MODULE 3

IDENTIFY HAZARDOUS EVENTS, AND ASSESS EXISTING CONTROL MEASURES AND EXPOSURE RISKS

SANITATION
SAFETY
PLANNING

SSP Manual
Pages
37 to 59

World Health Organization

SSP Modules

Page 37 of your SSP manual

What could go wrong? What existing control measures are in place and how effective are they? How significant are the risks?

MODULE 3

Identify hazardous events, and assess existing control measures and exposure risks

Module 3 answers the question:

“How significant are the risks?”

Module 3

Ensures that subsequent efforts and investments in system improvements and monitoring respond to highest health risks first.

Module 3 helps us understand how well the hazardous events are already controlled in the system.

MODULE 3

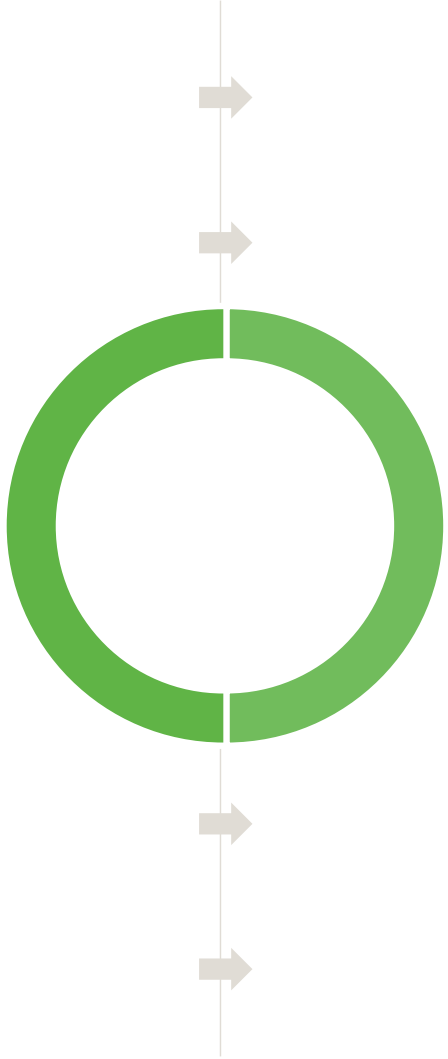
Overview

STEPS

3.1 Identify hazards and hazardous events.

3.2 Identify and assess existing control measures.

3.4 Assess and prioritize the exposure risk.



OUTPUTS

- A risk assessment table
- A prioritized list of hazardous events.

MODULE 3

Identify hazardous events, and assess existing control measures and exposure risks

Output 1: Risk assessment table

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 (L = likelihood; S = severity; R = risk (H = high; M = medium; VH = very high)				Under the most likely climate change scenarios (+ means increased risk, – means decreased risk, = means the same risk)		
Sanitation step	Hazardous event	Hazard	Exposure group	Number of people at risk	Description	Validation	L	S	Score (LxS)	R	Drought	More intense precipitation	
P1 Toilet and containment–storage/ treatment with soak pits and septic tanks	Ingestion after contact with excreta in nonfunctional toilets	All microbial pathogens	U1	30 000	Flush toilets and water supply	Visual and survey	4	2	8	M	+	-	Currently, households do not have a continuous water supply. This worsens in dry conditions, and there also is not enough water to flush toilets.
P2 Disposal of liquid fraction by infiltration	Ingestion of contaminated groundwater due to infiltration from soak pits and septic tanks into shallow groundwater	Faecal pathogens	L1	20 000	In some cases, safe distance from wells has been considered.	Field visits	5	4	20	H	+	+	High prevalence of diarrhoea is reported among among young children, especially during the dry season. Likelihood of groundwater use is expected to increase during drought periods. Severity will increase with more and prolonged flooding due to climate change. Consideration should be given to vulnerable communities that may have a reduced ability to find alternative water sources.
		Nitrates and nitrates	L1 (children less than 5 years old)	8000	Awareness-raising campaigns among mothers	Interviews with mothers	5	8	40	VH	+	+	

A summary of:

- hazards
- hazardous events
- exposure groups
- transmission routes
- existing control measures
- and their effectiveness

MODULE 3

Identify hazardous events, and assess existing control measures and exposure risks

Output 2: A prioritized list of hazardous events

Table 3.3. Newtown's prioritized hazardous events with very high risk

Sanitation step	Hazardous event	Exposure group	Number of people at risk	Risk	Projection of changes in risks with climate change scenarios	Priority given
P2 Disposal of liquid fraction by infiltration	Ingestion of contaminated groundwater due to leakage from soak pits and septic tanks into shallow groundwater	L1 (children less than 5 years old)	8000	Very high	Increases during drought and heavy rains	Very high
P4 Disposal of faecal sludge in open drains	Ingestion after contact with faecal sludge discharged without treatment to open drains	L2	50 000	Very high	Increases with flooding	Very high
P6 Use of wastewater in agriculture	Ingestion after contact with raw sewage from open drains during farming activities	F	150	Very high	Increases during drought	Very high

Table 3.4. Newtown's prioritized hazardous events with high risk

Sanitation step	Hazardous event	Exposure group	Number of people at risk	Risk	Projection of changes in risks with climate change scenarios	Priority given
P2 Disposal of liquid fraction by infiltration	Ingestion of contaminated groundwater due to leakage from soak pits and septic tanks into shallow groundwater	L1	20 000	High	Increases during drought and heavy rains	High
T1 Conveyance by vacuum trucks	Injury to the body, possible asphyxiation, caused by entering or falling into soak pits or septic tanks	W1	60	High	Stability of the tanks can be affected by flooding	High
T2 Open drains	Ingestion after contact with raw sewage in open drains during maintenance activities	W2	6	High	Remains high	High
T2 Open drains	Ingestion after contact with raw sewage in open drains	L2	50 000	High	Increases in both scenarios	High
T2 Open drains	Enhanced transmission of malaria caused by mosquito (vector) breeding in stagnant water	L2	50 000	High	Increases in heavy rains	High
P6 Use of wastewater in agriculture	Dermal contact with raw sewage (hookworm) in open drains during farming activities	F	150	High	Increases in both scenarios	High

This guides system improvements

MODULE 3

Identify hazardous events, assess existing control measures and exposure risks

How to approach Module 3?

Modules 3 requires:

- A technical understanding of the various components.
- An appreciation of the pathways that lead to exposure or contamination
- An inquisitive mind. Ask:
  - How could people be exposed to the hazard?
  - How has it caused an exposure in the past?
  - Is the hazard an ever-present hazard or is it only related to a specific event?
  - What has gone wrong in the past?
  - What could go wrong?

SSP is not a linear process!

Modules 3 involves:

- Desktop analyses
- Field investigations

STEP 3.1

Identify hazards and hazardous events

OBJECTIVE

This step lists circumstances of how the risk occurs during use, operation and maintenance of the sanitation system for the exposure groups.

SSP Manual Example 3.1 Page 41

Hazard ≠ **Hazardous Event (HE)**

A biological, chemical or physical constituent that can cause harm to human health.

SSP Manual Guidance note 3.1, page 40

Any incident or situation that:

- Introduces or releases the hazard (i.e. faecal pathogens) to the environment in which people are living or working, or
- amplifies the concentration of the hazard in the environment in which people are living or working,
- or fails to remove the hazard from the human environment.

STEP 3.1

Identify hazards and hazardous events

Hazard, hazardous event, effect, risk, ...!?

Hazard(s)	+	Hazardous event	→	Health effects
Example 1: wastewater channel Biological (e.g. bacteria, virus)	+	Ingestion after contact with wastewater while entering or falling into drains during maintenance	→	e.g. diarrhoea, fever, vomiting
Example 2: produce Biological (e.g. bacteria, virus, helminths)	+	Consumption of wastewater contaminated produce	→	e.g. cramps, dehydration and shock, helminthiasis e.g. neurological damage or cancer (in a long term)

STEP 3.1

Identify hazards and hazardous events

Hazard ≠ **Hazardous Event (HE)**

A good hazardous event tells a short story.

The **villain** is the **hazard** and the hazardous event (the story) says what happens - how the **villain** causes harm.

For example:

*Workers are **exposed** to **pathogens** in raw sewage in open drains during maintenance activities* ➡ **How exposed?**

STEP 3.1

Identify hazards and hazardous events

SSP Manual Guidance note 3.2, page 42

Hazardous events should describe how groups are exposed to hazards. Common exposure routes to consider in SSP:

- Ingestion after contact with wastewater/ excreta

- Ingestion of contaminated water

- Consumption of contaminated produce

- Dermal (skin) contact with excreta and wastewater

- Vector-borne with flies/mosquitoes/ cockroaches

- Inhalation of aerosols and particles

World Health Organization

STEP 3.1

Identify hazards and hazardous events

SSP Manual
Page 42

Hazards and hazardous events must be identified at each step along the sanitation chain

Existing – normal operation	• e.g. faulty equipment, system overloading, lack of maintenance
Potential – system failure or accident	• e.g. treatment failure (full or partial), power failures, equipment breakdown
Seasonal factors	• e.g. seasonal behaviour changes by farm workers, seasonal farm workers
Indirect	• e.g. hazards that relates to people not directly involved such as effects on downstream communities.
Cumulative	• e.g. chemicals in soils.

STEP 3.1

Identify hazards and hazardous events

SSP Manual
Example 3.2
Page 42

WHO Guidelines
Chapter 3
Page 31-34

Hazardous events:

Toilet

Existing and potential:

- **Vector-borne** transmission of pathogens to users, due to wrong design and/or construction of the toilets (e.g., lack of water seal or lid).
- **Ingestion** of pathogens after contact with excreta in toilets, due to lack of maintenance and cleaning.

World Health Organization

STEP 3.1

Identify hazards and hazardous events

SSP Manual
Example 3.2
Page 42

WHO Guidelines
Chapter 3
Page 34-38

Hazardous events:

Containment-storage/treatment

Existing and potential:

- **Ingestion** of groundwater contaminated with leachate percolating from pits or septic tanks.
- **Ingestion** of groundwater contaminated with leakage from cracked/damaged septic tanks.

World Health Organization

STEP 3.1

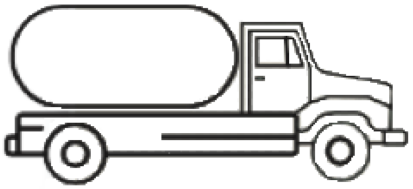
Identify hazards and hazardous events

SSP Manual
Example 3.2
Page 42

WHO Guidelines
Chapter 3
Page 39-44

Hazardous events:

Transport and conveyance



Existing and potential:

- **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.

STEP 3.1

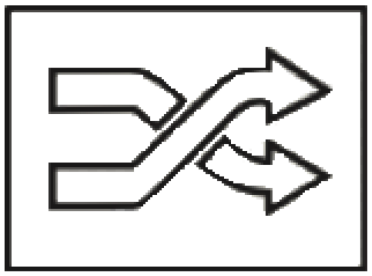
Identify hazards and hazardous events

SSP Manual
Example 3.2
Page 42

WHO Guidelines
Chapter 3
Page 44-49

Hazardous events:

Treatment



Existing and potential:

- **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.

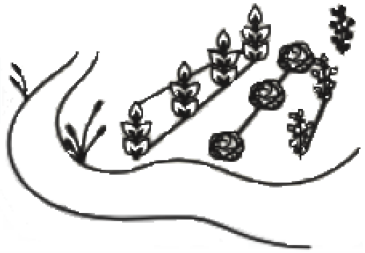
World Health Organization

SSP Manual
Example 3.2
Page 42

WHO Guidelines
Chapter 3
Page 49-52

Hazardous events:

End use/ disposal



Existing and potential:

- **Ingestion** of pathogens in surface waters due to discharge of partially treated or untreated effluent.
- **Inhalation** of particles and aerosols containing pathogens during spray irrigation with partially treated or untreated wastewater on nearby farms

STEP 3.1

Identify hazards and hazardous events

While identifying hazards and hazardous events

- It should be a combination of desk exercises and **field investigations**.
- Define a **separate hazardous event** for similar events that occur under different circumstances.

STEP 3.1

Identify hazards and hazardous events

Template for risk assessment

TOOL 3.1. Template for identification of hazards and hazardous events, and validation of existing controls

← Part A →				← Part B →		
COMPONENT	**HAZARD IDENTIFICATION**			**EXISTING CONTROLS**		**RISK ASSESSMENT** (Will depend on the risk assessment methodology chosen by the SSP team)
Sanitation step	**Hazardous event**	**Hazard**	**Exposure groups**	**Description of existing control measure**	**Validation of control**	

OBJECTIVE

To determine how well the existing system protects those at risk.

What is a control measure?

A control measure is any action or activity (or barrier) that can prevent or eliminate a sanitation-related hazard or reduce it to an acceptable level.

STEP 3.2

Identify and assess existing control measures

SSP Manual
ANNEX A1-6
Page 113

What are the typical control measures to protect…

Workers?

- Personal protective equipment (e.g. gloves, masks…)
- Trainings on safe handling of excreta

Farmers?

- Subsurface irrigation
- Personal hygiene

STEP 3.2

Identify and assess existing control measures

SSP Manual
ANNEX A1-6
Page 113

What are the typical control measures to protect…

Consumers?

- Additional polishing step at wastewater treatment plant
- Household food safety program

Local communities?

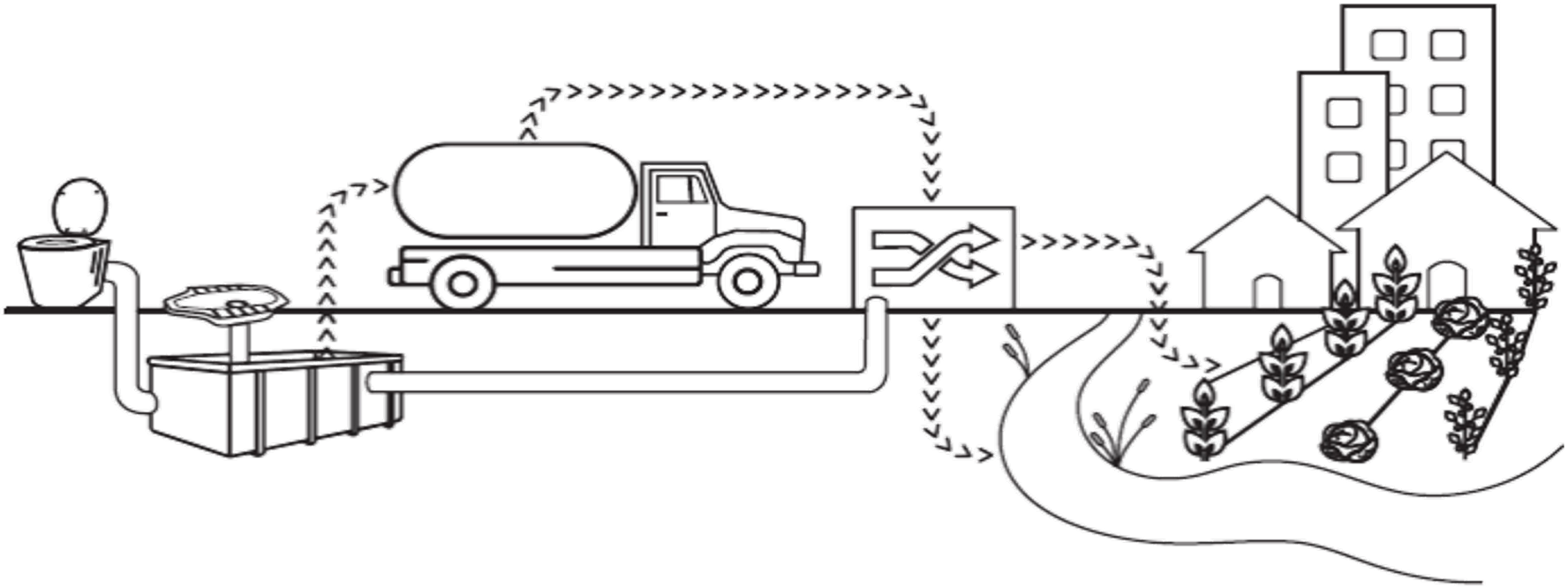
- Restricted public access to fields or waste-fed aquaculture facilities
- Fencing of waste treatment facility to prevent entry of children and animals

STEP 3.2

Identify and assess existing control measures

How do we determine

how effective is a control measure?



STEP 3.2

Identify and assess existing control measures

SSP Manual Guidance note 3.5, page 49

Consider how effective the existing control measure:

1. **could be**, assuming it was always working well (known as CM validation).

   - checking system loading against its design capacity;
   - checking historical performance under unusual conditions;
   - checking the credited reductions of pathogens for control measures.

2. **is in practice**, considering actual site conditions, enforcement of existing rules and regulations and operating practices.

Assessing control measures effectiveness in reducing pathogens load

Water supply

- E. Coli presence implies water may be contaminated
- E. Coli absence implies water very unlikely to be contaminated

Wastewater

- We know it is contaminated.
- We use the numbers of faecal indicator organisms, to indicate, the removals of faecal contamination.
- The larger the removal, the safer the wastewater is for reuse.

Log reductions as measure of effectiveness of control measures

Log reduction of organisms is widely used in WHO guidelines and risk quantification literature:

Example:

% reduction	Log reduction value		Original concentration units/100 mL	Concentration after control measure
90%	1	→	100 (=10^2)	10 (10^1)
99%	2	→	10,000 (=10^4)	100 (10^2)
99.9%	3	→	10,000 (=10^4)	10 (10^1)
99.99%	4	→	10,000 (=10^4)	1 (10^0)

STEP 3.2

Identify and assess existing control measures

2006 WHO Guidelines for Safe Use of Wastewater, Excreta and Greywater in Agriculture and Aquaculture

Chapter 5 in volumes 2, 3 and 4

- In agriculture uses, we use reductions in E. coli reductions as an indicator for risks of viral, protozoa and bacterial infections.
- For helminth pathogens: we use actual counts of helminth eggs.

STEP 3.2

Identify and assess existing control measures

SSP Manual
ANEEX 1
Pages 100-112

A1-2 Containment–storage/treatment

Table A1-2.1. Control measures relating to toilet and excreta containment–storage/treatment

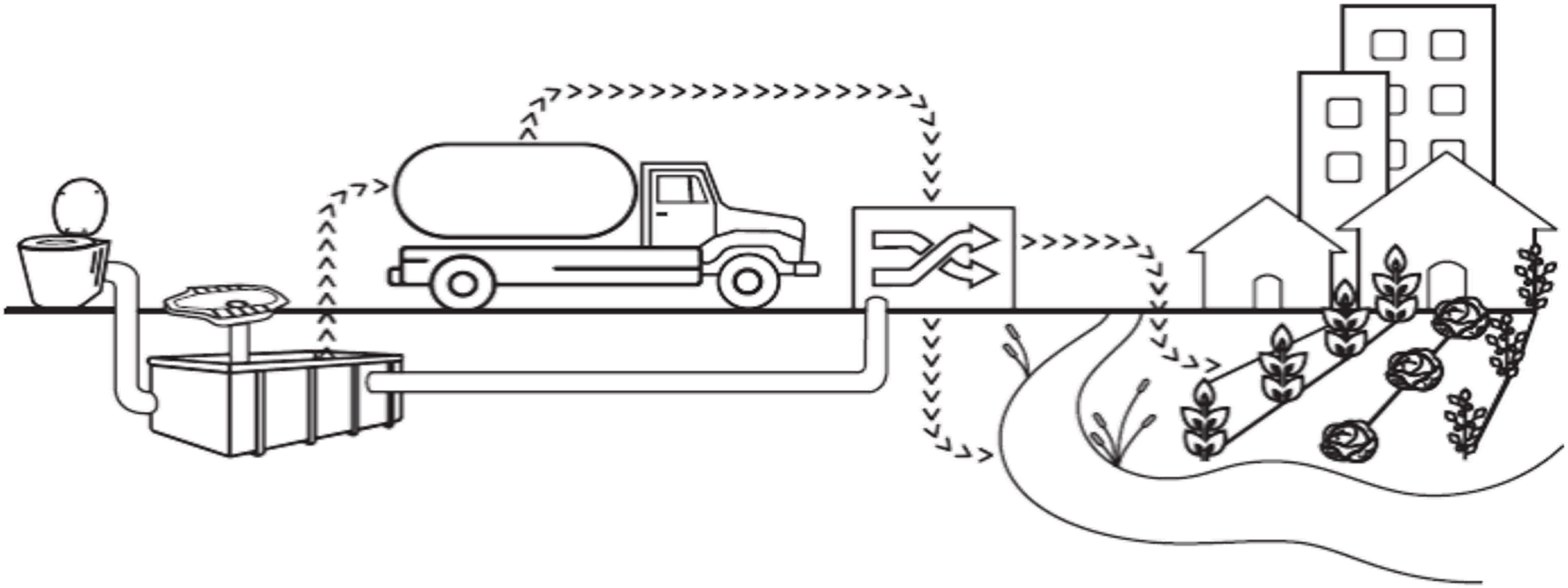
Measure	Effectiveness and log reduction	Remarks	Further reading
Dry toilets with single pit latrines (abandoned when full)	High >2 logs	• Treatment objectives are pathogen reduction and stabilization/nutrient management. • Single pits should not be emptied by hand. • The result is humus with low pathogen content.	WHO (2018), Chapter 3, section 3.3. Tilley et al. (2014), Section S (collection and storage/treatment), pp. 60–3.
Flush or pour toilets with single pit or open-bottomed tank	Low <1 log	• Material for treatment is liquid sludge with high pathogen content. • Liquid (leachate) high in pathogens is adsorbed aerobically into soil. Pathogen removal is dependent on soil conditions. • Pathogen die-off occurs with time. Risk relates to emptying practices. On-site contamination relates to siting, soil and hydrological conditions. • Unlined pit (or no liner on base) at least 1.5 m above water table to prevent groundwater contamination and an adequate hydrological horizontal distance. • Adequate pit ventilation is needed, appropriate to toilet type. Smell may discourage use, and wetness may increase fly breeding.	Stenström et al. (2011), pp. 14, 28–9, 32. WHO (2006), vol. 4, pp. 80, 83. Tilley et al. (2014), section S (collection and storage/treatment), pp. 60–3.
Flush toilet with twin pits for alternating use	High >2 log (except Ascaris eggs)	• Duel pits on toilets allow extended storage without fresh additions (designed for >1.5–2 years storage). • Pit alternation should be ensured. • Extended storage to protect waste handlers. • Unlined pit (or no liner on base) at least 2 m above water table to prevent groundwater contamination. • Adequate pit ventilation is needed, appropriate to toilet type. Smell may discourage use, and wetness may increase fly breeding. • Observe handling of water for anal cleansing. • "High" effectiveness refers to: o 1.5–2 years of storage at 2–20 °C where helminth infections are prevalent, or o at least 1 year storage at >20 °C, or storage of at least 6 months if pH is adjusted to >9 (e.g. with lime or ash).	Stenström et al. (2011), pp. 34–6, 87, 96. WHO (2006), vol. 4, pp. 69, 80, 82–3. Tilley et al. (2014), section S (collection and storage/treatment), p. 68.
Dry toilet with twin pits (fossa alterna)	High >2 log (except Ascaris eggs)	• Duel pits on toilets allow extended storage without fresh additions. • Pathogen reduction mechanism is storage of at least 2 years. • Extended storage provides protection to workers. • Temperature- and pH-dependent. • Adequate pit ventilation is needed, appropriate to toilet type.	Stenström et al. (2011), p. 87. WHO (2006), vol. 4, pp. 69, 82–3. Tilley et al. (2014), section S (collection and storage/treatment), p. 66.

STEP 3.2

Identify and assess existing control measures

SSP Manual
Guidance note
3.6, page 51

Control measure validation at each step of the sanitation system



World Health Organization

STEP 3.2

Identify and assess existing control measures

Containment-storage/treatment	Control measure	How effective is it in practice?
	• Septic tank	• Is it sealed? Does the effluent go to a soak pit? Is the groundwater located 2m below?
	• Single pits	• What is the location of the groundwater? Is it elevated? What happens in rainy season?

STEP 3.2

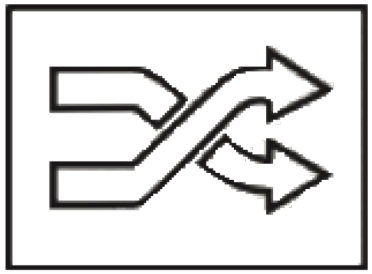
Identify and assess existing control measures

Conveyance/ emptying and transport	Control measure	How effective is it in practice?
	• Preventive emptying • Use of protective personal equipment (PPE)	• Do HHs really call the emptying trucks before the holding tanks are full? • Do the sanitation workers really use the PPE?

STEP 3.2

Identify and assess existing control measures

Treatment



CM validation: assuming it was always working well

Treatment process	Level	Treatment objectives	Pathogen reduction measures	PRL*	Treatment products & pathogen level**
Low flow rate					
Waste stabilization ponds	NA	BOD reduction Nutrient management Pathogen reduction	Aerobic ponds (maturation) Ultraviolet radiation	H	Liquid sludge with low pathogens Effluent with low pathogens
Constructed wetlands	Secondary or Tertiary	BOD reduction Suspended solid removal Nutrient management Pathogen reduction	Natural decay Predation from higher organisms Sedimentation UV radiation	M	Plants – no pathogens Effluent with medium pathogens
High flow rate					
Primary sedimentation	Primary	Suspended solid reduction	Storage	L	Liquid sludge with high pathogens Effluent with high pathogens
Activated sludge	Secondary	BOD reduction Nutrient management	Storage	M	Liquid sludge with medium pathogens Effluent with medium pathogens
Aerated lagoon and settling pond	Secondary	BOD reduction Pathogen reduction	Aeration	M	Liquid sludge with medium pathogens Effluent with pathogens
Trickling filters	Secondary	Nutrient management	Storage	M	Liquid sludge with medium pathogens Effluent with pathogens
High rate granular or slow rate sand filtration	Tertiary	Pathogen reduction	Filtration	H	Effluent with low pathogens

Table 3.2 Established wastewater treatment technologies

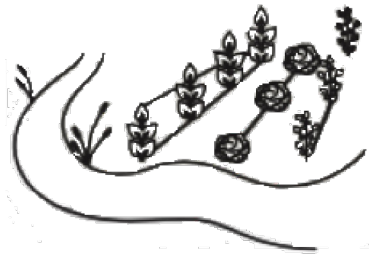
Table 3.3 Established sludge treatment processes

WHO Guidelines
Chapter 3
Pages 46 - 47

STEP 3.2

Identify and assess existing control measures

End use/ disposal



Pathogen level in end use product

Treatment product	Resource recovered	End use technology or product	Technology description	Pathogen level in end use product
Untreated sludge - buried	Organic matter Nutrients	Soil conditioner fertilizer	Untreated sludge buried and used to grow trees (e.g. arborloo or deep row entrenchment)	Low to high depending on absorption characteristics and travel time. The untreated sludge can contain a high level of pathogens, but once buried they may be adsorbed into soil and inactivated over time.
Dewatered sludge	Organic matter	Soil conditioner fertilizer	Dewatered sludge applied to land	High
Dried sludge	Materials	Building materials	Used in the manufacture of cement, bricks and clay-based products	Low but only after being subjected to high manufacturing temperatures.
Compost (powder or pellets)	Organic matter Nutrients	Soil conditioner, fertilizer	Compost, powder or pellets applied to land	Low
Effluent	Nutrients, water	Irrigation water	Treated effluent applied to land	Low to high depending on treatment technology.
Effluent	Water	Surface water recharge	Treated effluent disposed or discharged into rivers, lakes or oceans	Low to high depending on treatment technology.
Untreated effluent	Water	Groundwater recharge	Untreated effluent disposed or discharged into the ground via soak pit or leach field	Low to high depending on absorption characteristics and travel time. The untreated effluent can contain a high level of pathogens, but once in the ground they may be adsorbed aerobically into soil.

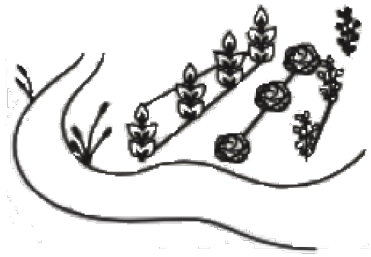
Table 3.4 Summary of established end use products

WHO Guidelines Chapter 3 Page 50

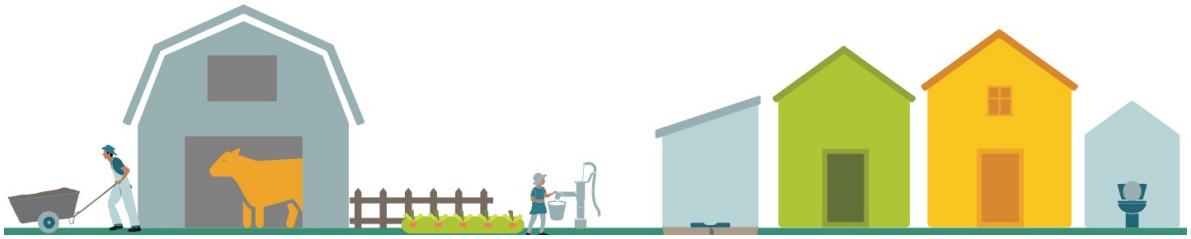
STEP 3.2

Identify and assess existing control measures

End use/ disposal



Control measure	How effective is it in practice?
• Restrictions of produce	• Are farmers only growing the products indicated?
• Use of protective personal equipment (PPE)	• Do farmers really use the PPE?



COMPONENT	HAZARD IDENTIFICATION				EXISTING CONTROLS	
Sanitation step	Hazardous event	Hazard	Exposure group	Number of people at risk	Description	Validation
P1 Toilet and containment–storage/ treatment with soak pits and septic tanks	Ingestion after contact with excreta in nonfunctional toilets	All microbial pathogens	**U1**	30 000	Flush toilets and water supply	Visual and survey
P2 Disposal of liquid fraction by infiltration	Ingestion of contaminated groundwater due to infiltration from soak pits and septic tanks into shallow groundwater	Faecal pathogens	**L1**	20 000	In some cases, safe distance from wells has been considered.	Field visits
		Nitrates and nitrates	**L1** (children less than 5 years old)	8000	Awareness-raising campaigns among mothers	Interviews with mothers
P1 Toilet and containment–storage/ treatment with soak pits and septic tanks	Ingestion after contact with wastewater from overflowing on-site systems due to damage or blockage	All microbial pathogens	**U1**	30 000	Septic tanks and soak pits present problems.	Interviews and field visits
			L2	50 000		
P5 Flush toilets discharging in open drains	Ingestion after contact with excreta in nonfunctional toilets	All microbial pathogens	**U2**	5000	Flush toilets and water supply	Visual survey

Worked example: SSP IN NEWTOWN

GROUP WORK

Applying Steps 3.1 and 3.2 to our case study

Analyse the information you have gathered during the field visit, and decide what are the hazardous events that you will be developing tomorrow.

MODULE 3: IDENTIFY HAZARDOUS EVENTS, AND ASSESS EXISTING CONTROL MEASURES AND EXPOSURE RISKS

In the following tables, you will conduct a health risk assessment of the sanitation system assigned to your group under **CURRENT CLIMATE CONDITIONS**.

STEP 3.1: Identify hazards and hazardous events

When **applying step 3.1**, only complete the columns **Component** and **Hazard identification**. Make sure you describe the **Hazardous event** telling the story of how the hazards cause harm, including the exposure route (ingestion after contact with excreta, ingestion of contaminated water, consumption of contaminated produce, dermal contact, vector-borne, inhalation). Revise the Newtown worked case study, the example 3.2 and guidance note 3.4 for examples).

STEP 3.2: Identify and assess existing control measures

When **applying step 3.2**, only complete the columns related to **Existing Controls**. Remember that in "Validation of control(s)" you should write if the existing control is working or not.

Sanitation step	Hazard Identification				Existing Control(s)		Risk Assessment Under current climate conditions				Comments
							L=Likelihood; S=Severity; R=Risk				
Component	Hazardous event	Hazard	Exposure Groups	Number of persons at risk	Description of existing control	Validation of control Explain if this is working	L	S	Score	R	
Toilet	Vector-borne transmission of pathogens to users, due to wrong design and/or construction of the toilets (e.g., lack of water seal or lid)										
Conveyance (sewer)	Ingestion of contaminated groundwater due to leakages of wastewater from cracked/damaged sewers into shallow groundwater	Faecal pathogens									
		Nitrates and nitrites									
Conveyance (sewer)	Dermal contact with pathogens due to effluent discharging directly into open drains/streams										
Conveyance (sewer)	Ingestion of pathogens after contact with wastewater during sewer cleaning and maintenance		Workers								
Conveyance (sewer)	Ingestion of contaminated drinking water due to cross contamination with sewer leakage										
Conveyance (sewer)	Ingestion after contact with wastewater from overflowing sewers due to blockage with solid waste										
WWTP - screening	Inhalation of aerosols containing pathogens when removing screens or grids with accumulated debris		Workers								
WWTP – inlet chamber	Ingestion after contact with leakages of raw or partially treated wastewater into the surrounding soil and groundwater, caused by breakage of inlet pipes										
WWTP- Biological treatment	Inhalation of harmful gases such as hydrogen sulfide (H_2S) or methane accumulating in confined spaces around the biological reactors, causing respiratory irritation, dizziness, or loss of consciousness for operators entering or working near tank covers or walkways.										

THANK YOU!

World Health Organization

Welcome to the Sanitation Safety Planning Training

Step-by-step risk management for safely managed sanitation systems

SANITATION
SAFETY
PLANNING

SSP Modules

Page 37 of your SSP manual

What could go wrong? What existing control measures are in place and how effective are they? How significant are the risks?

GROUP WORK

Applying Steps 3.1 and 3.2 to our case study

Tool: Sanitation Safety Plan

Moratuwa Ratmalana (Sri Lanka)

developed by participants of the SSP Training

In your SSP Document, for your assigned sanitation system, identify:

- Hazardous events
- Hazards
- Exposure groups and number of persons in risk
- Existing control measures

Component	Hazard Identification				Existing Control(s)		Risk Assessment						Comments justifying risk assessment, under current conditions or climate change scenarios, or effectiveness of the control
							Under current conditions L=Likelihood; S=Severity; R=Risk				Under the most likely climate change scenarios: + means increased risk - means decreased risk = means the same risk		
Sanitation step	Hazardous event	Hazard	Exposure Groups	Number of persons at risk	Description of existing control	Validation of control	L	S	Score	R			

In your flipcharts, copy the information in post-its:

STEP 3.3

Assess and prioritize the exposure risk

OBJECTIVE

This step uses a structured approach to identify and prioritize the highest risks for which system improvements are needed.

Helps to identify which hazardous events are serious and which are moderate or insignificant.

SSP Manual

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STEP 3.3

Assess and prioritize the exposure risk

Risk assessment methods

Simple sanitary inspection

- Suited for simple sanitation systems (on-site)

Team-based descriptive

- Limited data

Team-based semi-quantitative

- More experienced and more resourced teams

Quantitative methods

- Specialized studies
- Not used by SSP teams

- Depend on the judgement of the SSP team.

Choose a method that you are comfortable with and that is feasible

STEP 3.3

Assess and prioritize the exposure risk

SSP Manual
Tool 3.5
Page 58

Semi-quantitative risk assessment

- More rigorous risk assessment.
- Appropriated for more well-defined regulatory environments.
- Teams who are familiar with the WSP methodology.

Likelihood (L) x Severity (S) = Risk

	DESCRIPTOR	DESCRIPTION
Likelihood (L)		
1	Very unlikely	Has not happened in the past and it is **highly improbable** it will happen in the next 12 months (or another reasonable period).
2	Unlikely	Has not happened in the past but **may occur in exceptional circumstances** in the next 12 months (or another reasonable period).
3	Possible	May have happened in the past and/or **may occur under regular circumstances** in the next 12 months (or another reasonable period).
4	Likely	Has been observed in the past and/or is **likely** to occur in the next 12 months (or another reasonable period).
5	Almost certain	Has often been observed in the past and/or **will almost certainly occur** in most circumstances in the next 12 months (or another reasonable period).
Severity (S)		
1	Insignificant	Hazard or hazardous event resulting in **no or negligible health effects** compared with background levels.
2	Minor	Hazard or hazardous event potentially resulting in **minor health effects** (e.g. temporary symptoms of irritation, nausea, headache).
4	Moderate	Hazard or hazardous event potentially resulting in **self-limiting health effects or minor illness** (e.g. acute diarrhoea, vomiting, upper respiratory tract infection, minor trauma).
8	Major	Hazard or hazardous event potentially resulting in **illness or injury** (e.g. malaria, schistosomiasis, food-borne trematodiases, chronic diarrhoea, chronic respiratory problems, neurological disorders, bone fracture), and/or may lead to **legal complaints** and concern, and/or major **regulatory noncompliance**.
16	Catastrophic	Hazard or hazardous event potentially resulting in **serious illness or injury, or even loss of life** (e.g. severe poisoning, loss of extremities, severe burns, drowning), and/or will lead to **major investigation by regulator**, with prosecution likely.

STEP 3.3

Assess and prioritize the exposure risk

SSP Manual
Tool 3.6
Page 58

Semi-quantitative risk assessment matrix

Likelihood (L) x Severity (S) = Risk

			SEVERITY (S)				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	4	8	16
LIKELIHOOD (L)	Very unlikely	1	1	2	4	8	16
	Unlikely	2	2	4	8	16	32
	Possible	3	3	6	12	24	48
	Likely	4	4	8	16	32	64
	Almost certain	5	5	10	20	40	80
Risk score R = L × S			<6	6–12		13–32	>32
Risk level			Low risk	Medium risk		High risk	Very high risk

STEP 3.3

Assess and prioritize the exposure risk

TIPS

- **Be specific** in the risk assessment and relate it to **the hazardous event.**

- Any descriptive and semi-quantitative risk assessment approach needs to be undertaken by **several individuals for increasing objectivity** of the risk assessment.

- Treat **control measure failure** as a separate hazardous event in its own right, with its own likelihood and severity.

STEP 3.3

Assess and prioritize the exposure risk

COMPONENT	HAZARD IDENTIFICATION				EXISTING CONTROLS		RI Under current cond L = likelihood; S = severity; (H = high; M = medium; very high)		
Sanitation step	Hazardous event	Hazard	Exposure group	Number of people at risk	Description	Validation	L	S	Score (LxS)
P1 Toilet and containment–storage/ treatment with soak pits and septic tanks	Ingestion after contact with excreta in nonfunctional toilets	All microbial pathogens	**U1**	30 000	Flush toilets and water supply	Visual and survey	4	2	8
P2 Disposal of liquid fraction by infiltration	Ingestion of contaminated groundwater due to infiltration from soak pits and septic tanks into shallow groundwater	Faecal pathogens	**L1**	20 000	In some cases, safe distance from wells has been considered.	Field visits	5	4	20
		Nitrates and nitrates	**L1** (children less than 5 years old)	8000	Awareness-raising campaigns among mothers	Interviews with mothers	5	8	40

Worked example:
SSP IN NEWTOWN

Record the risk assessment for every hazardous event and exposure group

			SEVERITY (S)				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	4	8	16
LIKELIHOOD (L)	Very unlikely	1	1	2	4	8	16
	Unlikely	2	2	4	8	16	32
	Possible	3	3	6	12	24	48
	Likely	4	4	8	16	32	64
	Almost certain	5	5	10	20	40	80
Risk score R = L × S			<6	6–12	13–32	>32	
Risk level			Low risk	Medium risk	High risk	Very high risk	

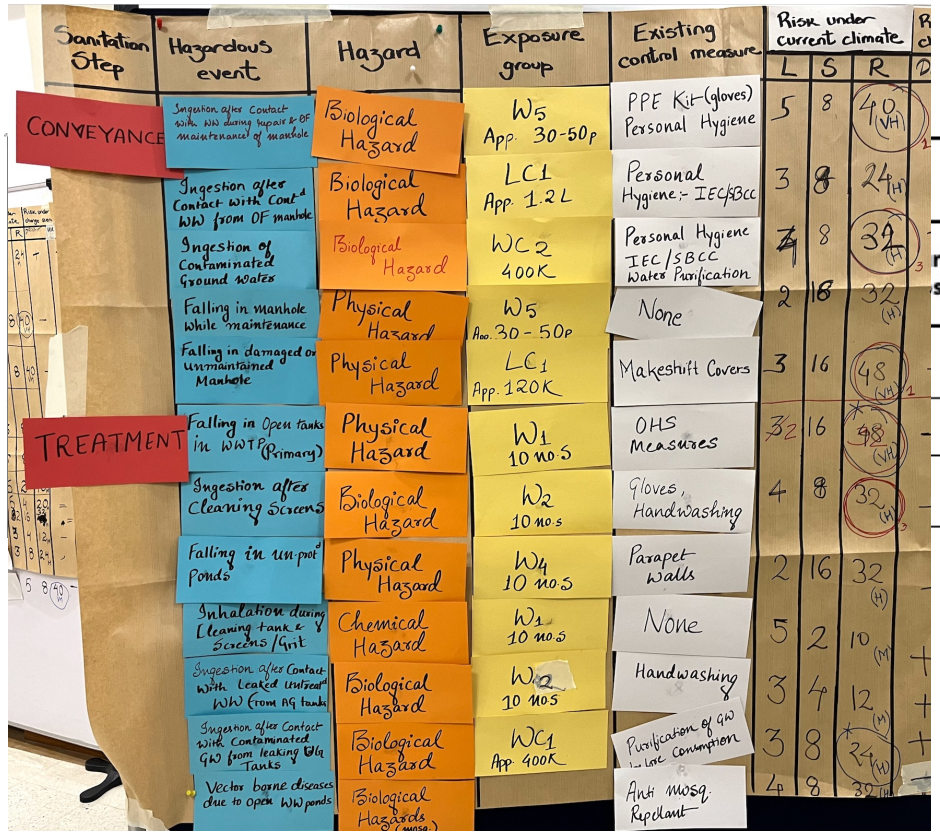
World Health Organization

GROUP WORK (1/2)

Applying Step 3.3 to our case study

In your SSP Document, for your assigned sanitation system:

- Assess risk under current conditions



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Tool: Sanitation Safety Plan

Moratuwa Ratmalana (Sri Lanka)

developed by participants of the SSP Training

	Number of persons at risk	Existing Control(s)		Risk Assessment				Comments justifying risk assessment, under current conditions or effectiveness of the control
		Description of existing control	Validation of control Explain if this is working	Under current climate conditions L=Likelihood; S=Severity; R=Risk				
				L	S	Score	R	

In your flipcharts, using black markers, fill in the risk assessment table in post-its

World Health Organization

GROUP WORK (2/2)

Applying Step 3.3 to our case study

In your SSP Document, for your assigned sanitation system:

- Prioritize 3 hazardous events

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After discussions with your team, write in the following table which are the hazardous events that you will prioritize UNDER CURRENT CLIMATE CONDITIONS.

Sanitation step	Hazardous event	Exposure Group	Number of persons at risk	Risk	Priority given

Risk assessment under climate change scenarios

STEP 3.1

Identify hazards and hazardous events

Climate change:

- Alters the frequency and intensity of hazardous events
- Creates new hazardous events

More variable and declining rainfall or run-off

- Longer dry seasons/periods
- Droughts reduced surface water flows
- Reduced groundwater levels

More variable or increasing temperatures

- Higher freshwater temperatures
- Hot and cold temperature extremes

More intense and prolonged precipitation

- Increased flooding
- Increased erosion, landslides
- Changes to groundwater recharge and groundwater levels

Sea level rise

- Saline intrusion in coastal/low-lying zones
- Higher risk of inundation, especially from extreme weather events

More frequent or intense storms or cyclones

- Increased flooding
- More extreme winds

STEP 3.1

Identify hazards and hazardous events

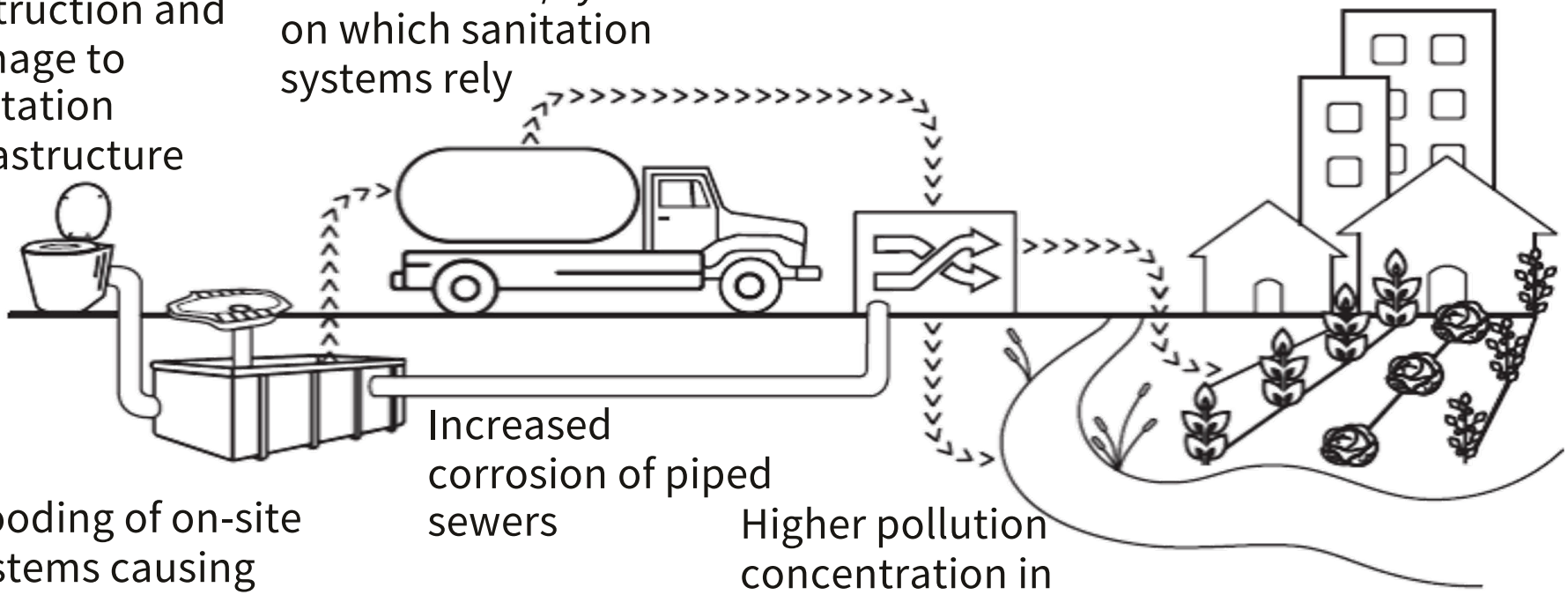
SSP Manual Guidance note 3.4, page 47

Think about climate-related **effects** that affect the sanitation system:

Declining water supply impeding function of water-reliant sanitation systems (e.g., flush toilets, sewerage, treatment)

Damage to other infrastructure/systems on which sanitation systems rely

Destruction and damage to sanitation infrastructure



Increased corrosion of piped sewers

Flooding of on-site systems causing spillage and contamination

Overflow and/or obstruction of sewerage and septic systems

Higher pollution concentration in wastewater and reduced capacity of receiving water bodies to dilute wastewater

Proliferation of algal blooms or microbes carried by vectors in water

STEP 3.1

Identify hazards and hazardous events

WHO Guidelines
Chapter 3
Page 31-34

Hazardous events:

Toilet

TIPS

WHO Guidelines

Table 3.6 – climate change potential impact on toilets

Page 54

Climate change related:

- **Ingestion** of contaminated groundwater contamination caused by toilet flooding.
- **Ingestion/asphyxiation** after falling in pits due to toilet collapse during inundation.

WHO Guidelines
Chapter 3
Page 34-38

Hazardous events:

Containment-storage/treatment

TIPS

WHO Guidelines

Table 3.6 – climate change potential impact on septic tanks

Page 55

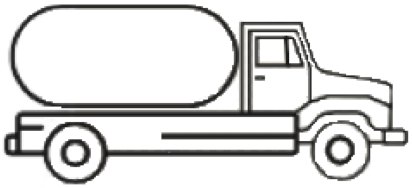
Climate change related:

- **Ingestion** of pathogens caused by structural damage to tanks during floods.

WHO Guidelines
Chapter 3
Page 39-44

Hazardous events:

Transport and conveyance



Climate change related:

- **Ingestion** to pathogens in households during events of back- flooding of raw sewage into buildings caused by extreme rainfall.
- **Ingestion** of pathogens during cleaning of increasing solid deposits caused by reduced water flows in drought periods.

TIPS

WHO Guidelines

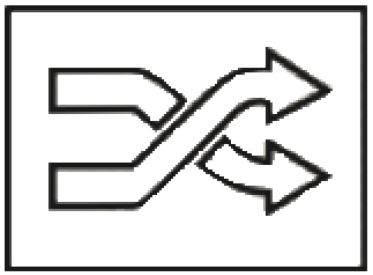
Table 3.6 – climate change potential impact on sewers

Page 55

WHO Guidelines
Chapter 3
Page 44-49

Hazardous events:

Treatment



TIPS

WHO Guidelines

Table 3.6 – climate change potential impact on treatment

Page 55

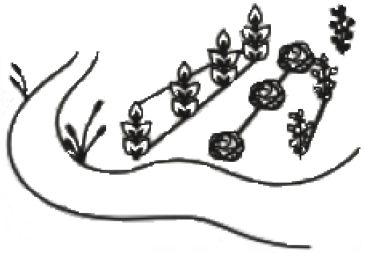
Climate change related:

- **Ingestion** of pathogens contained in untreated sewage during extreme weather events or floods damaging wastewater treatment systems.

WHO Guidelines
Chapter 3
Page 49-52

Hazardous events:

End use/ disposal



Existing and potential:

- **Ingestion** of pathogens in surface waters due to discharge of partially treated or untreated effluent.
- **Inhalation** of particles and aerosols containing pathogens during spray irrigation with partially treated or untreated wastewater on nearby farms

WHO Guidelines

Table 3.6 – climate change potential impact on reuse

Page 56

Climate change related:

- **Ingestion** after contact with raw sewage during farming activities, caused by increased fresh water scarcity.

STEP 3.1

Identify hazards and hazardous events

TIPS

While identifying hazards and hazardous events

- Draw on **climate projections** and existing vulnerability, resilience, and adaptation assessments to include hazardous events that could arise due to climate change.
- SP teams should define a specific hazardous event caused by climate change.

STEP 3.3

Assess and prioritize the exposure risk

Template to assess risk under different climate change scenarios

IDENTIFY HAZARDOUS EVENTS, AND ASSESS EXISTING CONTROL MEASURES AND EXPOSURE RISKS UNDER CLIMATE CHANGE SCENARIOS

In the following tables, you will conduct a health risk assessment of the sanitation system assigned to your group under different **CLIMATE CHANGE SCENARIOS**.

CLIMATE CHANGE SCENARIO 1: More intense or prolonged precipitation

Discuss in a few lines, if this is a climate change scenario is relevant for your location. Decide whether the locality is vulnerable to its effects.

[enter you answer here]
XXXXX

Now, conduct the health risk assessment of hazardous events caused by "more intense or prolonged precipitation". Keep in mind that there are already some effects and hazardous events identified. **This list is not comprehensive**. You and your team need to identify other in each step of the sanitation system assigned.

Causes of hazardous events	Evaluation of robustness			Hazard Identification				Existing Control(s)		Risk Assessment Under climate change scenario L=Likelihood; S=Severity; R=Risk				Comments justifying risk assessment, under climate change scenarios or effectiveness of the control
	Sanitation step	Effect on the sanitation system	Is the sanitation step/system robust? (yes, no). Explain	Hazardous events	Hazard	Exposure Groups	Number of persons at risk	Description of existing control	Validation of control Explain if this is working	L	S	Score	R	
Increased flooding	Toilet													
	Conveyance (fecal trucks)	Damage to other infrastructure/systems on which sanitation systems rely (e.g., electricity networks for pumping; road networks used by FSM vehicles)												
	Conveyance (sewers – pumping stations)													
	Treatment (units needing electricity)			Ingestion of surface water contaminated with raw sewage due to non-functioning wastewater treatment plant										
	Containment–storage/treatment (septic tank)	Flooding of treatment units, causing spillage and contamination		Ingestion after contact with fecal sludge during overflowing of on-site systems										
	Treatment (holding tanks, ponds)													
	Treatment													

STEP 3.3

Assess and prioritize the exposure risk

Template for the prioritization of hazardous events under climate change scenarios

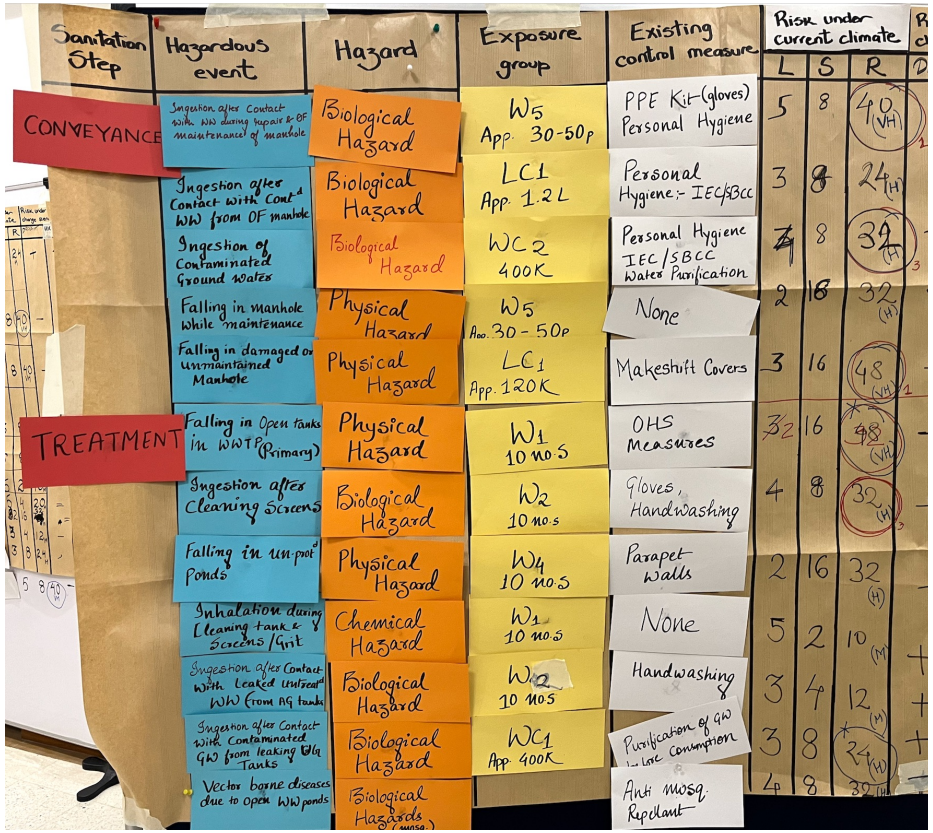
Climate change scenario	In general, is this sanitation system robust in the case of the climate change scenario?	According to the health risk assessment, write the **highest health risks for each climate change scenario**						Priority given
		Sanitation step	Hazardous event	Cause of hazardous event	Exposure Group	Number of persons at risk	Risk	
More intense or prolonged precipitation								
Sea-level rise								
More variable or increasing temperatures								
More frequent or intense storms or cyclones								
More variable and declining rainfall or run-off								

GROUP WORK

Applying Module 3 to our case study

In your SSP Document, for your assigned sanitation system:

- Assess risk under different climate scenarios



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CLIMATE CHANGE SCENARIO ... and declining rainfall or run-off

Discuss in a few lines, if this is a climate ch... t for your location. Decide whether the locality is vulnerable to its effects.

(enter you answer here)

XXXXX

Now, conduct the health risk assessment of hazardous events caused by "More variable and declining rainfall or run-off". Keep in mind that there are already some effects and hazardous events identified. **This list is not comprehensive**. You and your team need to identify other in each step of the sanitation system assigned.

Causes of hazardous events	Evaluation of robustness			Hazard Identification				Existing Control(s)		Risk Assessment Under climate change scenario L=Likelihood; S=Severity; R=Risk				Comments justifying risk assessment, under climate change scenarios or effectiveness of the control
	Sanitation step	Effect on the sanitation system	Is the sanitation step/system robust? (yes, no). Explain	Hazardous events	Hazard	Exposure Groups	Number of persons at risk	Description of existing control	Validation of control Explain if this is working	L	S	Score	R	
Water shortages	Toilet	Decreased water availability impairs the operation of flushing toilets		Ingestion after contact with non-functional toilets										
	Water-dependent treatment units	Decreased water availability impairs the operation of water-dependent sanitation processes, leading to reduced functionality of treatment systems		Ingestion after contact with wastewater that has not been treated sufficiently										
	Containment-storage/treatment (septic tank)	Increased reliance on alternative water sources for drinking		Ingestion of contaminated drinking water										
	Reuse	Increased reliance on alternative water sources for irrigation		Ingestion after contact with polluted irrigation water										
	Discharge	Potential contamination due to insufficient dilution		Ingestion after contact with polluted river water										
Longer dry seasons/periods														
Reduced groundwater levels														

In your flip-charts, using black markers, fill in the risk assessment table in post- its

MODULE 3

IDENTIFY HAZARDOUS EVENTS, AND ASSESS EXISTING CONTROL MEASURES AND EXPOSURE RISKS

SANITATION
SAFETY
PLANNING

World Health Organization