MODULE 2

DESCRIBE THE SANITATION SYSTEM

SANITATION
SAFETY
PLANNING

SSP Manual
Pages
19 to 35

World Health Organization

SSP Modules

What is the system; who is at risk?

Page 19 of your SSP manual

MODULE 2

Overview

STEPS

2.1 Map the system

2.2 Characterize the system flows

2.3 Identify exposure groups

2.4 Gather supporting information

2.5 Confirm the system description

OUTPUTS

- A map and description of the sanitation system.
- An understanding of the constituents (excreta and mixed waste) in flows at all steps of the sanitation system.
- Identification and characterization of exposure groups.
- An understanding of the factors affecting the performance and vulnerability of the system
- A compilation of all other relevant information.

STEP 2.1

Map the system

OBJECTIVE

To understand the source and path of flows through the system. This is critical in the later assessment of exposure groups at risk.

WHO Guidelines
Chapter 2
Pages 11-16

WHO Recommendations

Recommendation 2: Ensure universal access to safe systems along the entire sanitation service chain.

Consider full sanitation chain from waste generation to reuse or disposal: toilet, containment, transport, treatment and end use/disposal.

STEP 2.1

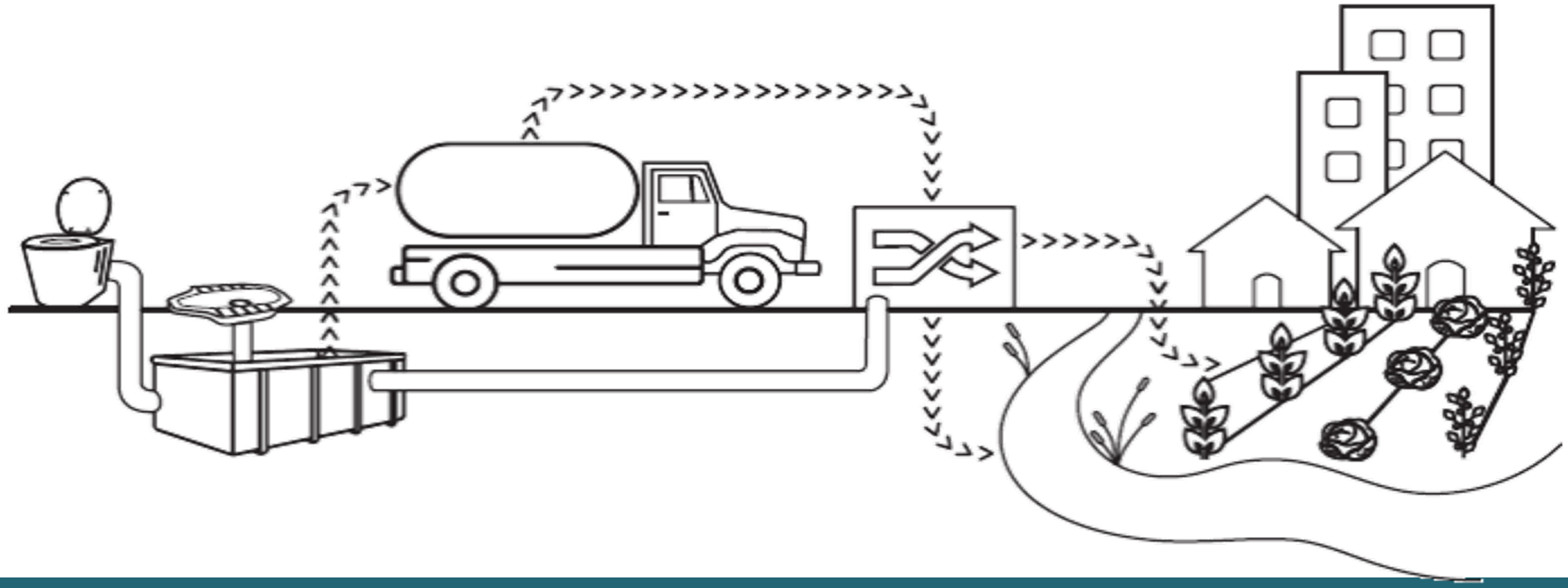
Map the system

WHO Guidelines
Chapter 3
Pages 29-58

WHO Recommendations – Chapter 3

Safe sanitation systems

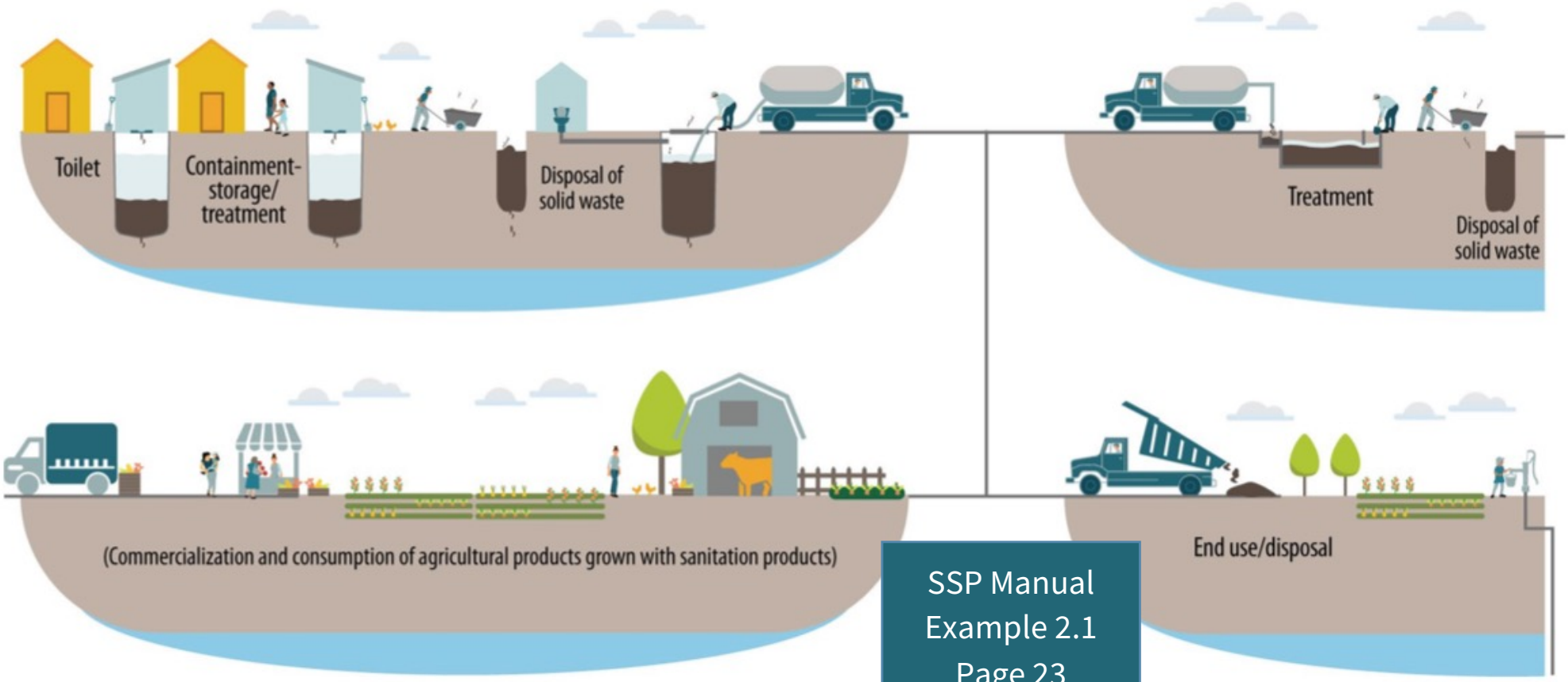
Sanitation systems are a combination of technologies and services that, when linked and properly managed, can form a safe chain.



STEP 2.1

Map the system

Simplified drawings or free-flowing sketches



SSP Manual
Example 2.1
Page 23

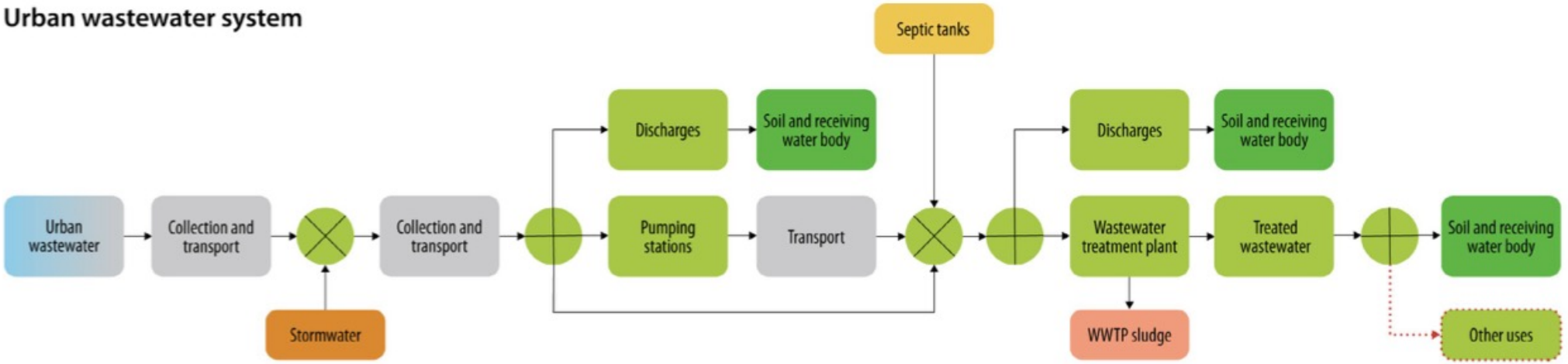
STEP 2.1

Map the system

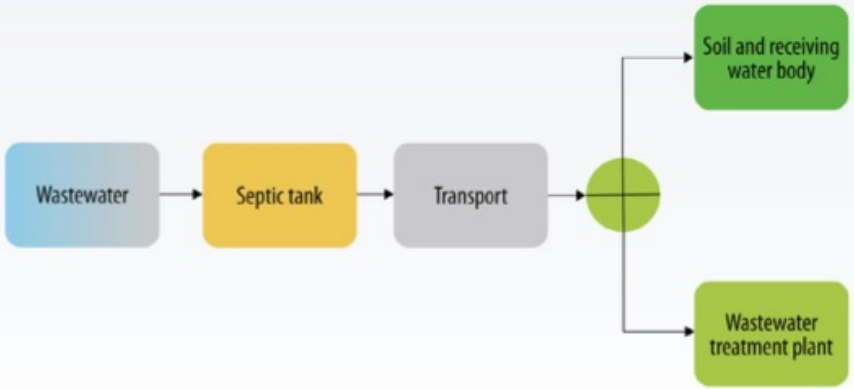
System process diagram

EXAMPLE: Map of system consisting of a dry or flush toilet with pit, liquid effluent infiltration and off-site treatment of faecal sludge for reuse

Urban wastewater system



On-site septic system



SSP Manual
Example 2.2
Page 24

STEP 2.1

Map the system

TIP

Checklist of issues to consider when developing a system map

- Identify **all the steps** of the sanitation service.
- Include **all sources** of system flows.
- Identify **areas in which faecal sludge is being dumped** legally and illegally.
- Identify areas where **open defecation** is known to occur.
- Identify **public and shared toilets** that serve a considerable proportion of the community.
- Include **drinking-water sources** where this is relevant to the system or could be affected by the sanitation system.

SSP Manual Guidance Note 2.2 Page 26

STEP 2.1

Map the system

Establish the path of different of system flows through the sanitation system

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

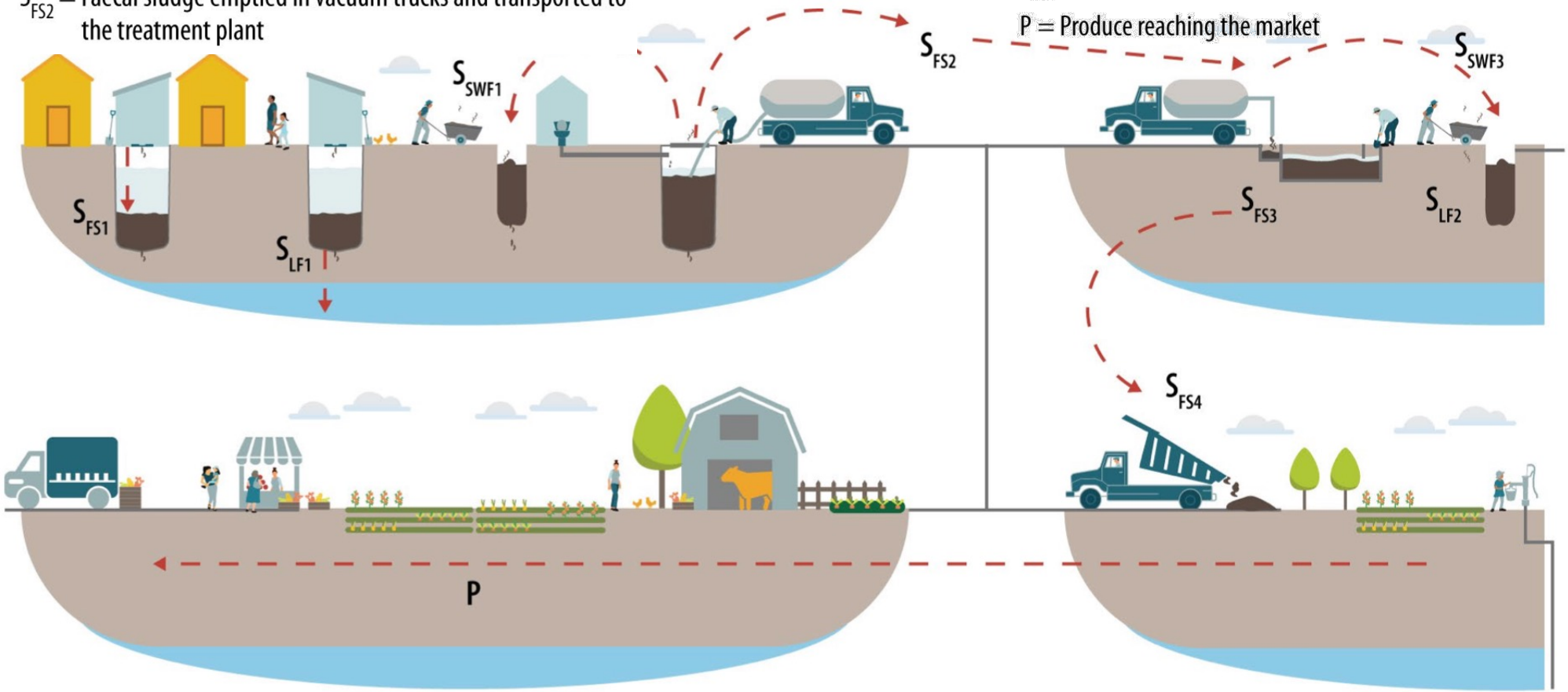
S_{SWF3} = Solid waste fraction screened out before treatment

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



STEP 2.2

Characterize system flows

OBJECTIVE

This step involves collecting key quantitative information, and examining the microbiological, physical and chemical constituents of flows along the sanitation system.

SSP Manual Guidance Note 2.2 Page 26

Factors to consider when characterizing system flows

- Focus on excreta-related inflows and effluents in each step of the system.
- Key information:
  - **flow rates**, where known, including for different seasons, or different levels of rainfall, in the context of potential climate change impacts; and
  - **capacity** or design loading of components, where known (e.g. treatment plant flow or loading limits, transfer system capacities).

STEP 2.2
Characterize system flows

SSP Manual
Tool 2.1
Page 27

Use the template to characterize system flows:

TOOL 2.1. Template to characterize system flows

SANITATION STEP	DESCRIPTION OF THE SYSTEM FLOW (Focus on excreta-related flows, such as wastewater or sludge. Also list other waste streams when relevant to the sanitation system)	KEY INFORMATION OF THE SYSTEM FLOW (Volume, flow, concentration, etc.)	EXPECTED VARIATIONS (Seasonal variations or unusual events, such as accidentally mixed components or climate events)	TYPE OF POTENTIAL HAZARD (Biological, chemical or physical)

STEP 2.2

Characterize system flows

Hazards

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

Biological

Microbiological pathogens:

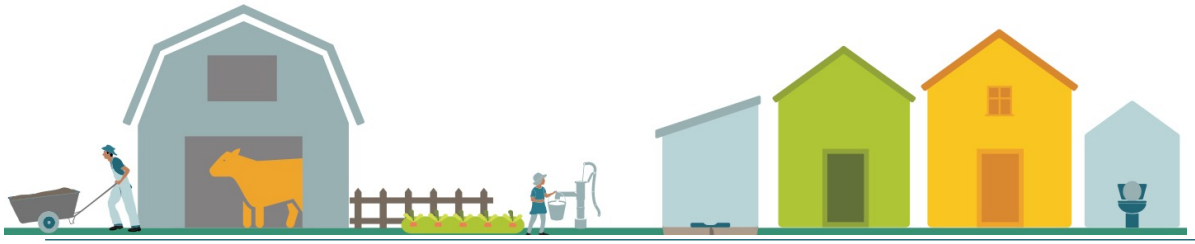
- Bacteria
- Viruses
- Protozoa
- Helminths
- Vector-borne

Chemical

- Heavy metals in sludge or biosolids
- Herbicides and pesticides

Physical

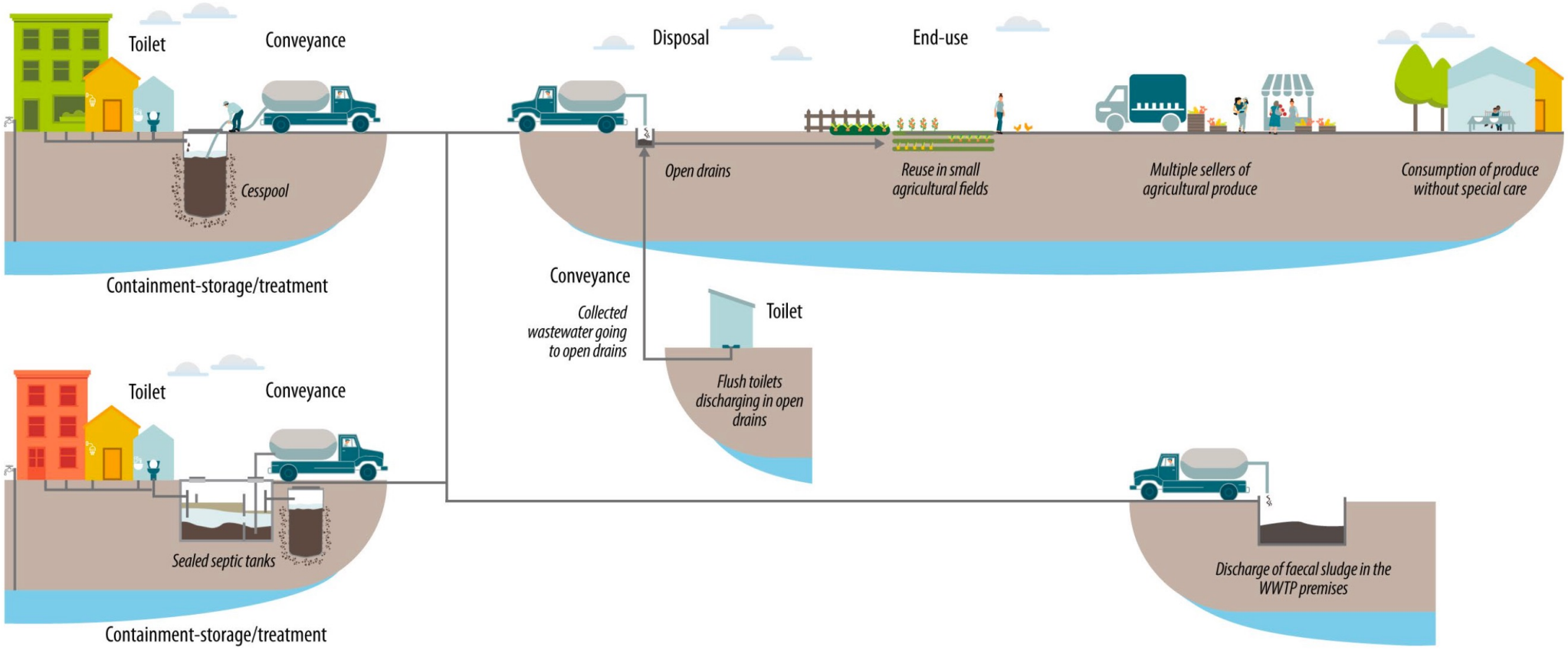
- Sharps (e.g. needles)
- Odours
- Physical injury from equipment

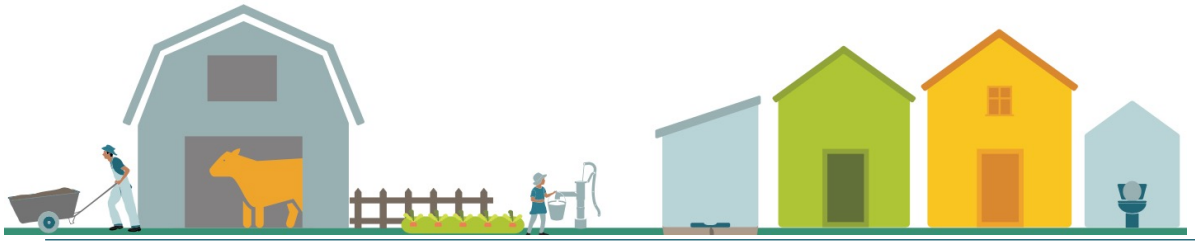


Worked example: SSP IN NEWTOWN

Module 2: Describe the sanitation system

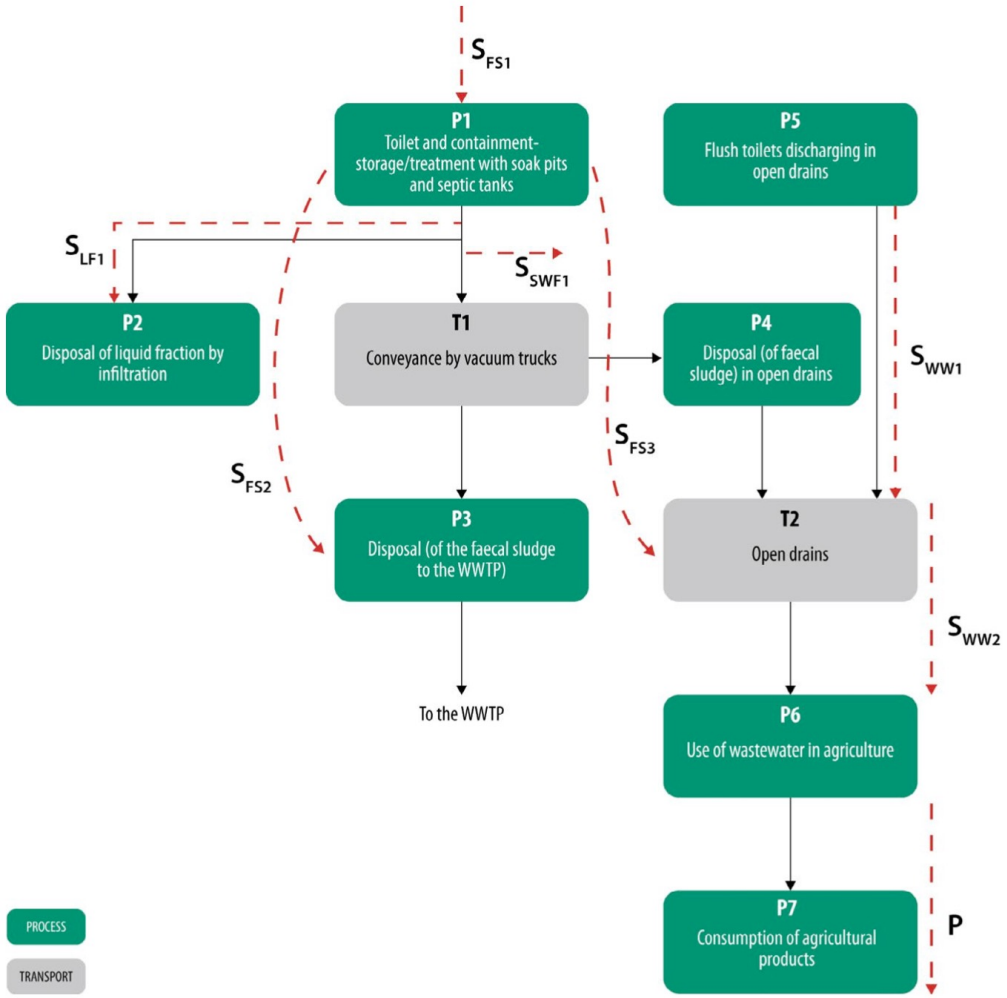
Step 2.1. Map the system





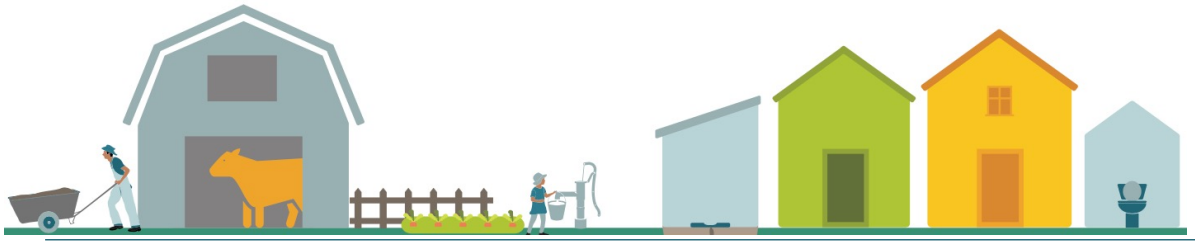
Worked example: SSP IN NEWTOWN

Step 2.1. Map the system



The description of each system flow is as follows:

- S_{FS1} = faecal sludge collected in soak pits and septic tanks
- S_{LF1} = liquid fraction that percolates from soak pits and septic tanks
- S_{SWF1} = solid waste fraction screened out during emptying of soak pits and septic tanks
- S_{FS2} = faecal sludge emptied into vacuum trucks and transported to the WWTP
- S_{FS3} = faecal sludge emptied into vacuum trucks and discharged in open drains
- S_{WW1} = wastewater transported from households directly to open drains
- S_{WW2} = wastewater transported in open drains
- P = produce reaching the market.



Worked example: SSP IN NEWTOWN

Step 2.2. Characterize system flows

Sanitation step	Description of the system flow	Key information	Expected variations	Type of potential hazard
P1: Toilet and containment–storage/ treatment with soak pits and septic tanks	S_{FS1} = faecal sludge collected in soak pits and septic tanks Faecal sludge – solids and water that are collected in underground tanks	About 7000 m^3 collected. BOD could reach 600 mg/L.	The sludge could contain anal cleansing materials, menstrual hygiene products, sharp objects and other foreign material. It may also contain chemicals present in greywater.	Biological Physical Chemical
P2: Disposal of liquid fraction by infiltration	S_{LF1} = liquid fraction that percolates from soak pits and septic tanks Liquid fraction resulting from infiltration of wastewater from soak pits and unsealed/broken septic tanks	Concentrations of nitrates and nitrites are estimated to be high in groundwater (>50 mg/L for nitrates).	Percolation increases with rainfall. There could be some traces of chemicals in greywater.	Biological Chemical
T1: Conveyance by vacuum trucks	S_{SWF1} = solid waste fraction screened out during emptying of soak pits and septic tanks Solid waste is screened out while pumping out the faecal sludge. Operators throw the solid waste into the nearest waste dump.	About 2 kg of solid waste is screened out each time.	With heavy rainfall, solid waste ends up in the open drains.	Biological Physical
P3: Transfer of the faecal sludge to the WWTP	S_{FS2} = faecal sludge emptied into vacuum trucks and transported to the WWTP	About 20 m^3 of faecal sludge is emptied every day.	No expected variations.	Biological
P4: Disposal of faecal sludge in open drains	S_{FS3} = faecal sludge emptied into vacuum trucks and discharged in open drains	About 40 m^3 of faecal sludge is emptied every day.	Heavy rainfall leads to heavy dilution in open drains.	Biological
P5: Flush toilets discharging in open drains	S_{WW1} = wastewater transported from households directly to open drains	About 1000 m^3 of wastewater. BOD could reach 600 mg/L.	No expected variations.	Biological Chemical
T2: Open drains	S_{WW2} = wastewater transported in open drains Stormwater – surface water including urban runoff mixed with wastewater	There are no data about stormwater. Diluted BOD could reach 300 mg/L.	No expected variations. The wastewater will contain a wide range of dilute constituents, including nutrients, metals, pathogens, organic material (oxygen-demanding substances), hydrocarbons, animal wastes and solid waste.	Biological Chemical Physical
P6: Use of wastewater in agriculture	S_{WW2} = wastewater transported in open drains Stormwater – surface water including urban runoff mixed with wastewater	It is not known how much water is used by farmers.		Biological Chemical Physical
P7: Consumption of agricultural products	P = produce reaching the market	There are no data about quantities.	In dry seasons, more products are expected to be grown using wastewater.	Biological

STEP 2.3

Identify exposure groups

OBJECTIVE

This step identifies and characterizes exposed groups in terms of who they are, how many there are, where are they in the system and how exposure occurs.

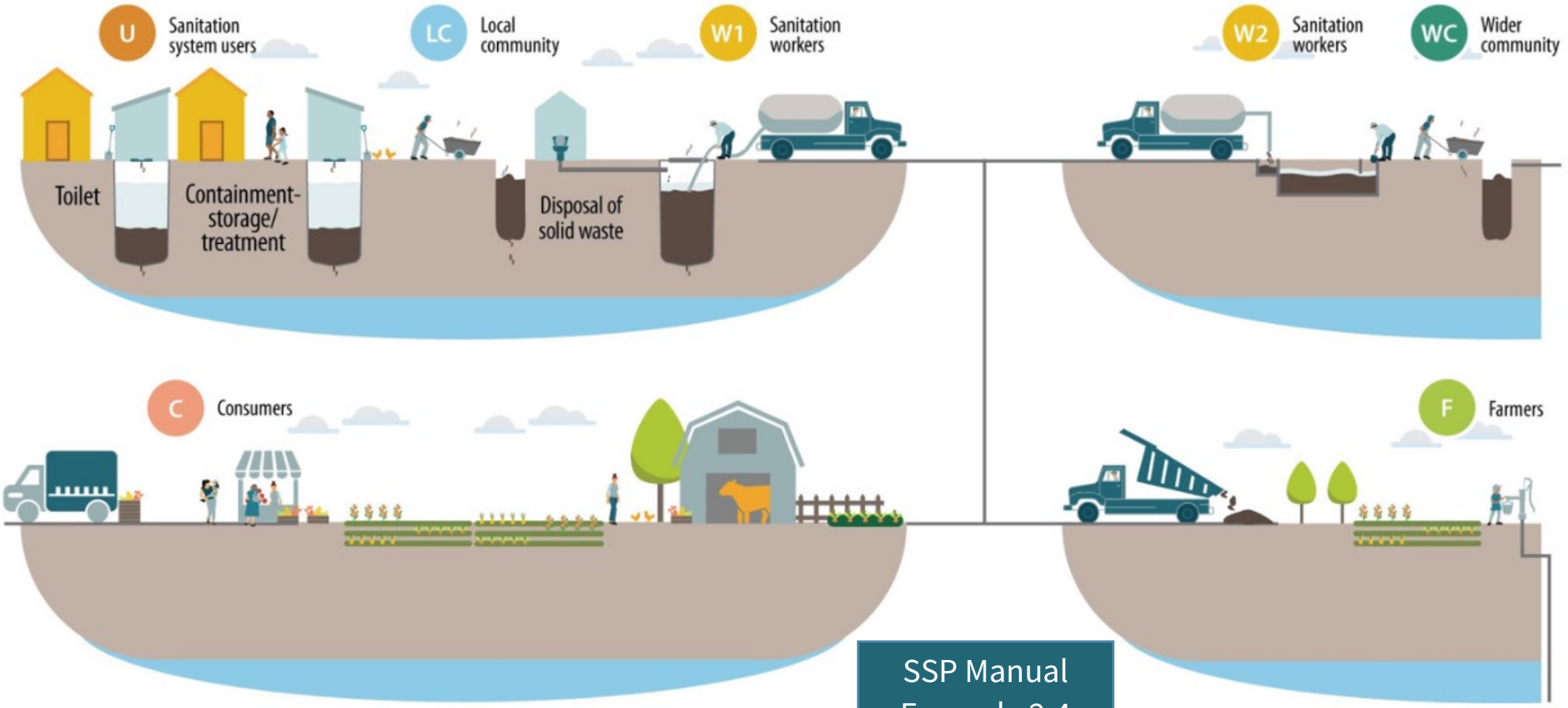
Exposure groups categories: People who might be exposed to sanitation –related health hazards.

SSP Manual Guidance Note 2.3 Page 28

- **U= Sanitation systems users**
- **L= Local community**
- **W= Sanitation workers**
- **WC= Wider community**
- **F= Farmers**
- **WC= Consumers**

STEP 2.3

Identify exposure groups



SSP Manual
Example 2.4

Page 31

World Health Organization

STEP 2.3

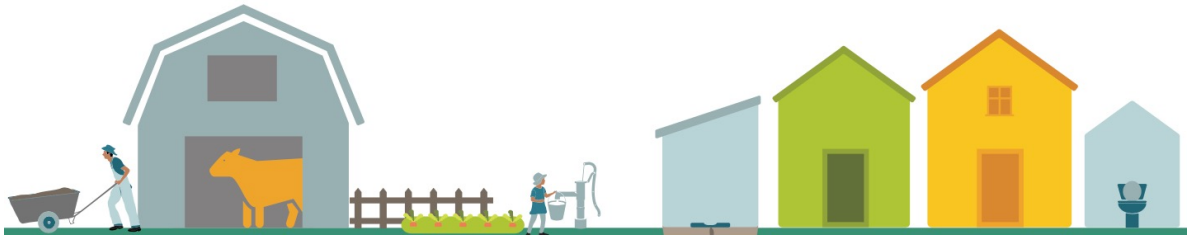
Identify exposure groups

Use tool 2.2 to characterize exposure groups

TOOL 2.2. Template to characterize exposure groups

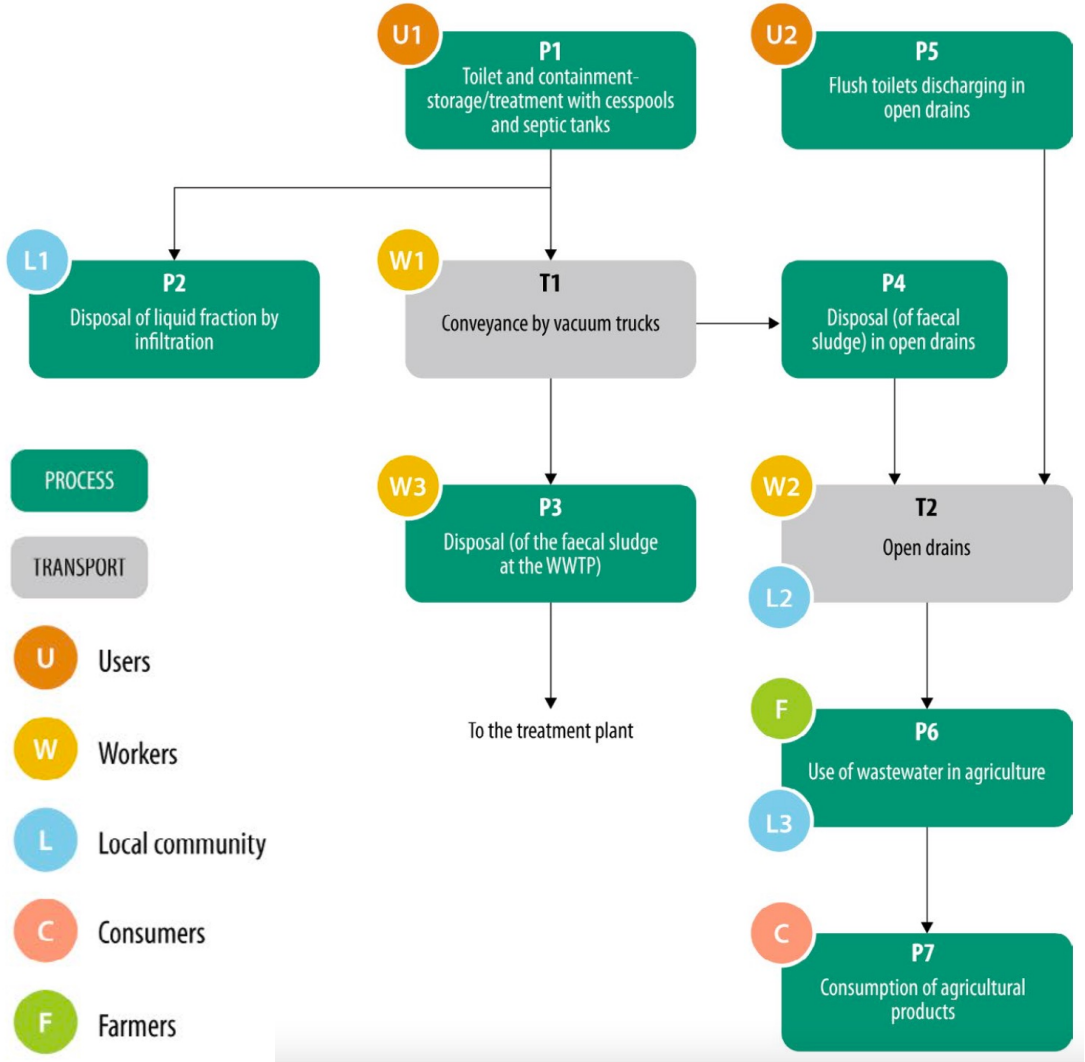
SANITATION STEP	EXPOSURE GROUP	WHO ARE THE EXPOSURE GROUPS? (Description of these people)	HOW MANY ARE THERE? (Actual numbers, if known; otherwise estimate)	WHAT ARE THEY DOING THERE? (Circumstances under which they might be exposed to hazards in the system flow)	WHAT ARE THEY EXPOSED TO? (Which system flows and which types of hazards they have contact with)	HOW OFTEN ARE THEY EXPOSED TO THIS? (Exposure frequency: daily, weekly, once a year, etc.)
Containment–storage/ treatment	U1	Users of flush toilets connected to septic tanks on their properties	400 households (around 2000 people); about half are children	Septic tanks are usually outside the house, in the backyard. Children play and adults perform different activities in the vicinity of the tank.	They could have contact with wastewater during overflows. They are exposed to microorganisms.	It could happen every 3 years, but is more frequent during heavy rainfall.
Disposal	WC1	Visitors to the nearby river	About 5000 people; about 70% are children	These are local tourists who come to the river for recreation. They swim and gather along the river during weekends.	Microbial contamination when the treatment ponds overflow. They could ingest contaminated river water.	Daily contact during summer months.

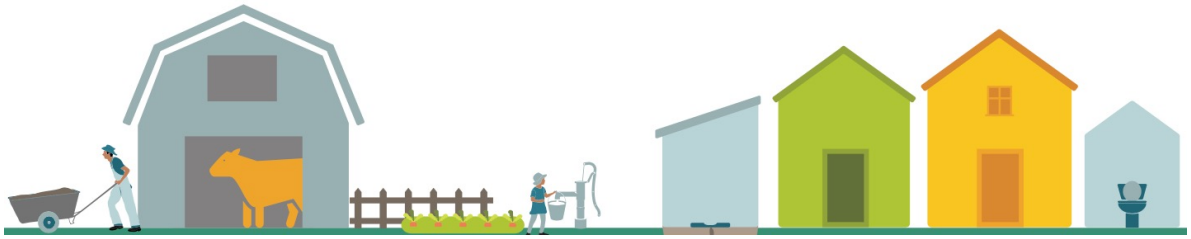
SSP Manual
Tool 2.2
Page 30



Worked example: SSP IN NEWTOWN

Step 2.3. Identify exposure groups





Worked example: SSP IN NEWTOWN

Sanitation step	Exposure group ID	Who are the exposure groups?	How many are there?	What are they doing there?	What are they exposed to?	How often are they exposed?
P1: Toilet and containment–storage/treatment with soak pits and septic tanks	U1	Users of flush toilets connected to septic tanks and soak pits in their properties	6000 households (around 30 000 people). About 40% are children.	Septic tanks and soak pits are usually outside the house, in the backyard. Children play and adults perform different activities in the vicinity of the tank.	They could have contact with wastewater during overflows. They are exposed to microbial pathogens.	Overflow could happen every 3 years, but is more frequent during heavy rains.
P2: Disposal of liquid fraction by infiltration	L1	Families living in areas where septic tank effluent and soak pits infiltrate to the groundwater	4000 households (about 20 000 people). About 40% are children.	They usually have shallow wells because the water supply is not reliable.	High concentrations of *E. coli* in water samples from shallow wells	It could be daily when the water supply is low. However, this situation is worst during dry periods.
P5: Flush toilets discharging in open drains	U2	Users connecting their wastewater pipes to open drains	1000 households (about 5000 people)	They live in houses not connected to the sewer systems.	There could be a backflow to their houses when the water levels in open drains are too high.	This is very rare.
T1: Conveyance by vacuum trucks	W1	Private vacuum truck operators	About 20 operators (10 trucks, working in groups of 2)	They open the underground tanks, insert the hose and empt the soak pits. They also handle the solid waste extracted.	They are in direct contact with faecal sludge, which contains microbial pathogens.	Every day
P3: Transfer of the faecal sludge to the WWTP	W3	WWTP operators who receive faecal sludge	3 operators (working in shifts of 2 people)	They usually do not come into contact with the sludge (i.e. only administrative work).	They are not in direct contact with faecal sludge.	Not applicable
P4: Disposal of faecal sludge in open drains	L2	All citizens of Newtown	50 000 people	They walk and live beside the open drains, which were designed for stormwater. Children play near the drains.	Mosquitoes breeding, pathogens from the wastewater and sharp objects in the solid waste. They are also exposed to blockages and inundation during heavy rainfall.	Every day; the problem increases during heavy rains.
T2: Open drains	W2	Open drain workers	6 operators (working in shifts of 2 people)	They are in charge of removing the solid waste from the drains and cleaning blockages.	Pathogens in the wastewater. During the dry season, they are exposed to aerosols and sharp objects.	They clean the open drains twice a month.
P6: Use of wastewater in agriculture	F	Farmers using the open drain wastewater to irrigate their land	30 families (about 150 people)	They are in direct contact with the water.	Pathogens, including helminths, and mosquitoes	Every day, but specially during the dry season.
	L3	Community living around the farming plots	150 families (about 750 people)	They live around the farms.	Occasional bad smells and mosquitoes. Children play in the area, and hookworms are very common.	Every day, but specially during the dry season.
P7: Consumption of agricultural products	C	Consumers of farm products	200 families. It is thought that only families living around the farms buy the products.	They eat the products without much care.	Pathogens	Every day, but specially during the dry season.

STEP 2.4

Gather supporting information

OBJECTIVE

To identify the relevant health hazards to which our exposure groups are exposed.

For that, we collect and document information about the context (the reality) in which the sanitation system exists.

Potential hazards:

Biological

Microbiological pathogens:

- Bacteria
- Viruses
- Protozoa
- Helminths
- Vector-borne

Chemical

- Heavy metals in sludge or biosolids
- Herbicides and pesticides

Physical

- Sharps (e.g. needles)
- Odours
- Physical injury from equipment

Relevant hazards:

- Actual presence of the pathogens in the community
- Actual performance of the treatment system… etc.

STEP 2.4

Gather supporting information

Let's recap:

Waste fractions from Step 2.2 → Potential health hazards → Contextual and health data → Identify relevant health hazards

Use epidemiological and environmental data where available.

For example, if helminths have been identified as a potential health hazard, the characterization aims to determine which species are endemic and to what extent.

STEP 2.4

Gather supporting information

Environmental transmitted pathogens

- We are continuously exposed to microorganisms
- Only a small proportion cause infection and disease.

Pathogens: microorganisms that cause disease

Enteric pathogens: Microorganisms transmitted by the fecal-oral route and infect the gastrointestinal tract.

To cause illness, the pathogen must usually first grow within or on the host.

STEP 2.4

Gather supporting information

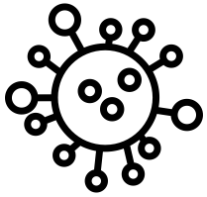
Organism	Per Gram of Feces
Protozoan parasites	10^6–10^7
Helminths	
Ascaris	10^4–10^5
Enteric viruses	
Enteroviruses	10^3–10^7
Rotavirus	10^{10}
Adenovirus/Norovirus	10^{11}
Enteric bacteria	
Salmonella spp.	10^4–10^{10}
Shigella	10^5–10^9
Indicator bacteria	
Coliforms	10^7–10^9
Fecal coliforms	10^6–10^9

At any time during infection the pathogen may be released into the environment by the host in faeces, urine or respiratory secretions.

The concentration of organisms released into the environment varies with the type of organism and the route of transmission.

Excreta related pathogens

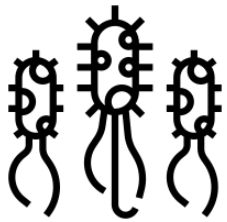
WHO Guidelines
Chapter 6
Pages 100-124



Viruses

- 20 – 100 nm

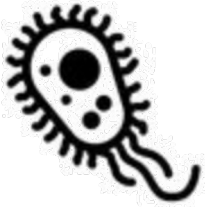
- Can be excreted in very high numbers and are transported long distance in water.
- Predominantly cause gastroenteritis, hepatitis A&E and viral meningitis.



Bacteria

- 0.2 – 2 µm

- Enteric, transmitted by faecal-oral route.
- Cause gastroenteritis, typhoid, E. coli diarrhoea
- Cause severe health outcomes and long term effects

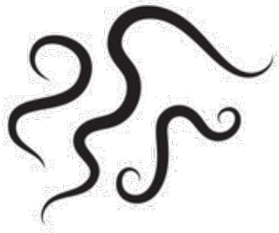


Protozoa

3 – 20 µm

hair

- Enteric, cause gastroenteritis, Amoebic dysentery, giardiasis.
- Production of cysts or oocysts enhance the survival in the environment.



Helminths

1 – 300 µm

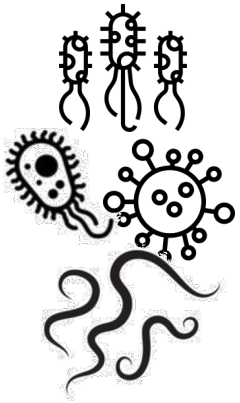
Visible

- Soil-based and water based-worms.
- Ingestion of eggs or skin penetration.
- Cause ascariasis, hookworms infections.

Excreta related pathogens

Environmental transmission of pathogens in faecal waste

WHO Guidelines
Chapter 6
Pages 114-119



Occurrence

Pathogens must be excreted into the environment in sufficient quantities by infected people

Persistence

Pathogens must survive on surface, water, sewage and soil, and remain infectious

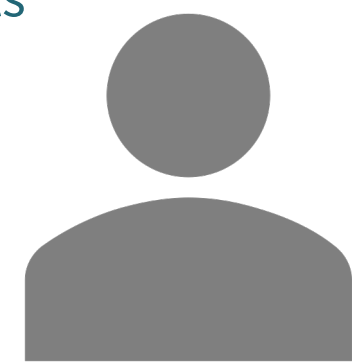
Infectivity

Specific strain and virulence

How do we detect pathogens in the environment?

Vector or hosts

Presence and abundance of any required vectors or intermediary hosts



Individual's susceptibility to infections

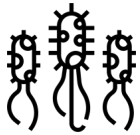
Immune status, nutritional status, age, pre-conditions

Excreta related pathogens

Environmental transmission of pathogens in faecal waste

WHO Guidelines
Chapter 6
Pages 114-119

How do we detect pathogens in the environment? (Chapter 6.3.1 WHO Guidelines)



- bacteria

- viruses

- protozoa

Indicator of faecal contamination

E. coli as combined indicator

Also enterococci and bacteroides phage

Not perfect indicators!

But

- Useful
- Feasible
- Economical

In some circumstances, it might be important to identify the source and movement of an specific pathogen.

Excreta related pathogens

Table 6.1

WHO Guidelines
Chapter 6
Pages 105-113

Table 6.1 Excreta-related pathogens (main source: Mandell, Bennett & Dolin, 2000)

Pathogen	Health significance	Transmission pathways	Important animal source	Likely importance of sanitation for control†	Concentration excreted in faeces	Duration of excretion	Additional references
BACTERIA							
Campylobacter spp.	Most common	Predominantly	Poultry	Low	106 – 109 / g	Up to 3 weeks	
VIRUSES							
Adenoviruses	A large group of distinct viruses	Person-to-person, through both	None – strict human	Low	10^{11}/g (lower with	Months after	
PROTOZOA							
Cryptosporidium spp.	One of the most common causes	Person-to-person, and	Of the two main species, C. parvum	High	—	—	Hunter & Thompson, 2005
HELMINTHS							
Ascaris lumbricoides (roundworm)	One of the most common human helminth infections globally. Largely asymptomatic. Can lead to bowel/ intestine obstruction,	Via consumption of contaminated soil and food, and hand contamination.	No (animal roundworm species not thought to be pathogenic to human).	High	10^5 eggs/g	While infection persists	Bethony et al., 2006

Excreta related pathogens

Environmental transmission of pathogens in faecal waste

Helminths

It is important to understand which helminth are endemic in the locality of the SSP.

This is because:

- Helminth infections are context specific.
- Species and concentrations of Helminth eggs in waste influence the control measures.

Examples of helminth infections

Schistosomiasis

Eggs infect snail that lives in standing waters.

Cercarie will swim and penetrate the skin of humans in the water.

Ascariasis

Transmitted by the faecal-oral route.

Contamination of produce grown with contaminated water and faecal sludge.

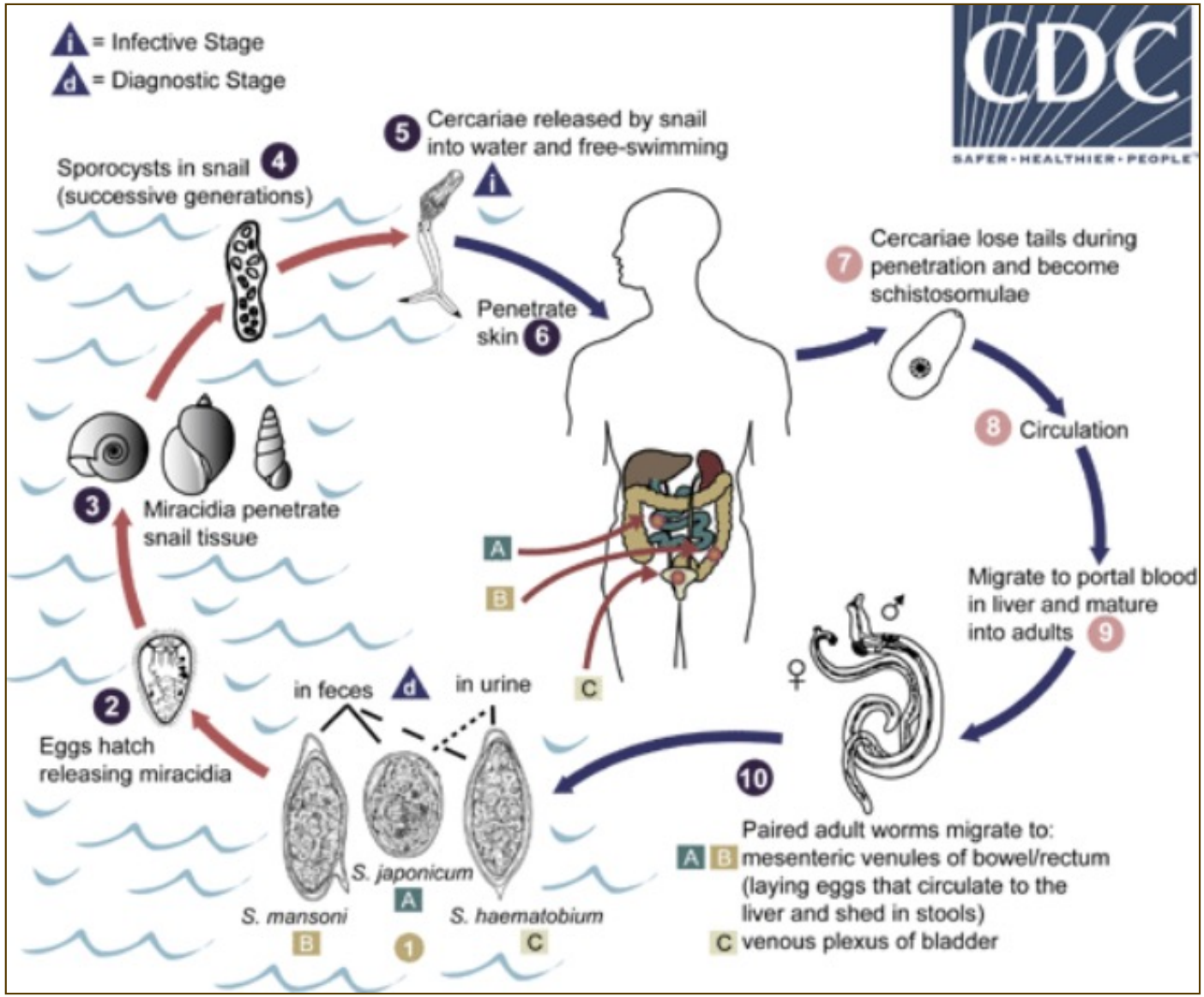
Hookworm infection

Eggs shed via faeces and the larvae penetrates the skin, usually at the feet.

Transmission route affects risk and required control measures

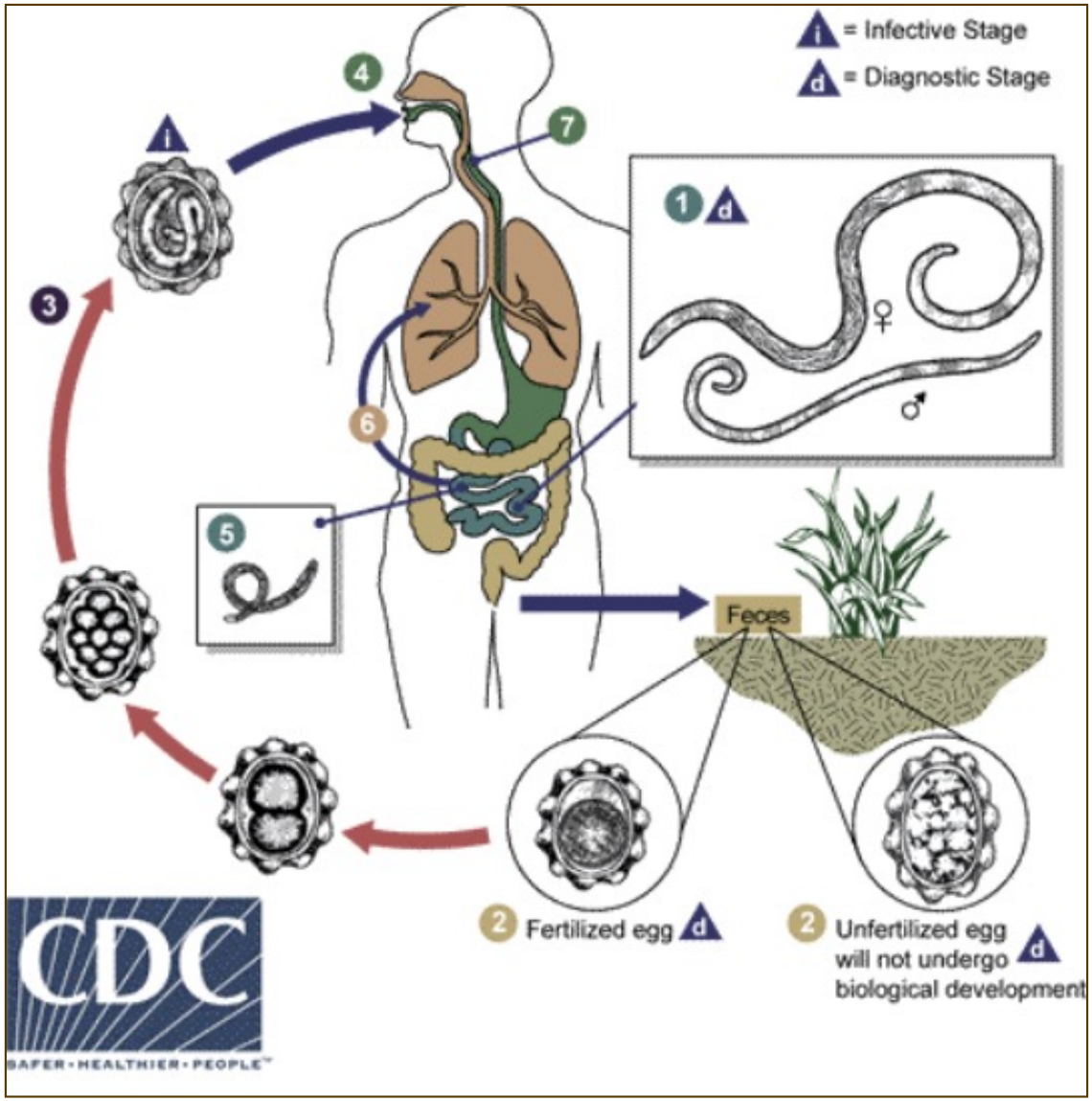
Excreta related pathogens

Helminths: transmission of Schistosomiasis



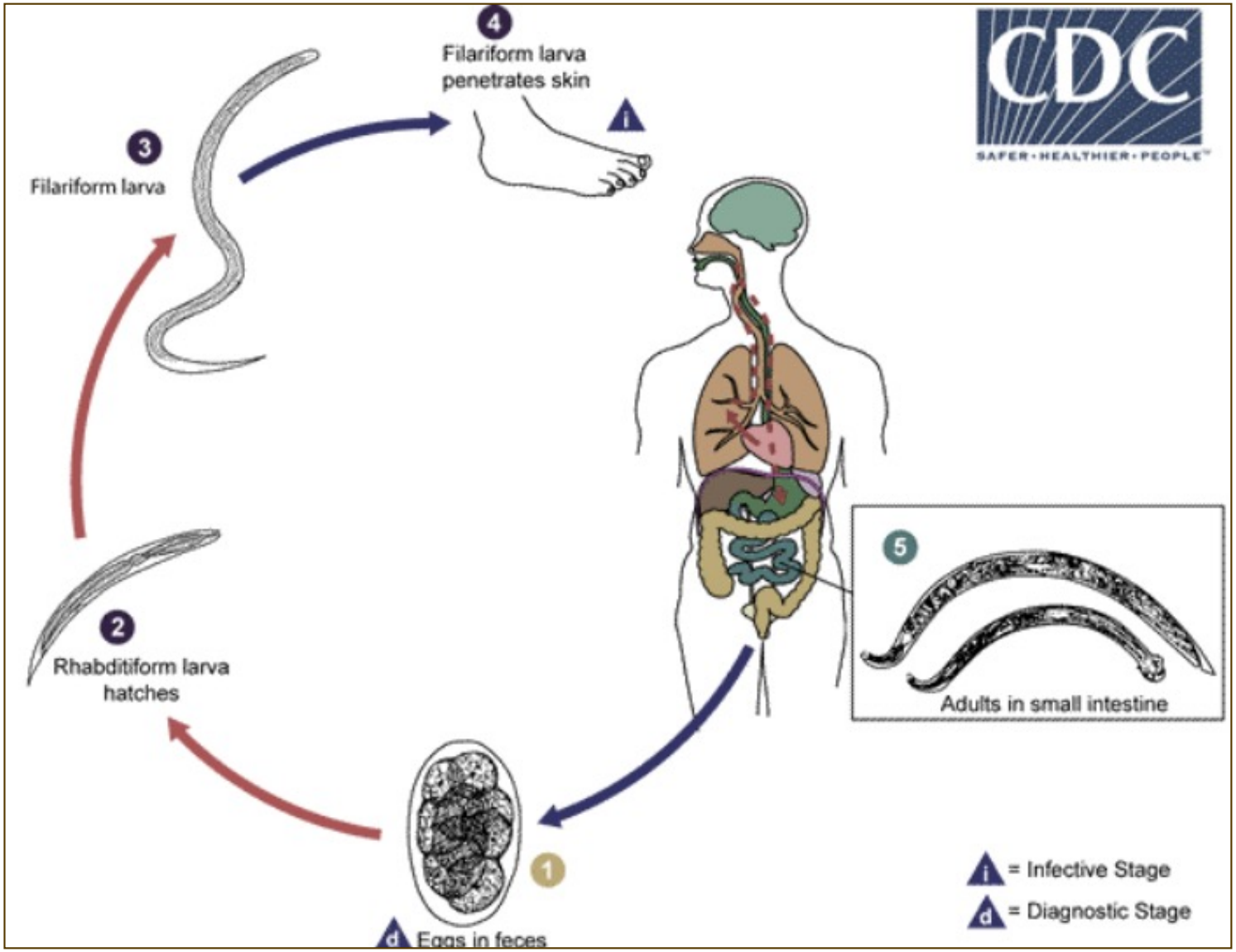
Excreta related pathogens

Helminths: transmission of Ascariasis



Excreta related pathogens

Helminths: transmission of Hookworm infection



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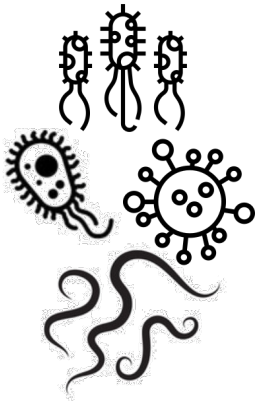
Excreta related pathogens

Environmental transmission of pathogens in fecal waste

WHO Guidelines
Chapter 6
Pages 114-119



Occurrence

Pathogens must be excreted into the environment in sufficient quantities by infected people

Infectivity

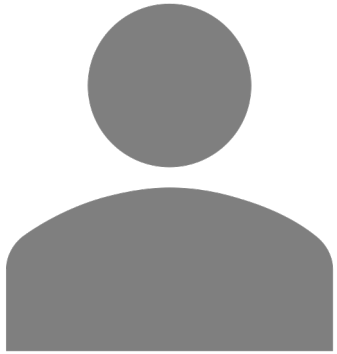
Specific strain and virulence

Persistence

Pathogens must survive on surface, water, sewage and soil, and remain infectious

Vector or hosts

Presence and abundance of any required vectors or intermediary hosts



Individual's susceptibility to infections

Immune status, nutritional status, age, pre-conditions

Why do we need to consider vectors in SSP?

Excreta related pathogens

Environmental transmission of pathogens in faecal waste

WHO Guidelines
Chapter 6
Page 104

Excreta facilitated vector breading (Chapter 6.3.1 WHO Guidelines)

- Excreta, water and waste may serve as breeding sites.
- Insects can act as vectors of disease by mechanically transporting pathogens in the environment.

Cockroaches:

Breed in excreta, such as pit latrines.

Carry human pathogens
High microbial counts.

Enhance faecal-oral transmission, providing pathways from excreta to food or kitchen utensils.

Flies:

Carry a variety of enteric pathogens, including bacteria and protozoa.

Cause trachoma.

Mosquitos

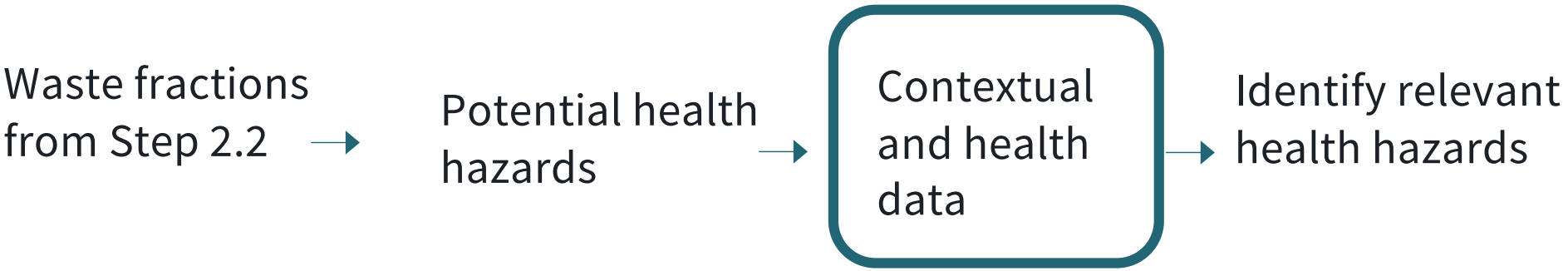
Improper drainage, stagnant water and ponds contribute to their breading.

Wide range of mosquito-borne diseases: dengue, malaria, West Nile virus, chikungunya, yellow fever…

Vector-habitat and mode of transmission must be considered in SSP

STEP 2.4

Gather supporting information



What information should we gather for our SSP?

SSP Manual Guidance Note 2.5, Page 34

Compiling biological hazard information

What should you collect?

Information about disease conditions and pathogen concentrations:

- Enteric (gastrointestinal) and urinary transmitted pathogens that exist in the community
- Vector-borne diseases (e.g. mosquito borne malaria and dengue fever, rat borne)
- Biological hazard information in relevant waste fractions (minimum: E. coli and helminth eggs)

From which sources?

- Desktop literature
- Public Health Authority
- Consultation of personnel working in health facilities

STEP 2.4

Gather supporting information

Range and quality of data

Depends on:

- What is really needed? Range of relevant information needed.
- What is available? Data availability (e.g. secondary data) and quality.
- What resources are available? Resource considerations (financial, human, time).

Data that should be sufficient:

- Official health reports, statistics
- Literature and research articles
- Direct observation
- Participatory data collections

Nice to have:

- Environmental sampling
- Epidemiological studies
- Environmental assessments

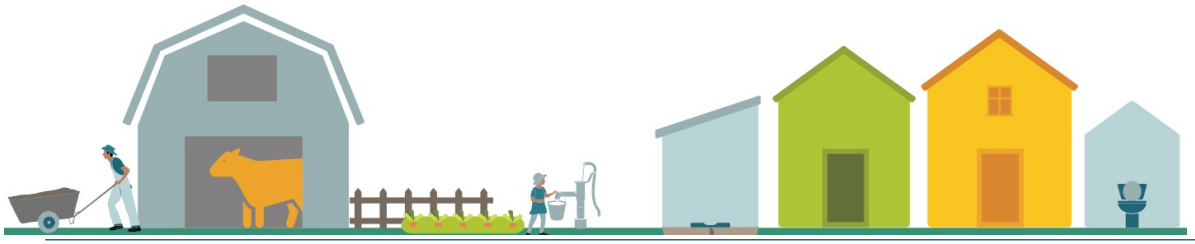
STEP 2.5

Confirm the system description

OBJECTIVE

- To ensure that the system description is complete and accurate.

- Previous steps probably largely a desk exercise.
- There is a need to check through field investigations to ensure that the information is complete and accurate.
- Tools: sanitary surveillance, transect walks, focus group tools etc.
- Validate claimed treatment efficiency by references, testing programmers etc.
- Map, system description and waste fraction characterization need to be updated after validation.



Worked example: SSP IN NEWTOWN

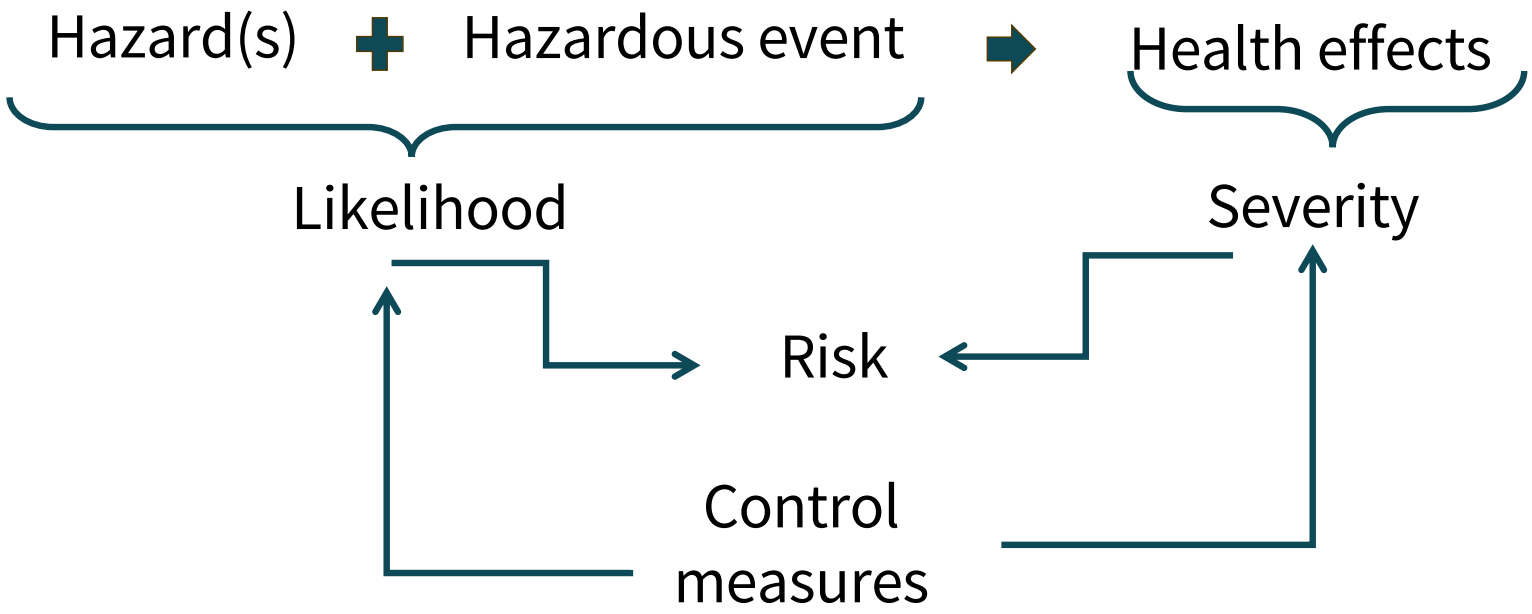
Step 2.4. Gather supporting information

Information sources	Summary of key observations
Standards and regulations	
Sanitola National Effluents Standard 2010	BOD and SS limits. *E. coli* limits of 1000/100 mL are given. Does not include limits for helminth egg concentrations. Enforcement is limited.
Sanitola Biosolid Standards and Regulations 1998	Use of WWTP sludge in agriculture is prohibited in Sanitola because of concerns about heavy metals.
Information related to system management and performance	
2020 Regional Health Department "Epidemiological study on the prevalence of helminthic infections in school-aged children"	A total of 300 school-aged children (9–14 years) were enrolled in a cross-sectional study carried out at the 10 major schools of Newtown in 2019. Hookworm and *Ascaris lumbricoides* were the most common helminth infections, with a prevalence of 21.9% and 18.4%, respectively. *Trichuris trichiura* infection was detected in 1.5% of the children. No *Schistosoma* eggs were found in any of the stool and urine samples. Outbreaks of *Cryptosporidium* have occurred in low-lying areas following flooding.
Demographics and land-use patterns	Limited space is available in Newtown. Populations from rural areas are migrating to the town in search of employment opportunities. Many move to informal settlements at the periphery of the town or in low-lying flood-prone areas where sanitation conditions are poor.
Changes relating to weather or other seasonal conditions	During the cooler months (December–February), use of wastewater by farmers is low. Reduced rainfall during the dry season causes occasional water restrictions, resulting in some households using shallow groundwater wells and an increased demand for wastewater use by farmers. Demand for pit emptying also increases during heavy rainfall events, but flooding makes access to some areas difficult. Sewers overflow during severe rain events as a result of high flow and blockages caused by solid waste.

Step 2.5: Confirm the system description

Hazards	Key information
Biological	Different viruses, bacteria and protozoa are present in the solid and liquid waste fractions. Diarrhoea prevalence is high among young children, especially during the dry season. Foodborne disease outbreaks are frequent. Helminth infections are common among the local population (prevalence of soil-transmitted helminths in school-aged children: 18–22%), with hookworm and *Ascaris lumbricoides* being the predominant species. Malaria (*Plasmodium vivax*) is the most important vector-related disease, with occasional cases being recorded at health facilities.
Chemical	Data from the national environmental monitoring programme show that concentrations of toxic chemicals such as heavy metals are below national and international reference values in Newtown's surface waters. This reflects the absence of industry in the catchment area.
Physical	Work-related injuries during maintenance of repairs of drains blocked by solid waste.

Tomorrow: Module 3



Hazard

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

Hazardous Event (HE)

Any incident or situation that:

- **introduces or releases the hazard** to the environment in which people are living or working
- **amplifies the concentration of the hazard** in the environment in which people are living or working,
- or **fails to remove the hazard**

GROUP WORK

Preparation for field visit

Sanitation Safety Planning
Dehiwala-Mount Lavinia, Sri Lanka. December 8th -12th, 2025

World Health Organization

NATIONAL WATER SUPPLY & DRAINAGE BOARD

Worksheet 1

Preparing for the field visit
Moratuwa Ratmalana
On Tuesday, December 9th, 2025

Questions regarding the description of the system (steps 2.1 and 2.2)

After discussing with your group, write in the first column in the table below what you need to find out tomorrow **to map the system** and **characterize the system flows**?

Question	**Answer** (to be filled during field visit)

Questions regarding the exposure groups and the actual hazards (steps 2.3 and 2.4)

After discussing with your group, write in the box below what you need to find out tomorrow **to identify the exposure groups** and **the actual hazards** (pathogens existing in the community?

Question	**Answer** (to be filled during field visit)

Questions regarding possible hazardous events, their probability, severity as well as the control measures in place (module 3)

Tomorrow, after the field visit, you and your group will be preparing the **health risk assessment table** of the sanitation system. This responds to the questions: *what could go wrong?* (Hazardous event), *who could get affected?* (Exposure groups), *how many of them?* And *what is in place to control the risk?* (Existing control measures). Whitin your groups, you will be completing the table, which already contains some hazardous events. During the visit, you should: (1) decide if these are relevant, (2) find out other hazardous events not listed here and (3) find all the information needed to complete the risk assessment.

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	Fecal 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.										
WWTP – Aeration tanks	Inhalation of aerosols generated by high-intensity aeration in the aerobic reactors, leading to potential exposure to bacteria, viruses, or endotoxins, especially during maintenance when operators lean over tanks or when aeration equipment malfunctions.		Workers								
			Local community								
WWTP -Sludge Dewatering – Belt Filter Press and Drying Beds	Inhalation or ingestion of pathogen-containing dried sludge dust during handling, cleaning, or loading of dewatered sludge, particularly during dry weather when particles become airborne.										

Questions regarding to climate resilience of the sanitation system

During the field visit, you should be able to evaluate the robustness of the existing infrastructure in different climate change scenarios (e.g. more intense/prolonged precipitation, sea-level rise, variable temperature, more frequent storms). To do this, complete the following table:

Climate change scenario	Is this expected?	Causes of hazardous events	Sanitation step	Effect on the sanitation system	Is the sanitation step/system robust? (yes, no). Explain	What would be the hazardous events?	Is this relevant in your system?
More intense or prolonged precipitation		Increased flooding	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				
			Treatment (holding tanks)	Treatment plants receive flows that exceed their design capacities, resulting in flows bypassing the treatment processes		Ingestion of contaminated water with raw sewage due to bypassing wastewater treatment plant	
		Increased erosion, landslides	Conveyance (sewers – pumping stations)	Destruction and damage to sanitation infrastructure			
			Treatment			Ingestion of contaminated water with raw sewage due to non-functioning wastewater treatment plant	
		Contamination of and damage to surface water and groundwater supplies	Treatment	Treatment plants receive flows with concentrations of pollutants that exceed their design capacities, resulting in lower treatment performance		Ingestion of contaminated water in partially treated sewage due to higher pollutant concentration	
		Changes to groundwater recharge and groundwater levels	Containment– storage/treatment (septic tank)	Floating of septic systems due to groundwater levels		Ingestion of pathogens after contact with fecal sludge due to floating of septic tank	
				Collapse of septic tanks, via groundwater		Injury to the body, possible asphyxiation, caused by falling into septic tanks due to collapsing latrine structure	
Sea-level rise		Saline intrusion in coastal/low-lying zones	Treatment	Damage to wastewater treatment works (which are often low-lying/coastal) from exposure to saltwater		Ingestion of microbial pathogens in surface water contaminated with partially or non-treated sewage	
				Reduced effectiveness of biological treatment processes due to saltwater exposure from saline intrusion into wastewater influent		Ingestion of microbial pathogens in surface water contaminated partially treated sewage due to higher pollutant concentration	

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Welcome to the
Sanitation Safety Planning
Training of practitioners

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

SANITATION
SAFETY
PLANNING

Welcome back from our field visit

SSP Modules

What is the system; who is at risk?

GROUP WORK

Applying Steps 2.1 to 2.4 to our case study

Within your groups:

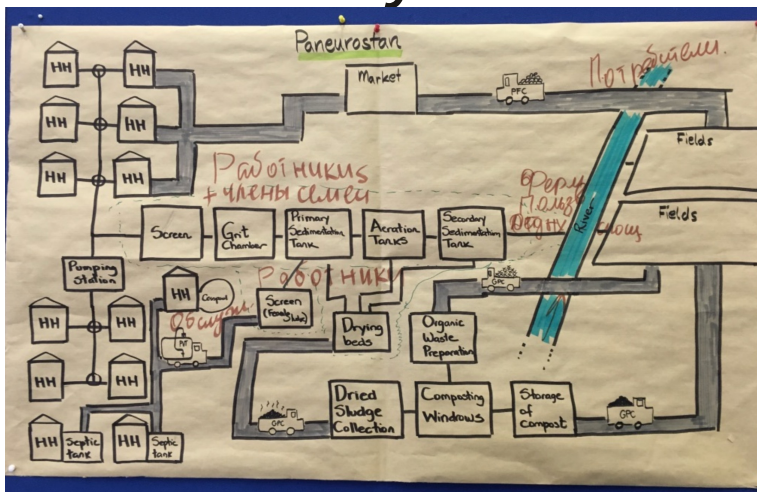
- Using markers and the flipchart provided, **prepare a map of your sanitation system**.

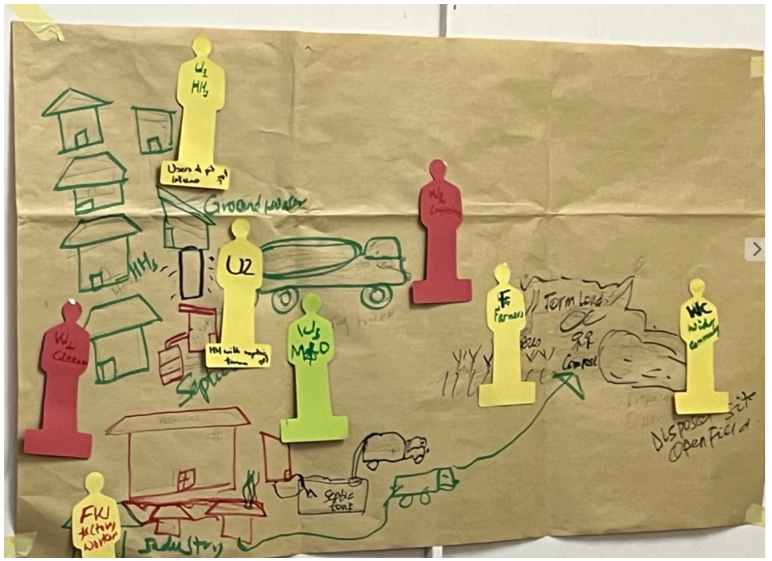
In your **maps**:

- **Establish the path** of different waste fractions through the sanitation system.
- Identify the **exposure groups**.

In your **SSP Document**:

- Characterize all system flows.
- Characterize the exposure groups.
- Identify the supporting information that needs to be collected.





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GROUP WORK

MODULE 2 Describe the sanitation system

STEP 2.1 Map the system

• Which system is your team responsible of analyzing?
Indicate in the box below what is the sanitation system that you and your team are analyzing:

[enter you answer here]
XXXXX

STEP 2.1: Map the system

Based on the description provided, what you saw during the field visit and using the brown paper and markers given to you and your team, prepare a sanitation map of the sanitation system that was assigned to you.

Remember to include all steps of the sanitation system: toilet, containment-storage/ conveyance/emptying/ transport, treatment and disposal/reuse. Use the example 2.1 in page 25 of your manual.

Don't forget to establish the path of different system flows through the sanitation system and give a System Flow Code to each flow (e.g. F_1: excreta collected in pits, F_2: sludge emptied from pits…).

[Take a picture of the brown paper and paste it here]

STEP 2.2: Characterize system flows

Use the following table to characterize system flows (for instance, feces, urine, excreta, wastewater, greywater, sludge collected, sludge emptied, dried feces, solid waste dumped in the pit etc.). Read guidance note 2.2 and tool 2.1 for more information. Include all the quantitative information you have and identify if the system flow might have a biological, chemical or/and physical hazards.

System flow code	Sanitation step	Description of the system flow	Key information of the system flow	Expected variations	Type of potential hazard

STEP 2.3: Identify exposure groups

In your maps, identify the exposure groups, using the letters U, L, W, WC, F and C are as symbols. You might want to define sub-groups, such as U1: users of latrines, U2: users of flush toilets. Use SSP manual Tool 2.2 to characterize the exposure groups. Remember the exposure groups are:

U: Sanitation system users L: Local community W: Sanitation workers
WC: Wider community F: Farmers C: Consumers:

Sanitation step	Exposure Group ID	Who are the exposure groups?	How many are there?	What are they doing there?	What are they exposed to?	How often are they exposed to this?

STEP 2.4: Gather supporting information

Write down any information you will want to obtain to characterize the system. Indicate the source of the information. Record below:

Regulatory requirements	Demographics and land use patterns
System management and performance	**Changes related to climate and weather**

MODULE 2

DESCRIBE THE SANITATION SYSTEM

SANITATION
SAFETY
PLANNING