – Lighter red

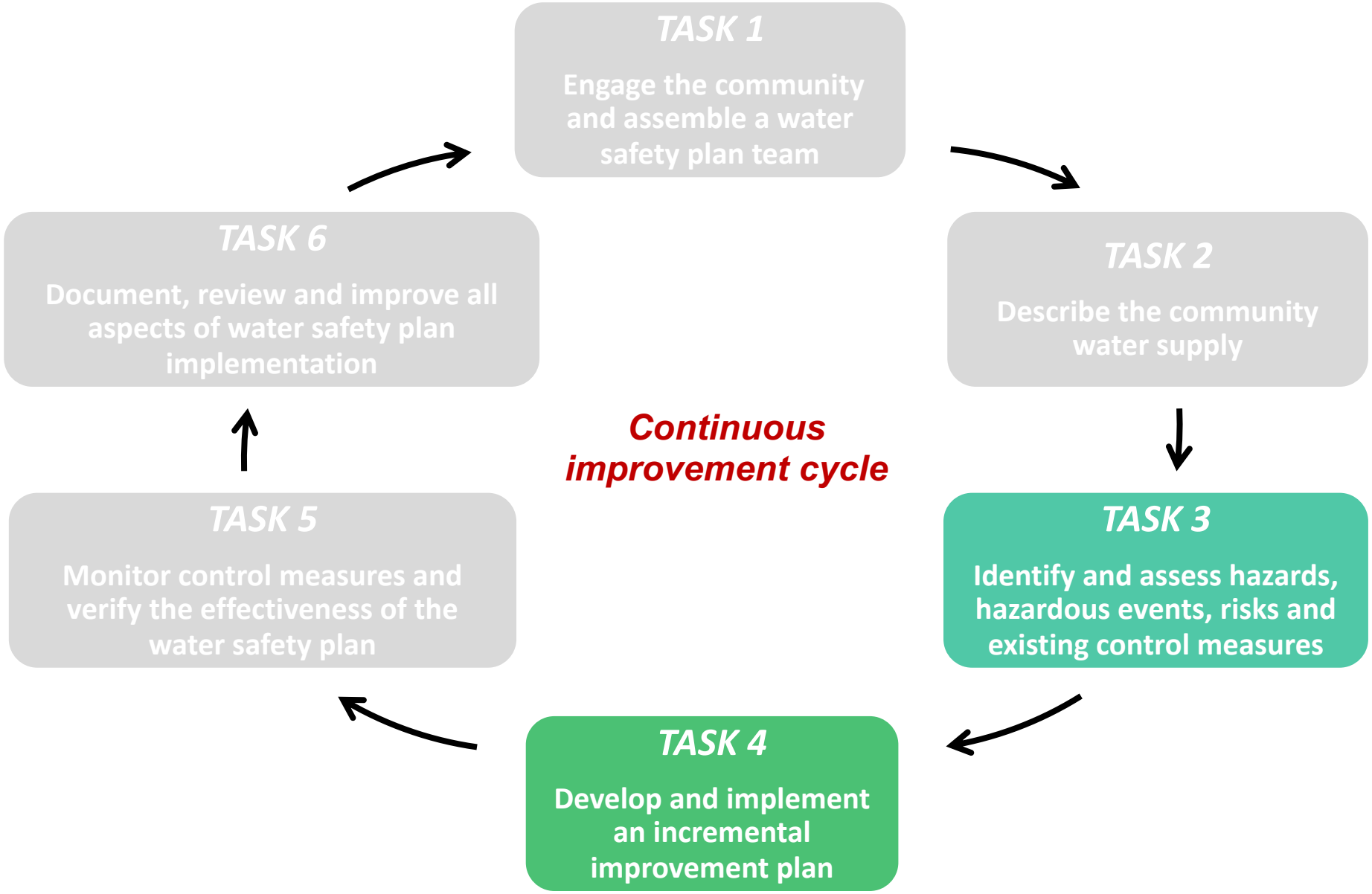
Predicted to be subject to inundation by 2030

Households use untreated surface water sources during flood

Well #3
Potential future water source (high fluoride)
60 m
20 L/s

Raw Water → **Treated Water**

Integrating CLIMATE RESILIENCE into the WSP approach



Task 3 & 4

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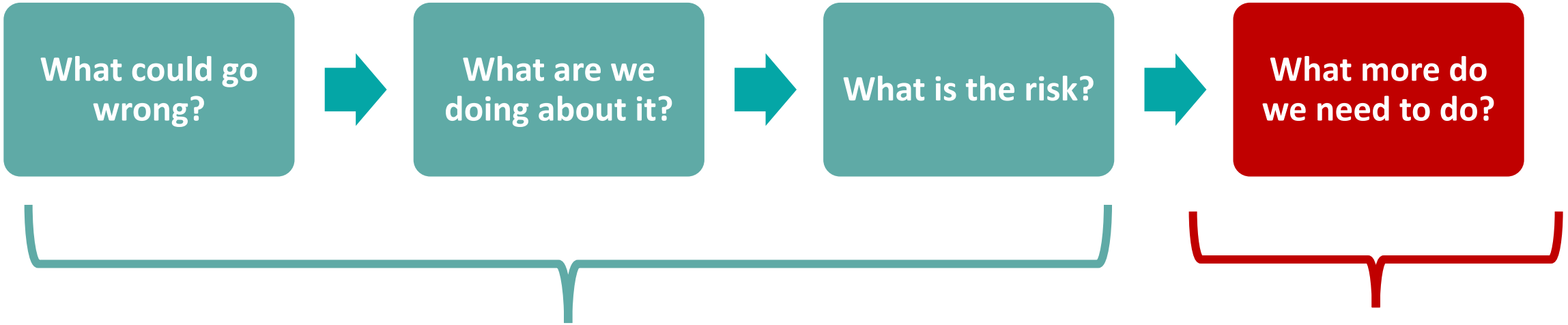

Identify hazards, assess control measures & prioritize the risks

Task 3

Plan for improvements

Task 4

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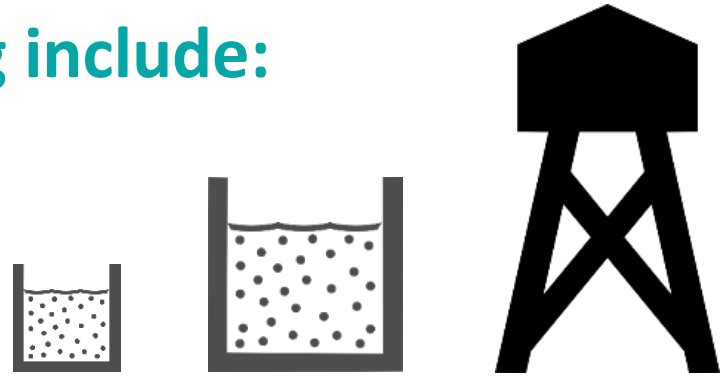
Task 4: Prioritization of significant climate risks supports incremental improvement planning

Examples of climate resilient improvement planning include:



Designing adaptable/resilient infrastructure

- e.g. enhanced storage capacity; elevating critical assets above flood-level

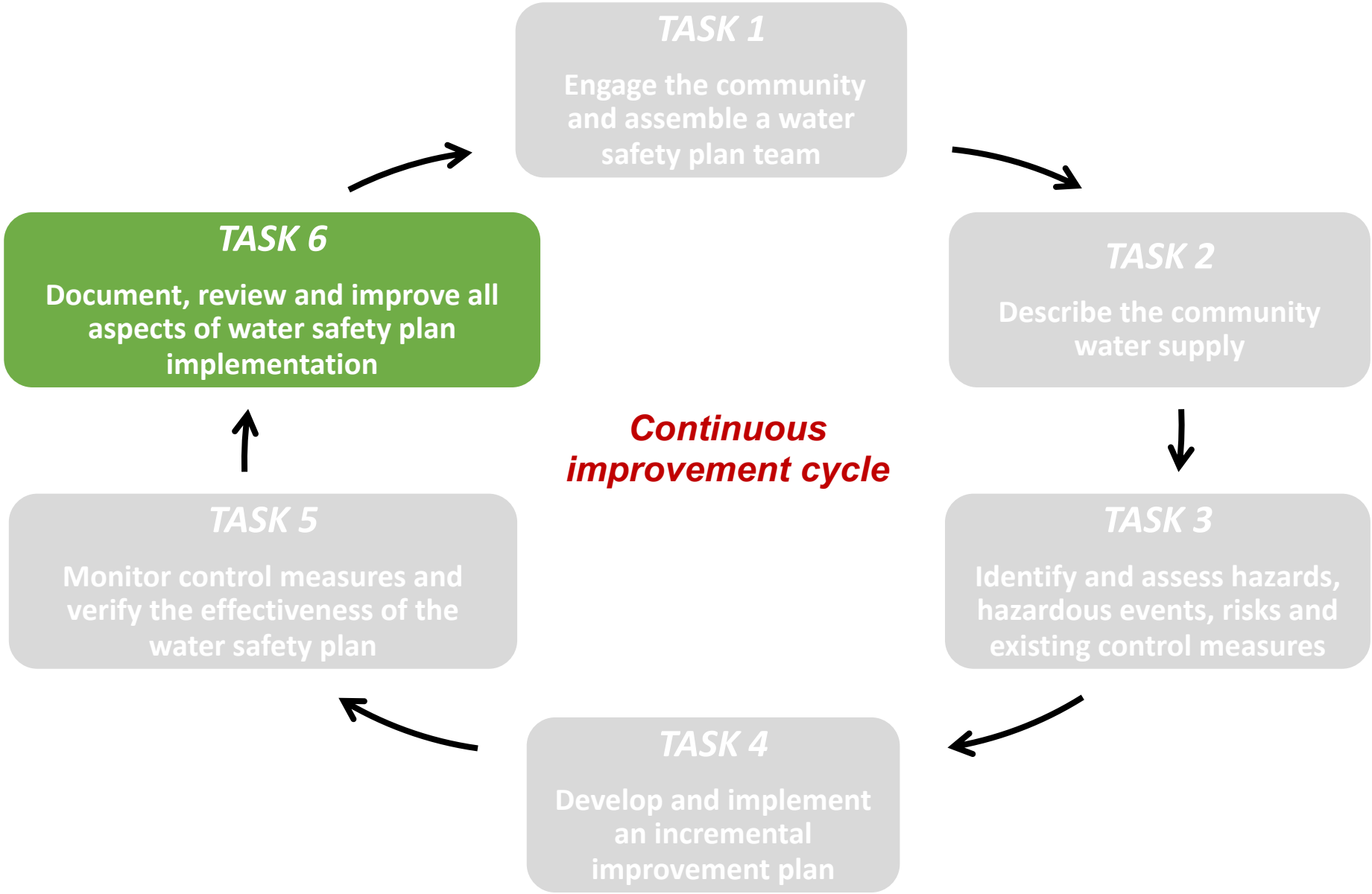
Utilizing a range of options to achieve an outcome

- e.g. diversifying use of water sources

Supporting infrastructure with non-infrastructural measures

- e.g. actions to influence usage/behaviour

Integrating CLIMATE RESILIENCE into the WSP approach



Task 6: Management procedures

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Management procedures can consider climate-related emergencies

↳ Emergency response planning supports preparedness for climate-related incidents, extreme events & disasters

Credit: UNICEF Pakistan/2012/Asad Zaidi

Emergency plans ensure rapid & effective responses:

- ☑ Response actions (including monitoring)
- ☑ Roles/responsibilities (internal/external)
- ☑ Communication, notification protocols
- ☑ Emergency/alternative water supplies

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World Health Organization

TASK 6: Supporting programs

Supporting program can build capacity to manage climate-related risks

Capacity building programs

- e.g. safe household practices during an emergency event

Stakeholder engagement and outreach programs

- e.g. building partnerships for improved source protection

Targeted investigations

- e.g. potential impacts of an alternative water source on quality and quantity

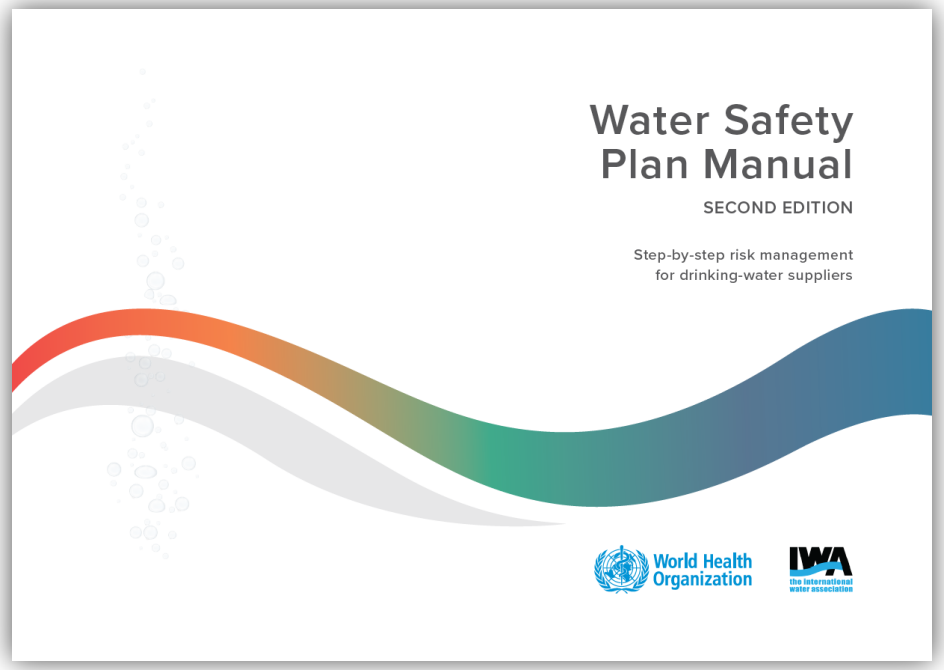
Effective water safety planning for climate resilience

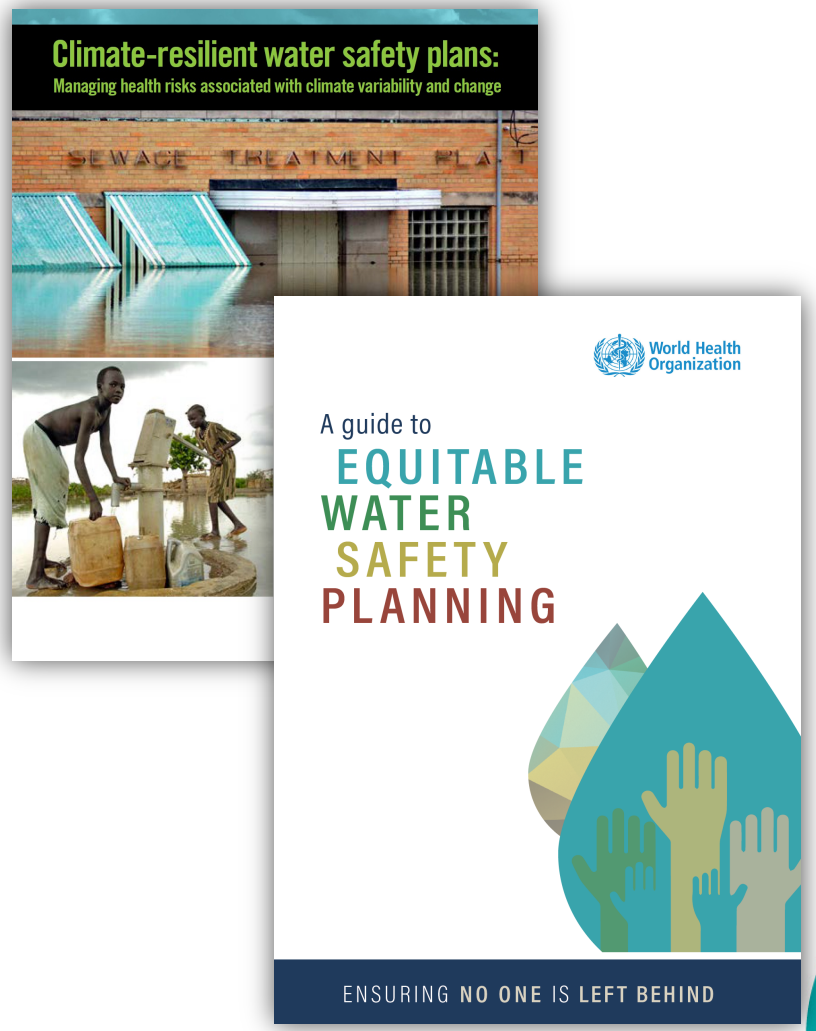
- Start simple, seek ad hoc support where needed, and **progressively improve** over time
- Where resources/capacity are limited, approach should **be pragmatic**
- Ensure that the **WSP is dynamic** with regards to new information available
- Consider “no-regret/low-regret” improvement measures with **adaptable improvement planning**

Further guidance on water safety planning…

World Health Organization

WSPs for larger supplies…





LAUNCHING MARCH 2023!!!

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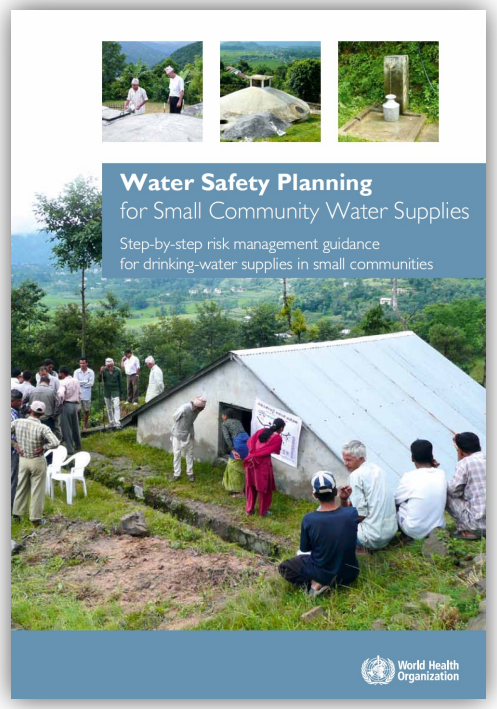
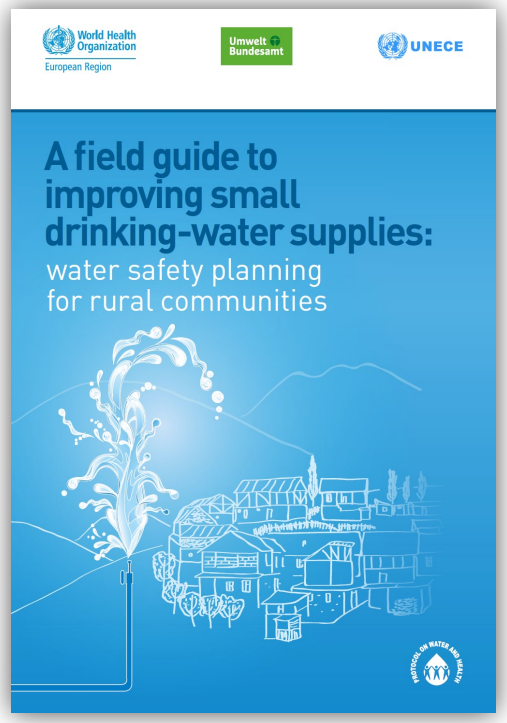
Further guidance on water safety planning…

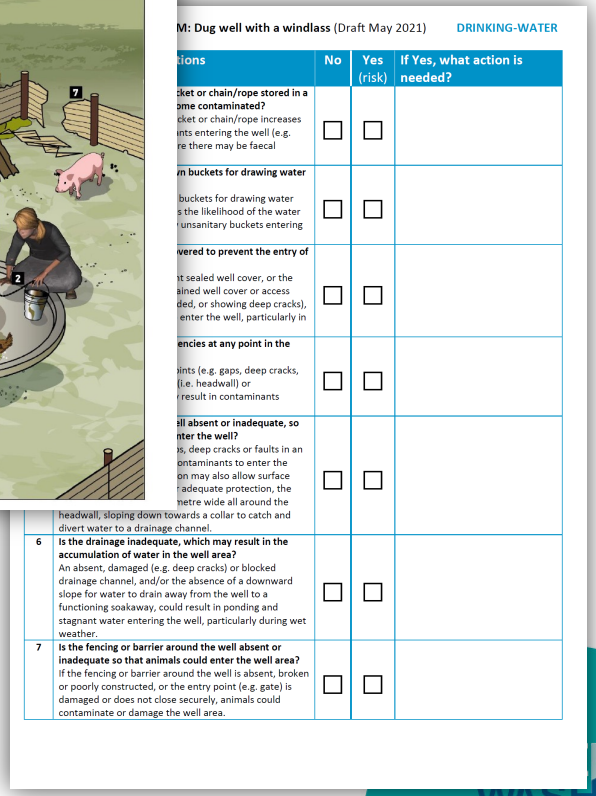
…WSPs for small supplies





2nd edition launched 2022

Revised sanitary inspection packages for drinking-water



M: Dug well with a windlass (Draft May 2021) DRINKING-WATER

	tions	No	Yes (risk)	If Yes, what action is needed?
	cket or chain/rope stored in a ome contaminated? cket or chain/rope increases nts entering the well (e.g. re there may be faecal	☐	☐	
	n buckets for drawing water buckets for drawing water s the likelihood of the water unsanitary buckets entering	☐	☐	
	vered to prevent the entry of t sealed well cover, or the ained well cover or access ded, or showing deep cracks), enter the well, particularly in	☐	☐	
	encies at any point in the nts (e.g. gaps, deep cracks, (i.e. headwall) or result in contaminants	☐	☐	
	ll absent or inadequate, so nter the well? s, deep cracks or faults in an ontaminants to enter the on may also allow surface adequate protection, the metre wide all around the headwall, sloping down towards a collar to catch and divert water to a drainage channel.	☐	☐	
6	**Is the drainage inadequate, which may result in the accumulation of water in the well area?** An absent, damaged (e.g. deep cracks) or blocked drainage channel, and/or the absence of a downward slope for water to drain away from the well to a functioning soakaway, could result in ponding and stagnant water entering the well, particularly during wet weather.	☐	☐	
7	**Is the fencing or barrier around the well absent or inadequate so that animals could enter the well area?** If the fencing or barrier around the well is absent, broken or poorly constructed, or the entry point (e.g. gate) is damaged or does not close securely, animals could contaminate or damage the well area.	☐	☐	

www.who.int/teams/environment-climate-change-and-health/water-sanitation-and-health

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Overview

Explore tools to strengthen the resilience of water & sanitation systems via

1. Water safety planning
2. Sanitation safety planning

Sanitation safety planning (SSP)

- Step-by-step approach for local risk assessment and management along the entire sanitation chain

- Identify and prioritize highest health risks to inform system improvements

SSP manual 2nd edition (2022)

- Supports recommendations in the *WHO Guidelines on sanitation and health (2018)*
- Simplified SSP process
- Includes climate risks

Sanitation safety planning

Objectives

☑ Maximize health benefits and minimize health risks

☑ Guide efforts to where it will have most impact

☑ Help coordinate efforts among stakeholders along the entire sanitation chain

SSP manual at a glance

SSP process in 6 modules

Guidance notes and examples

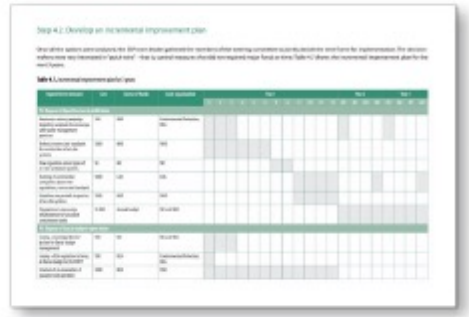
Get further information on key concepts and their application in examples and real-world cases for each module

Tools

Get a quick start for a first SSP by using the templates provided, adapting them to your local context.

Worked example

Follow a full worked example from the start to finish of the SSP process using tools and with decision points along the way explained.



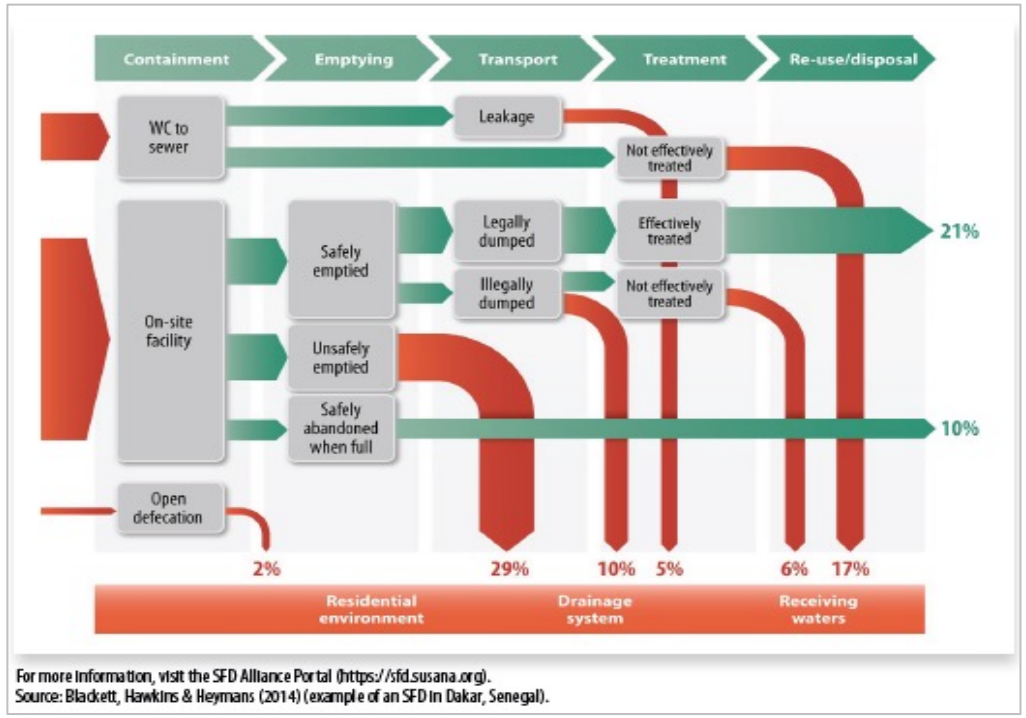
Module 1: Prepare for SSP

1.1 Define the SSP area and lead organization

1.2 Assemble the SSP team

1.3 Establish SSP priorities

Tools like the *Excreta Flow Diagram* and *Sanipath* can help establishing SSP priorities

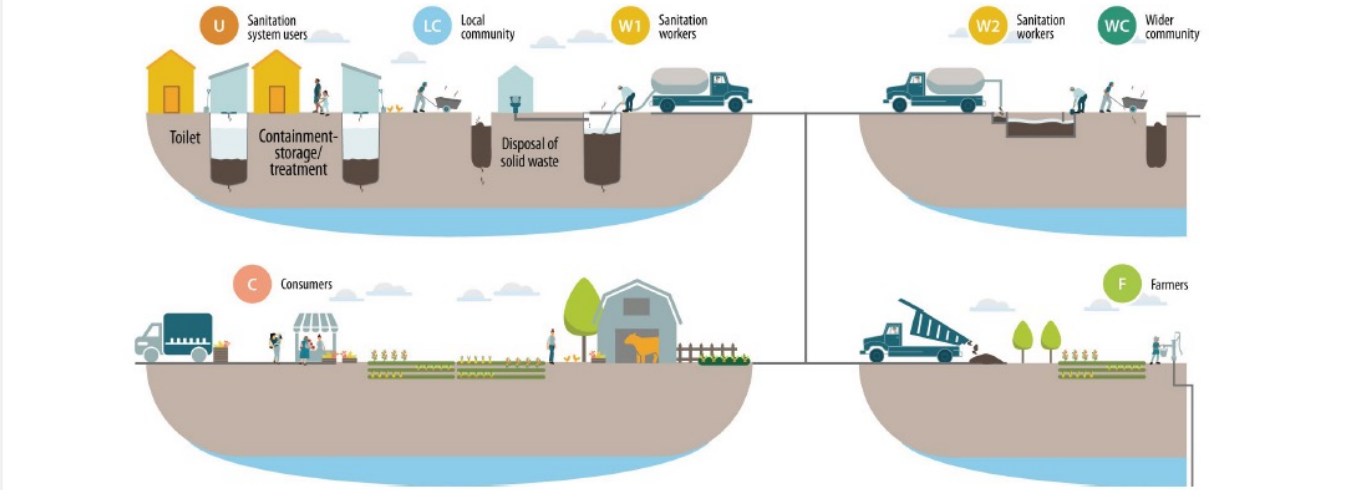


For more information, visit the SFD Alliance Portal (https://sfd.susana.org).
Source: Blackett, Hawkins & Heymans (2014) (example of an SFD in Dakar, Senegal).

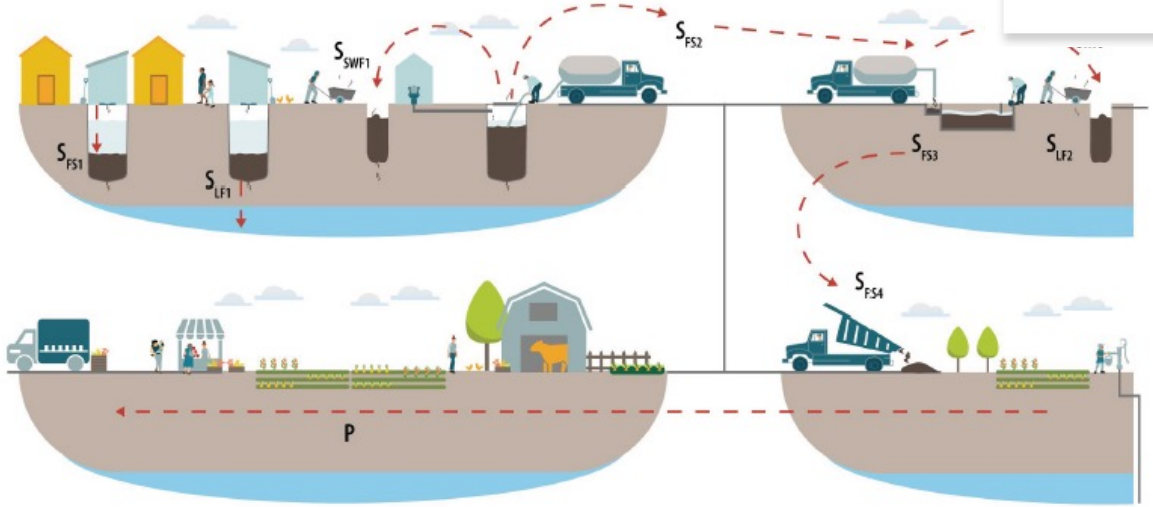
Module 2: Describe the sanitation system

- Sanitation steps
- Faecal wastes types and flows
- Exposure groups

Example 2.4. Illustration of exposure groups indicated in a sanitation map



Example 2.3. Illustration of system flows indicated in a sanitation map



S_{FS1} = Faecal sludge collected in pit latrines
S_{LF1} = Liquid fraction that percolates from the pits
S_{SWF1} = Solid waste fraction obtained during emptying of pits
S_{FS2} = Faecal sludge emptied in vacuum trucks and transported to the treatment plant
S_{SWF3} = Solid waste fraction screened out before treatment
S_{FS3} = Faecal sludge treated
S_{LF2} = Liquid fraction infiltrated from the treatment plant
S_{FS4} = Dried faecal sludge trasported to agricultural land
P = Produce reaching the market

Module 3: Identify hazardous events, assess existing control measures and prioritize exposure risks

3

3.1. Identify hazardous events

3.2. Identify and assess existing control measures

3.3. Assess and prioritize risks

- Simple sanitary inspection
- Team-based descriptive risk assessment
- Semi-quantitative risk assessment
- Quantitative methods

GUIDANCE NOTE 3.4.

Major climate change effects and resulting hazardous events

Below are examples of climate change effects and resulting hazardous events that can be reviewed relevant to the local context and sanitation systems.

CLIMATE CHANGE EFFECT	CAUSES OF HAZARDOUS EVENTS	EFFECT ON THE SANITATION SYSTEM	EXAMPLE OF HAZARDOUS EVENT	HAZARD	EXPOSURE GROUPS
More intense or prolonged precipitation	Increased flooding	Damage to infrastructure on which sanitation systems rely (e.g. electricity networks for pumping, road networks used by FSM vehicles)	Ingestion of surface water contaminated with raw sewage due to nonfunctioning wastewater treatment plant	All pathogens	LC, WC
		Flooding of on-site systems, causing spillage and contamination	Ingestion of pathogens after contact with faecal sludge during overflowing of on-site systems	All pathogens	U, LC
			Dermal contact with faecal sludge due to overflowing of on-site systems	Hookworm	U
		Treatment plants receiving flows that exceed their design capacities, resulting in flows bypassing the treatment processes	Ingestion of contaminated water with raw sewage due to bypassing of wastewater treatment plant	All pathogens	LC
	Increased erosion and landslides	Destruction of, or damage to, sanitation infrastructure	Ingestion of water contaminated with raw sewage due to nonfunctioning wastewater treatment plant	All pathogens	LC
	Contamination of, and damage to, surface water and groundwater supplies	Treatment plants receiving flows with concentrations of pollutants that exceed their design capacities, resulting in lower treatment performance	Ingestion of water contaminated with partially treated sewage due to higher pollutant concentration	All pathogens	LC
	Changes to groundwater recharge and groundwater levels	Floating of septic systems due to groundwater levels	Ingestion of pathogens after contact with faecal sludge due to floating of septic tank	All pathogens	U, LC
		Collapse of pit latrines via groundwater	Injury to the body and possible asphyxiation, after falling into the pit due to collapsing latrine structure	Injury to the body, including drowning	U

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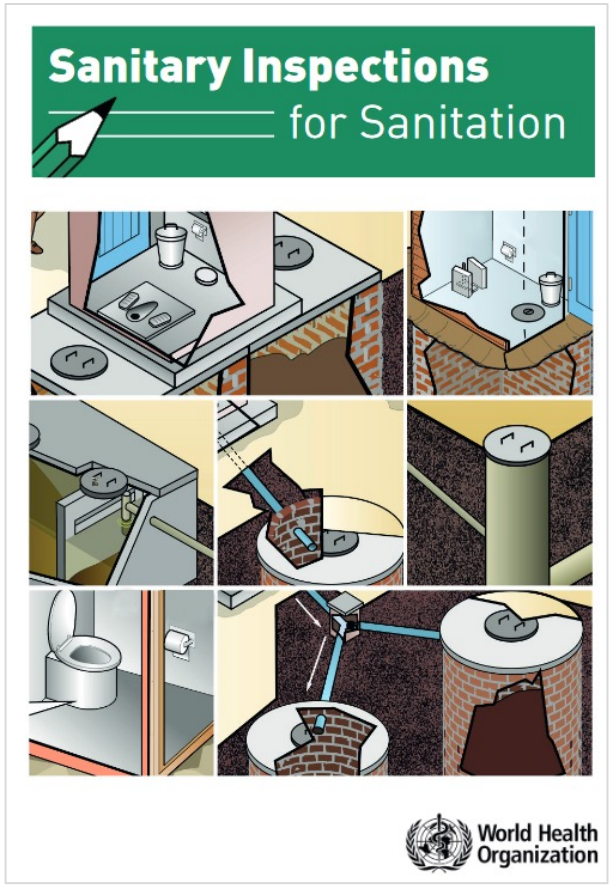
Simple sanitary inspection



WHO Sanitary Inspections for Sanitation Systems

I. GENERAL INFORMATION

A. Location

Provide the following information on the location of the toilet facility.

A1. Village/town
A2. District
A3. Province
A4. State
A5. GPS coordinates
A6. Additional location information
A7. Number of households served by this facility

B. Setting

The following factors describe the potential for risks or challenges to be present in the local area surrounding the toilet. Select the appropriate level for each setting factor based on the descriptions provided.

B1. Population density – Density of people living in the immediate area

- **Low** – Rural or low-density settlements where significant open space exists between houses
- **Medium** – suburban or peri-urban neighborhoods, small towns or village centers
- **High** – urban areas with multistory buildings and houses with minimal open land between them

B2. Difficulty accessing the toilet – How difficult is it for a service provider to access the toilet to remove sludge using a manual or motorized emptying method

- **Low** – the pit / septic tank is easy to reach by truck or gulper device; access is available through a removable cover
- **Medium** – the pit / septic tank can be reached but with some degree of difficulty due to the location or the design of the tank
- **High** – household is difficult to reach by truck due to high density or narrow streets; or, the pit / septic tank itself is difficult to access due to its location on the property or lack of a removable cover

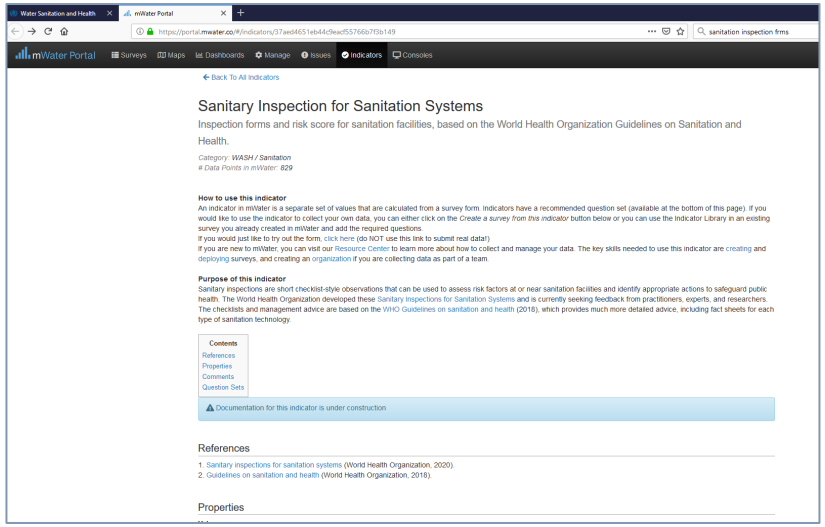
B3. Reliance on groundwater used for drinking – the potential for local groundwater sources to be contaminated by inadequate sanitation and fecal sludge management practices

- **Low** – households in this area do not use groundwater for drinking
- **Medium** – groundwater is used in the area but the sources used for drinking and bathing are located far away and are well-protected
- **High** – households in this area use shallow groundwater (dug wells, tube wells, springs)

Digital SI forms available on then m-water portal:

m-Water portal

https://portal.mwater.co/#/indicators/37aed4651eb44c9eacf55766b7f3b149



Semi-quantitative risk assessm

How is the risk affected under the most likely climate change scenario?

GUIDANCE NOTE 3.8.

Risk assessment for climate change and climate variability

COMPONENT	HAZARD IDENTIFICATION				EXISTING CONTROLS		RISK ASSESSMENT						COMMENTS JUSTIFYING RISK ASSESSMENT (Under current conditions, climate change scenarios, or effectiveness of the control)
							UNDER CURRENT CONDITIONS, ALLOWING FOR THE EXISTING CONTROLS L = likelihood; S = severity; R = risk level (e.g. high)				UNDER THE MOST LIKELY CLIMATE CHANGE SCENARIOS (In the cells below, record two scenarios, e.g. drought, heavy rainfall. + means increased risk, – means decreased risk, = means the same risk)		
Sanitation step	Hazardous event	Hazard	Exposure groups	Number of people at risk	Description of existing control measure	Validation of control	L	S	Score (LxS)	R	Scenario 1	Scenario 2	
											Drought	More intense precipitation, floods	
Conveyance	Ingestion of contaminated groundwater due to leakage from sewers into shallow groundwater	All pathogens	Local community	50 000	Awareness-raising campaigns to encourage families to use household water treatments (HWTS) such as filters and chlorination	Not effective – household-level surveys show that families are not using HWTS	4	4	16	H	+	+	Under drought, the likelihood of collecting water for drinking from shallow sources increases. Under flooding scenarios, the quality of groundwater is affected by pollutants.

Module 4: Develop and implement an incremental improvement plan

4.1 Consider options to control identified risks

4.2 Develop an incremental improvement plan

4.3 Implement the improvement plan

Example 4.1. Examples of improvement options along the sanitation service chain

STEP OF THE SANITATION SERVICE CHAIN	TYPE OF IMPROVEMENT OPTION			
	REGULATORY[a]	TECHNICAL[b]	MANAGERIAL AND OPERATIONAL[b]	BEHAVIOUR CHANGE[c]
Toilet	Technical standards on material, dimensions and location	Installation of flush toilets	Training of masons for correct installation	Communication campaign to encourage correct use and maintenance of the toilet
Containment–storage/treatment	Guidelines on periodic inspection of on-site systems	Installation of sealed and impermeable septic tanks	Building a database of on-site sanitation infrastructure	Programme to encourage refurbishment of nonsealed containment tanks
Conveyance	Licensing of emptying service providers	Installation of faecal sludge transfer stations	Establishing a call centre for septic tank emptying	Consumer protection programme indicating rights and responsibilities of users of faecal sludge emptying services
Treatment	Liquid effluent standards; guidelines on control of nuisances (odours, flies, noise) from treatment facility	Construction of, or improvements to, a faecal sludge treatment plant	Developing standard operating procedures for operation and maintenance	Internal awareness-raising programme to ensure occupational health and safety
End use or disposal	Standards for sludge products, categorized by type of use	Additional treatment of dried sludge (e.g. co-composting)	Training farmers in crop selection (e.g. only crops not eaten raw)	Household food safety programme (to encourage washing of products)

GUIDANCE NOTE 4.7.

Examples of climate adaptation options for a specific sanitation system

The table shows some examples of adaptation options to build climate-resilience in certain sanitation technologies (WHO, 2018).

SANITATION TECHNOLOGY	MOST PROBABLE CLIMATE CHANGE SCENARIO	EFFECT ON SANITATION SYSTEM	HAZARDOUS EVENT	EXAMPLE OF ADAPTATION OPTIONS
Dry and low-flush toilets	More intense or prolonged precipitation	Reduced soil stability, leading to lower pit stability	Injury to the body, possible asphyxiation, caused by falling into the pit due to collapsing latrine structure	Line pits using local materials. Use locally adapted toilet designs: raised toilets; smaller, frequently emptied pits; vault toilets; raised pit plinths; compacting soil around pits; etc.
Septic tanks	More intense or prolonged precipitation	Rising groundwater levels, causing structural damage to tanks	Ingestion of groundwater contaminated with faecal pathogens	Install sealed covers for septic tanks and non-return valves on pipes to prevent backflows.
Conventional sewerage	Sea level rise	Rising water levels in coastal sewers, causing back-flooding	Ingestion of pathogens in surface water contaminated with partially treated sewage due to higher pollutant concentration	Use special gratings and restricted outflow pipes. Install non-return valves on pipes to prevent backflows.

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Module 5: Monitor control measures & verify performance

5

5.1 Define and implement operational monitoring

5.2 Verify system performance

5.3 Audit the system

Example 5.1. Operational monitoring plan for co-composting step in a faecal sludge treatment plant

OPERATIONAL MONITORING PLAN				
Operational monitoring plan for: Temperature reached in co-composting piles to treat dewatered faecal sludge with organic solid waste				
Operational limits[a]	Operational monitoring of the control measure: Co-composting step of the faecal sludge treatment plant		Corrective action when the operational limit is exceeded	
<60 °C (temperature should not fall below 60 °C)	What is monitored?	Temperature	What action is to be taken?	Inform the Quality Manager. Actions: check the C:N ratio and the moisture content by mixing different waste streams together. Water the pile and turn the heap.
	How is it monitored?	Using the pile thermometer		
	Where is it monitored?	At the centre and outside the pile	Who takes the action?	Quality Manager
	Who monitors it?	Co-composting worker	When is it taken?	Immediately when the temperature of the pile falls.
	When is it monitored?	Every day at 9:00 am and 4:00 pm during the first 30 days of the composting process (exothermic step)	Who needs to be informed of the action?	Quality Manager should annotate in the logbook to discuss in management meetings.

TOOL 5.2. Template for operational monitoring

OPERATIONAL MONITORING PLAN				
Operational monitoring plan for: (Give control measure short description)				
Operational limits[a]	Operational monitoring of the control measure		Corrective action when the operational limit is exceeded	
	What is monitored?		What action is to be taken?	
	How is it monitored?			
	Where is it monitored?		Who takes the action?	
	Who monitors it?		When is it taken?	
	When is it monitored?		Who needs to be informed of the action?	

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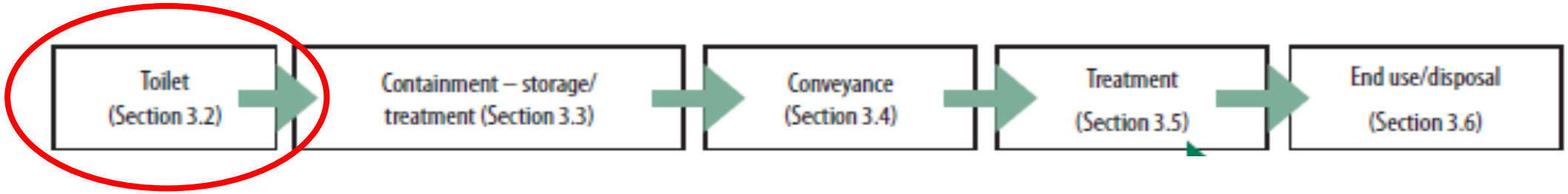
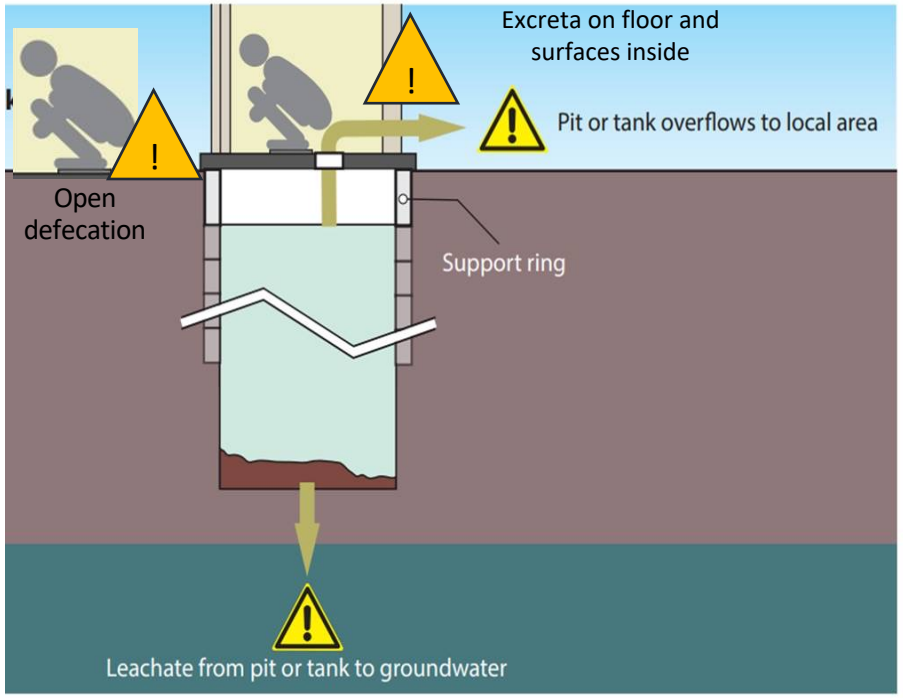


Typical risks



Example controls

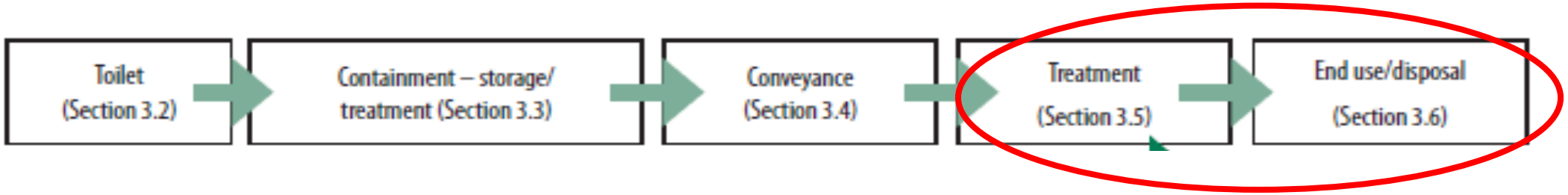
(behavior, design, management, oversight/regulation)

- Toilet use – behavior change rooted in local determinants
- Supply of a range of safe toilet options meeting minimum standards (and matched to culture, economy and environment)
- Routine cleaning maintenance

Monitoring

(Operation and verification)

- Periodic sanitary inspection by local government



Typical risks

Example controls
(behavior, design, management, oversight/regulation)

- Well designed WWTPs and FSTPs
- SOPs for treatment plant operation
- Monitoring of effluent and sludge
- Standards for treatment and reuse
- Protections for farmers and consumers of wastewater and sludge products (e.g. produce, compost etc.)

Monitoring
(Operation and verification)

- Retentions times/flow rates in treatment processes
- Effluent quality
- Exposure to effluent – e.g. crop irrigation, recreational use.

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Module 6: Develop supporting programs and review plans

6

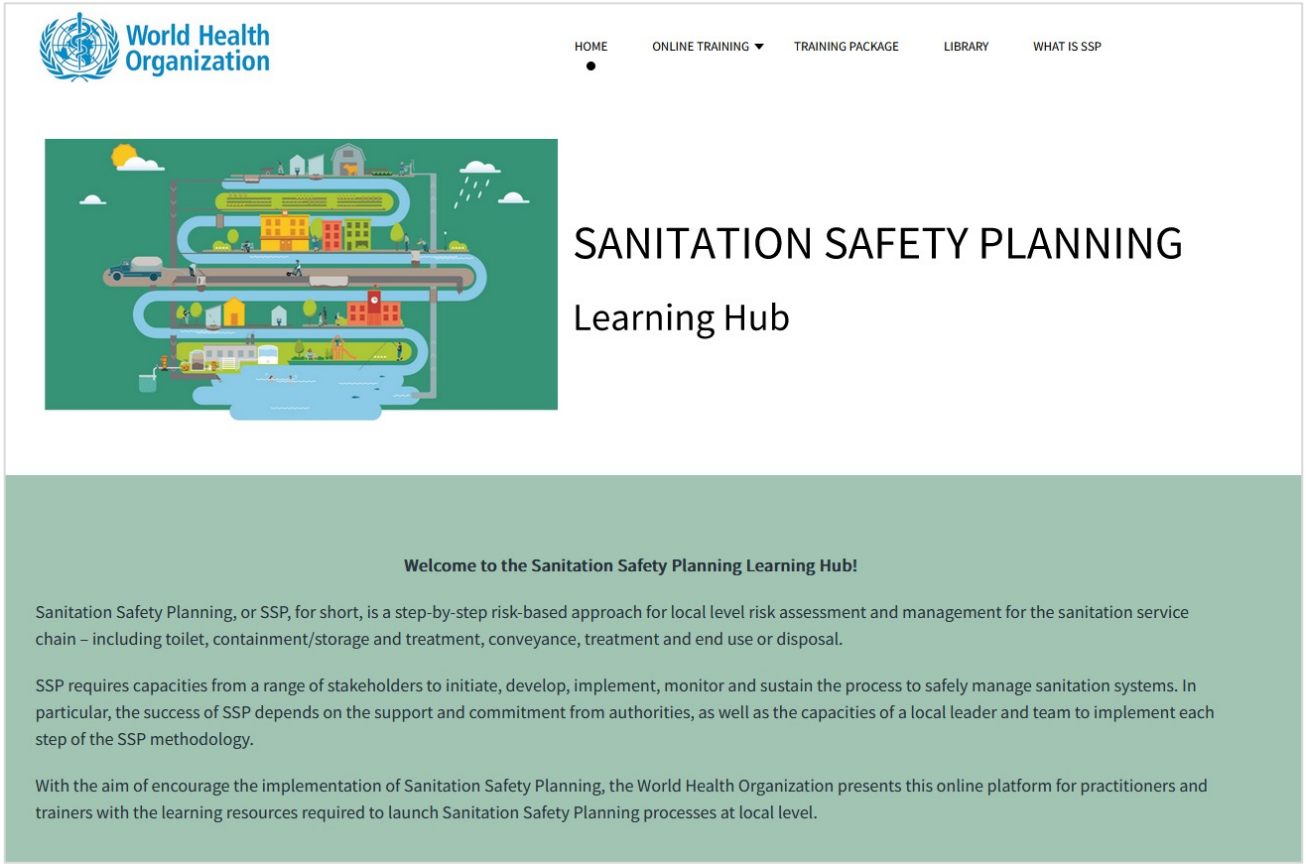
6.1 Identify and implement supporting programmes

SSP implementation is supported with sustainable sanitation enterprises, research programmes, and evidence-based engagement in national-level policy and planning

6.2 Periodically review and update the SSP outputs

Responds to a dynamic environment, adapting SSP as new controls are implemented, or new hazards and hazardous events emerge

Supporting resources: SSP learning package



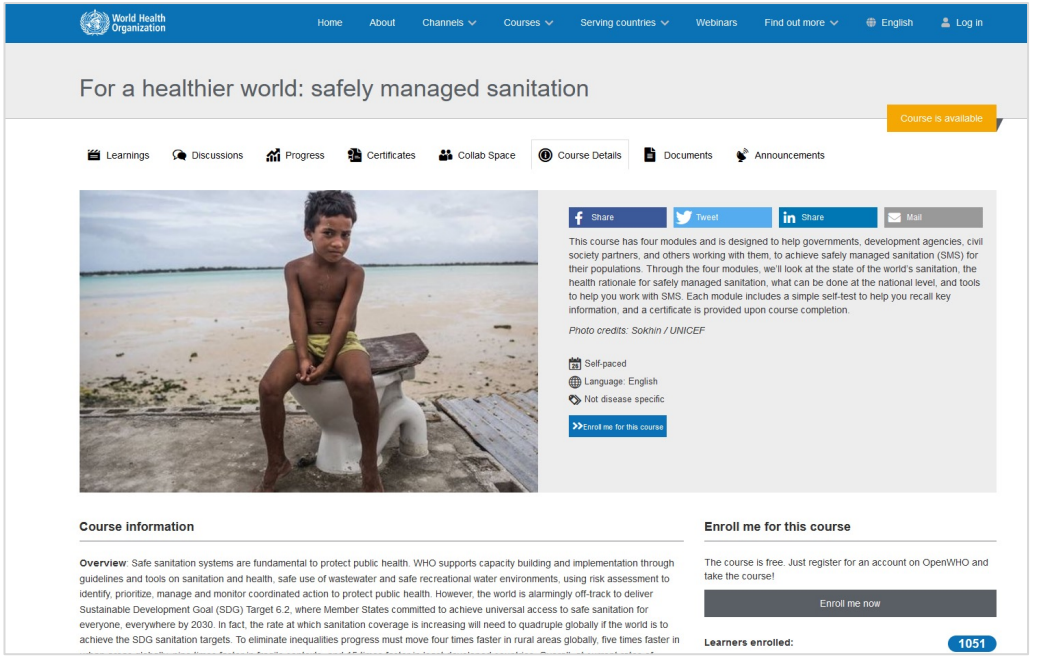
- SSP manual etc.
- PowerPoints
- Short videos
- SSP trainer's guide
- Worksheets
- SSP worked example

https://ssp.creation.camp/

Learning package

Open WHO Course

Course Overview	
Module 1	State of the World's Sanitation
Module 2	The health rationale and definitions for safely managed sanitation (SMS) in different contexts.
Module 3	Embedding SMS in national policy, programmes, standards, regulations and plans
Module 4	Assessment tools for use at national and local level



https://openwho.org/courses/wash-safely-managed-sanitation

International Network for Drinking-water & Sanitation Regulators (REGNET)

- Expanded sanitation membership
- Closer links with regional networks
- Private sharing platform
- Focus on increasing membership, clarifying regulatory mandates and accountability, and regulators' role in data for decision making

https://www.who.int/publications/m/item/regnet-flyer

[Sign up for the WASH Newsletter!!!]

WHO *Framework for safe drinking-water*

World Health Organization