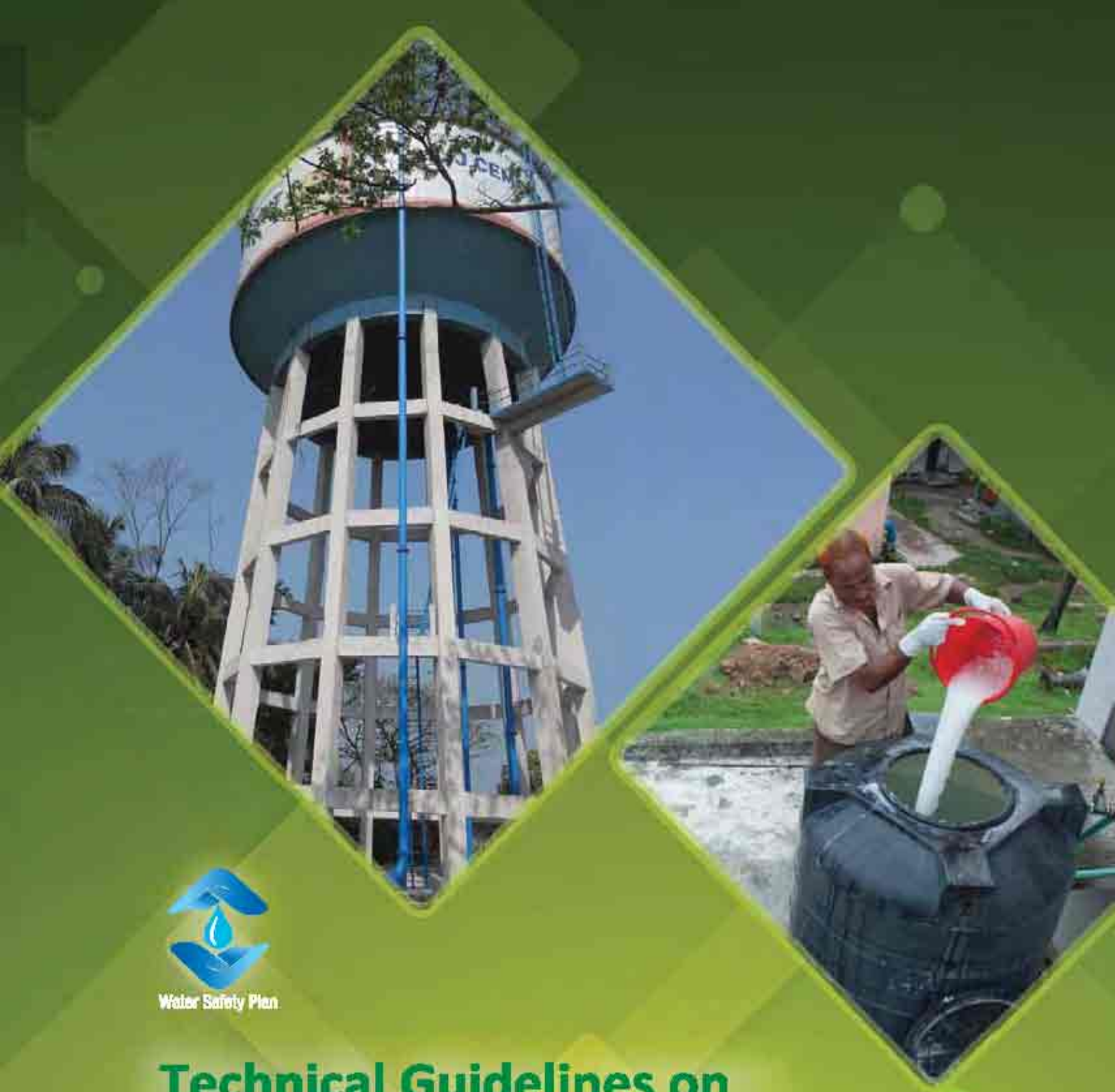

Water Safety Plan

Technical Guidelines on WSP Implementation

for Water Supply Operators

World Health Organization

Country Office for Bangladesh

TECHNICAL GUIDELINES ON WSP IMPLEMENTATION FOR WATER SUPPLY OPERATORS

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Technical Guidelines on WSP Implementation

for Water Supply Operators

Water Safety Plan

Technical guidelines for implementation of water safety plan

Who has this guidelines been prepared for?

The guidelines have been prepared for Responsible Engineer, Pipeline Mechanic or Plumber or Assistant Mechanic, Pump Operator, Sanitary Inspector/Water quality Inspector, Water Superintendent and those who are working as mechanics for technologies like: Tube well, PSF, Rain water harvesting, Ring well etc.

Purpose of the technical guidelines for water safety plan implementation

Safe water is indispensable for life. For that reason, water should be safe in all steps like collection from source, treatment, storage, distribution and uses. But due to environmental pollution, risk for water sources is on the verge of increasing. Financial cost for water treatment is also constantly increasing. It has become a challenge to properly select water source, water lifting, storage, treatment and supply by maintaining water quality. Facing this challenge, there is dearth of proper guidelines to implement water safety plan.

- Considering the above situation to implement safe drinking water supply, this technical guideline has been prepared so that the water supply operators can identify the risk of water lifting from sources, storage, treatment, supply and the means to overcome this. This will help them to lift water from the sources, preserve, purify and supply properly to the users.

- On the other hand, there are also some guidelines to implement water safety plan. But these guidelines have been prepared based on rural technologies or for the use of higher officials who are connected with water supply of municipality level. So far, there is no publication in lucid language for the mechanics who operate different technology based specially piped water supply system. Whereas technicians who are working at different stages of water supply institutions cannot lift, preserve and supply in proper way, for which the consumers cannot get safe drinking water. Considering the ways to get safe drinking water, this guideline has been prepared to support technicians involved in water supply based on different technologies at rural and urban areas in Bangladesh.

Contents

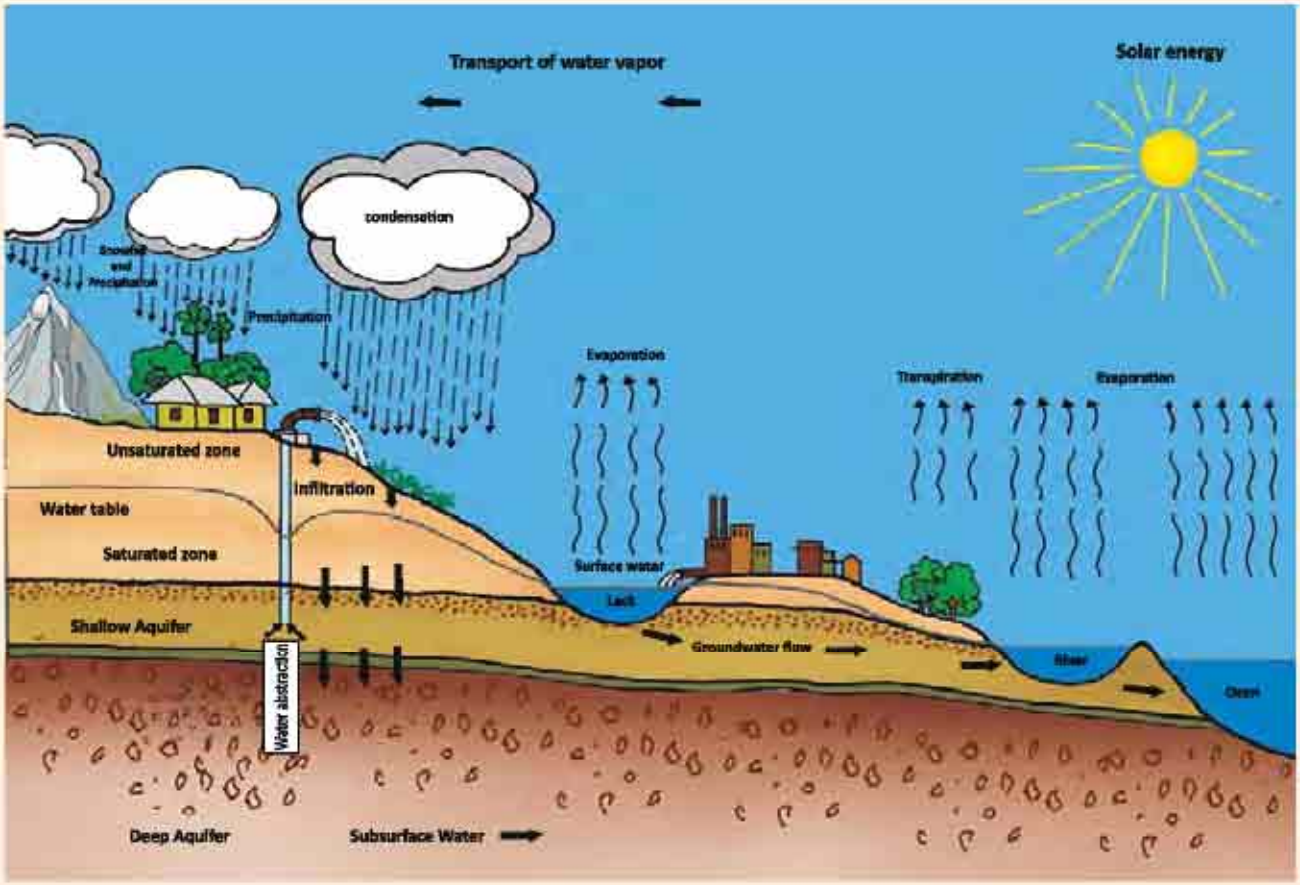
1 (One)
Water safety plans – some basics

1.1 Safe water and its source

The water which is free from microorganisms and contains acceptable level of chemicals and minerals may be called safe water. Safe water is good for drinking and is colorless and odorless.

Drinking water can be taken from three different sources:

a. Groundwater
b. Surface water
c. Rainwater



Picture: water cycle

1.2 Main technologies used to collect water from source

Piped water supply technology which may use either groundwater or surface water

Tubewell technology which uses groundwater

Pond Sand Filter (PSF) technologies which use surface water

Rain water harvesting technology which uses rainwater

Ring well technologies which use groundwater

Gravity flow system technologies which use surface water

1.3 Causes of water pollution

Causes for pollution:

- Naturally occurring chemical elements like arsenic, salt and manganese when present beyond acceptable limits in the groundwater.
- Surface water may be contaminated by different wastes.
- If water technology is not handled properly or if there are faults in the supply/ distribution line and repairs and maintain is not done properly.

1.4 Where in the water supply system does water get polluted?

Generally water is contaminated in five stages from source to the point of drinking/use, as shown below:

Stage-1

Source of water and extraction of water through technology from the sources

Stage-2

Water treatment

Stage-3

Storage

Stage-4

Distribution system

Stage-5

Collection of water, and storage and use at home

1.5 Why are water safety plans important?

Water safety plans are systematic way of managing water supply to keep water safe from its source to the point of drinking. This process emphasizes the need to keep water supply continuous and keeping water safe through proper supervision. Water safety plans cover all stages of supply from water collection to safe delivery to keep it pollution free.

When implementing WSPs, it is to be kept in mind that it is a risk-based management system. This has been shown by the picture given on the side.

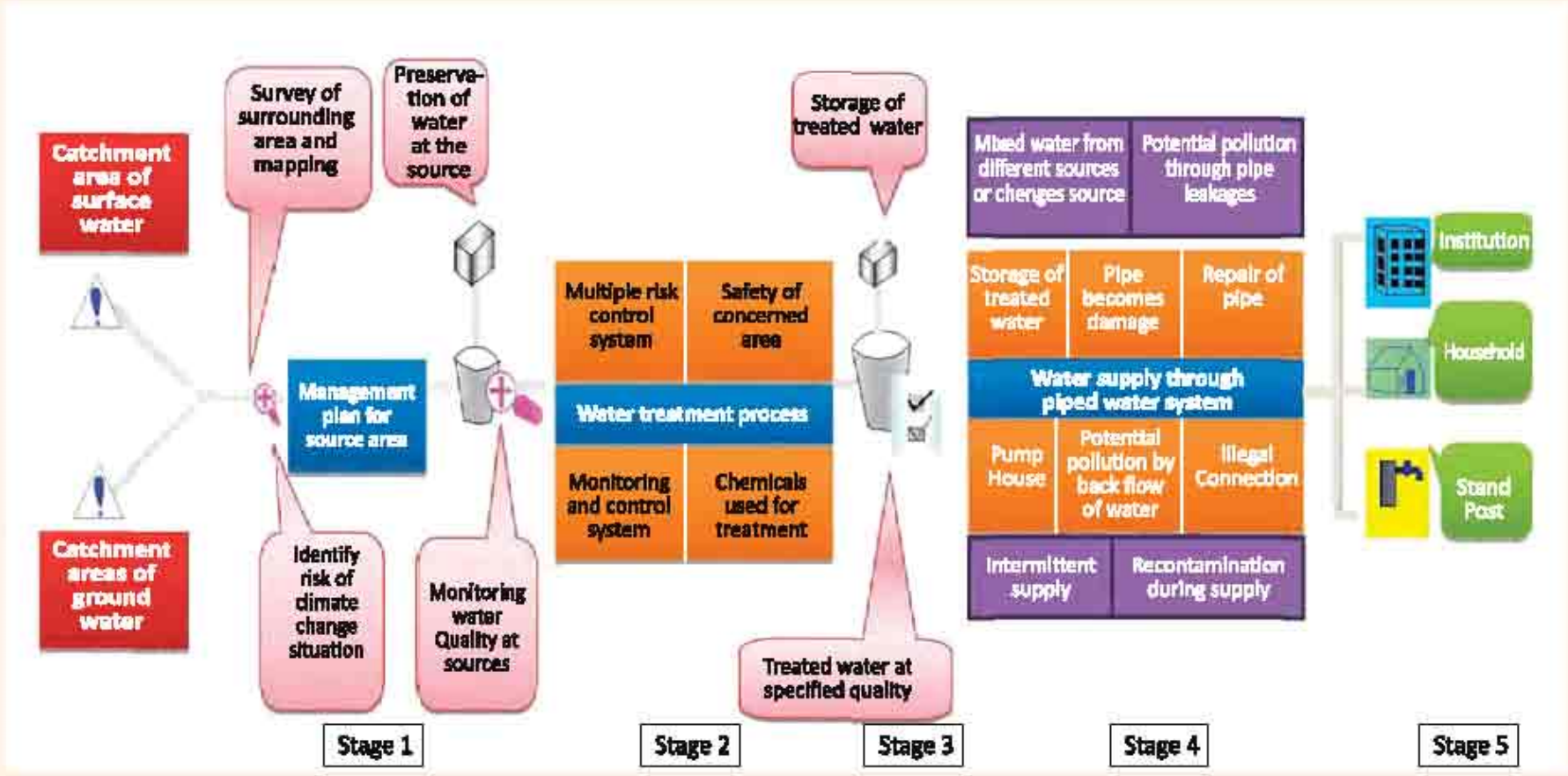
To implement this, the following things will have to be done:

- Firstly, determine the risks to the water supply system
- Then think how to manage the risks
- Lastly, regularly check that the risks are still under control. When this checking is going on, new risks may also be identified and measures will have to be taken to control these. This process of risk management should continue throughout the operation of the water supply system.

Remember: Technologies used to supply water to difrent households and establishments can be affected by various reasons including ignorance or carelessness of supply staffs. Supplying safer water to the consumers is a very important responsibility and this can be realized by implementing water safety plans in your system.

1.6 Who manages what water safety?

When thinking about the five possible stages where contamination of water can happen, risk management activities to keep water safe could be divided into two: a) the activities within the water supply system, and b) tthe activities to be carried out within the household. If these activities for water protection management are done properly, supply of safe water can be ensured to a large extent. Those activities relating to protection of the water supply technology lie with water supply staff (such as Pump Operator, Pipeline man and Mechanic). On the other hand, activities related to management of water usage lie with the consumers. Risk management related to water technology at five diferent stages is shown in the figure below:



Risk management/control system relating to water supply at different stages as stated above picture has been shown below:

Stage 1: Abstraction of safe water stage:

- Identification of risk through survey around catchment areas for surface and underground water.
- Make risk map/table as per survey data
- Prepare and implement risk management plan for water sources through analysis risk-map/table

Stage 2: Water treatment stage

- Adopt effective multiple risk management measures by analyzing present and possible risks at different stages of treatment plant during purification of water abstraction from the source
- Ensure security around treatment plant
- Regularly monitor control/protection system to ensure proper quality of water
- Properly select chemicals for water purification and maintain quality of chemicals and proper uses

Stage 3: Water storage stage

- Adopt preventive/control measures at times before or after purification and preservation in reservoir after supply. Examples include use of proper cover, regular cleaning of reservoirs etc.

Stage 4: Water distribution stage

- Adopt measures to control or prevent risks of contamination. Examples include reducing or stopping pipe leakage, back flow and illegal connections and repairing decaying or non-functioning pipes.
- Adopt possible preventive or control measures during water supply in the pipe network. Examples include maintaining minimum standard pressure & using disinfectant like chlorine to maintain residual effect.

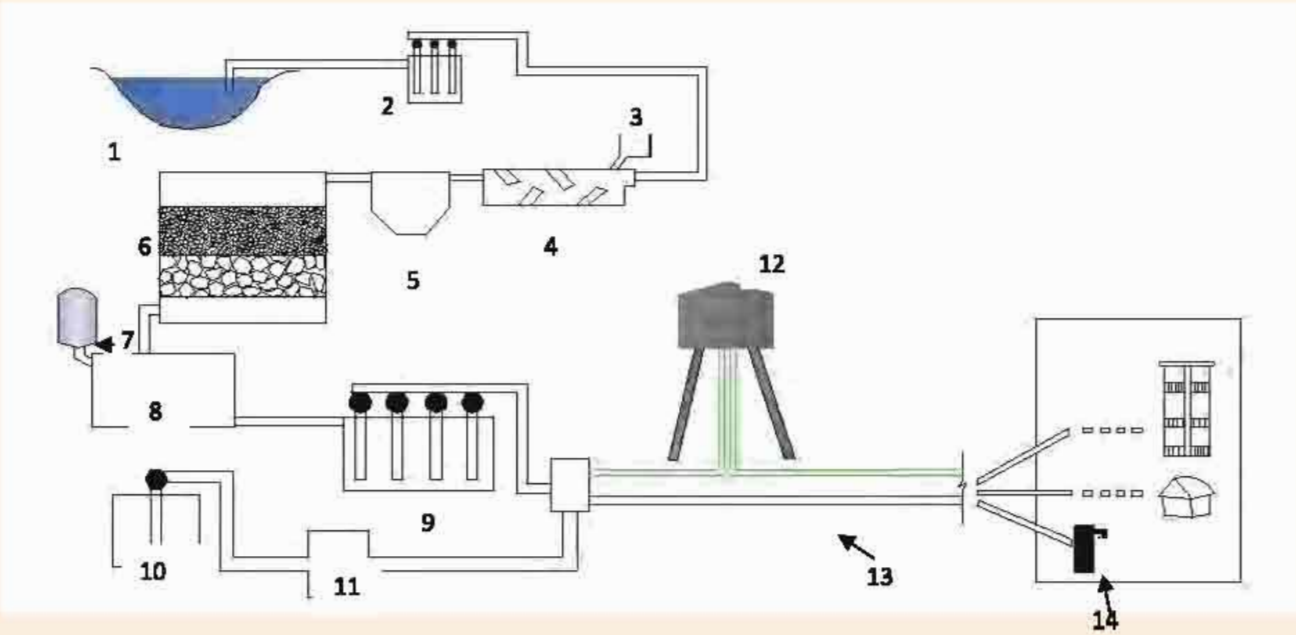
Stage 5: Water uses stage

- Adopt different risk control / prevention measures against contamination of water for different consumers such as government, non-government and private establishments, residential properties and road side or informal community settlements.

2 (Two)
Piped water supply technology

2.1 Description of piped water supply technologies

Piped water supply technologies abstract water from either surface or groundwater sources and supply to consumers through a pipeline. Water treatment is usually essential. The process of a typical piped water supply system is shown in the diagram below and on the pages that follow, photographs of the stages and components of a piped water supply system.



Surface Water		Ground Water
1. Collection of water from surface through intake	8. Storage of water in underground reservoir	10. Water abstraction through pump from ground water
2. Water abstraction through pump	9. Water supply through pump	11. Treatment of ground water
3. Mixing of alum or chemicals for coagulation	12. Water storage in overhead tank	12. Water storage in overhead tank
4. Promoting flocculation in baffle channel	13. Water supply through pipeline	13. Water supply through pipeline
5. Sedimentation in basin	14. Pipe line water connection of various water consumers	14. Water connection of various water consumers
6. Filtration in filtration chamber		
7. Chlorination or other chemicals for removal of microorganisms		

Different stages of piped water supply using surface water as source are pictorially presented below.

1. Collection from surface water source through intake

2. Water lifting through pump

3. Mixing of alum or chemicals for coagulation

4. Promoting flocculaton in baffle channel

5. Sedimentation basin

6. Filtration chamber

7. Disinfection (with chlorine) to kill microorganisms

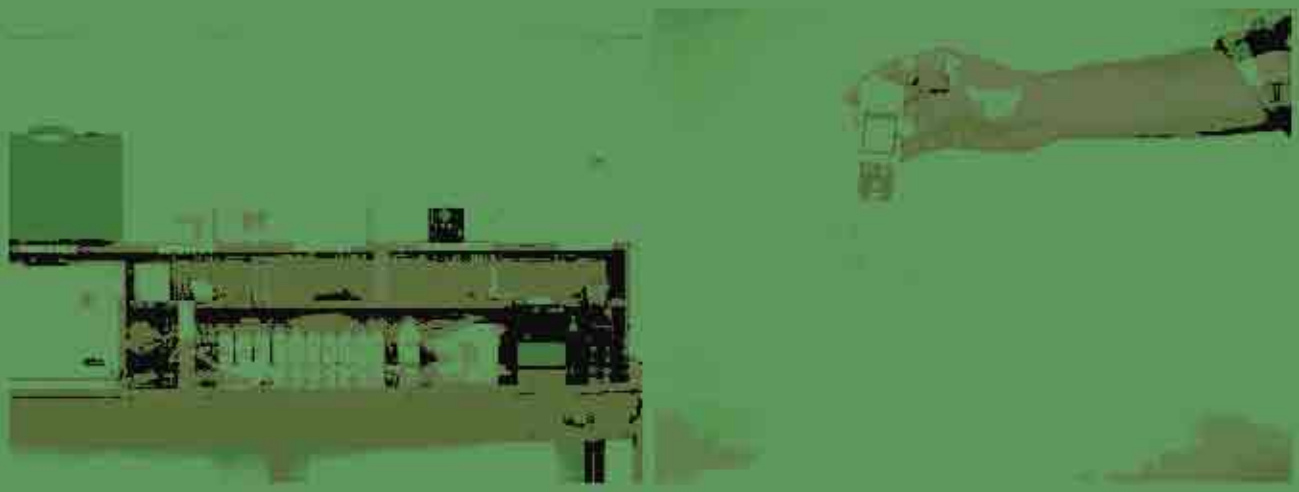
8. Water storage in ground reservoir

9. Water distribution through pump

12. Water storage in overhead tank

13. Water supply through pipeline

14. Water connection at the consumer end



15. Water quality testing following guidelines at different stages of water supply such before and doning treatment, before and after supply

Groundwater also is supplied through pipes after abstraction and treatment. Different stages of groundwater supply through pipelines are pictorially presented below:

10. Groundwater is lifted by pump

11. Treatment of ground water

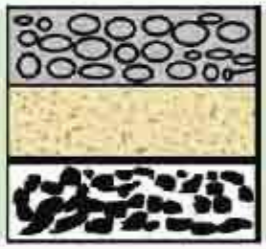
12. Water storage in overhead tank

13. Water supply through pipeline

14. Pipeline connection for various water consumers

2.2 Surface water treatment process

The treated surface water may be considered safe if its turbidity is below 5 NTU (i.e. it becomes crystal clear) and free from microorganisms (bacteria, virus & protozoa). Surface water is generally treated through the following four steps after collection from intake.

Coagulation/Flocculation	Sedimentation	Filtration	Disinfection/ Chlorination
			
Alum (aluminum sulfate) is added to the water to destabilize natural fine particulate matter suspended in water. This process is known as coagulation. After adding alum, the water is channeled through flocculation basins where it is gently mixed that bring small particles into contact so that they will collide, stick together, and grow to a size that will readily settle. These large particles are known as floc. Formation of proper floc is necessary for particles to be removed during sedimentation and filtration.	After flocculation, the water and flocs moves slowly through large basins known as sedimentation or settling basins. Here the flocs settle to the bottom of the basin that are collected and removed regularly. Clear water above the floc layer flows out to the filters. Removal of particles in the sedimentation basin improves the operation of the filters that comprises the next treatment process.	In this step, purifying of the water is accomplished by passing water through a bed of sand and gravel. Here the remaining particles of suspended matter are trapped in the sand bed. Filtered water flows from the underdrains into clear water reservoirs. To keep operating the filters are backwashed regularly. Backwashing cleans the filters by forcing clean water backward through the sand to remove the solids that are deposited in waste drains.	Water is disinfected to kill any pathogens that pass through the filters and to provide a residual effect. The most common disinfection method involves chlorination. Generally, sodium hypochlorite (also known as household bleach) is used for chlorination that releases free chlorine when dissolved in water. Low levels of chlorine (approximately 0.2 ppm) should be maintained in the distribution systems pipes and home plumbing to prevent the growth of microorganisms.

2.3 Groundwater treatment process

Usually treatment for microorganism is not needed for groundwater. But, if water contains chemicals like arsenic, iron, manganese or chloride (salt) above the acceptable limit then treatment is needed to bring them within acceptable limits. Some removal technologies are described below.

Arsenic removal technology

Sidko filter

Sono filter

Various types of filters to remove arsenic from water are available in the market. These include Sidko filter/plant at community level, and Read-F and Sono-filters at household level.

Chloride (salinity) removal technology

Reverse osmosis

Reverse osmosis is used to remove chloride. This is costly to operate and maintain. Reverse osmosis can removes arsenic also.

Arsenic–iron removal system

There are usually two components in an iron removal system. These are for aeration and a sandstone based filter-bed. Through this process, the level of iron and arsenic can also be reduced.

3 (Three)
Risks associated with piped water supply technologies and their control or prevention

In order to maintain the safty of water it is important to focus our work at all the five stages of water system where contamination generally takes place through implementation of water safety plan. Generally, two types of activities are considered at each stage: 1. identify the causes of water contamination (and the associated risks) and adopt measures to prevent or control them, and 2. monitor these control measures. Examples of risks and their control measures are shown below for both surface and groundwater systems.

3.1 Water safety plan activities during abstraction of water from sources (Stage 1)

3.1.1 Risks of water contamination near surface water source and intake and risk control measures

The place in the river or water body from where surface water is collected is called intake point. Sometimes, waste going into the same surface water at different places can gather or accumulate near the intake point and contaminate the source water. This is why, the risk of contamination near the intake point, types of risk and measures to prevent risks should be known. The following table shows some of the main risks of water contamination and means to prevent it.

Source and risk of water contamination	Measures to control risk
	
• Industrial waste / residual of fertilizer and insecticides / untreated sewerage may discharge into the upstream flow of the river water or at the intake point (In some cases within the fixed distance)	• Observe whether industrial waste / fertilizer and insecticides / untreated sludge is discharged into the water near intake point. • Inform the appropriate authority about the discharges. • Try to move the intake point away from (upstream of) the industrial area. If there is any factory near the intake point, action should be taken to influence them to build ETP (effluence treatment plant) plant as per directive of the Department of Environment).

Source and risk of water contamination	Measures to control risk
• Oil, chemical or any other contaminant may spill into river from the plying vessels.	• Observe vessels carrying oil or chemicals plying or anchored near the intake point and inform the authority. • Do not select intake point near areas of vessels plying with oil or chemicals.
	
• People may take bath or wash their animals, wash clothes, defecate and dump household waste near the intake point. • Hyacinths or lichen may accumulate around the intake point	• Do not build bathing or washing platforms and dustbins near the intake point. • Arrange fences to protect the intake point from accumulation of hyacinths or lichen • Observe regularly to ensure safety of the intake point from the above hazardous events. • If above events cannot be stopped, appropriate authority need to be informed for necessary action.
	
• If the intake pipe remains without support.	• Make support arrangement for the intake pipe.

Some other risks to consider before selecting the intake point include insufficient quantity of water is available in the dry season and water becomes excessive turbid during the rainy season.

3.1.2 Risk of water contamination in the aquifers for groundwater collection and risk control measures

The underground place from where water is collected is called an aquifer. It can be contaminated due to various reasons so causes and areas of contamination and control measures should be known. The following table describes some causes and control measures.

Source and risk of water contamination	Measures to control risk
	
• The area around the pump is not fenced or without pump house meaning pump is unprotected.	• Build pump house and fence to protect pump and surrounding area.
	
• Water is contaminated by nearby pit latrine, soakpit of septic tank or feces of animals	• Do not construct pit latrine or soakpit of septic tank within 30 feet of the pump. • Arrange to transfer those that are already constructed within 30 feet.

- Broken platform of the pump house or waste accumulating inside or outside of the pump house may cause dirty water to enter into the production well.
- Pump without cover/seal or broken seal dirty water may spill from the root of the pipe.
- If the non-return valve does not work properly, dirty water from the supply line may flow back into the production well.

- Keep the platform of the pump house in good shape and clean inside and outside of the pump house.
- Cover or seal the pump to protect against spilling of waste water at the root of the pipe.
- Repair or replace non-return valve.

- Chemical fertilizers or insecticides used in agriculture may contaminate surface water through surface run-off.

- Meeting with local agriculture officer to carry out awareness campaign on prevention of excessive fertilizer or insecticide use in agricultural land.

Other things that need to be taken care for the selection of the depth of the tubewell or appropriate aquifer include:

- Aquifer should have sufficient water, that means ground level should have coarse sands and pebble and with deep layer.
- Water should be lifted from the level of aquifer where water is free of, or has acceptable limits of, arsenic, iron manganese and chloride.

3.1.3 Measures to take to maintain water quality during collection of surface water and lifting of groundwater

Different water tests should be carried out to know the quality of the surface or groundwater as often as possible. Technicians should have sufficient knowledge about which water quality parameter is to be tested and when to test it. The Bangladesh water quality standard for few parameters are shown below.

	Surface water	Ground water
Drinking water quality standard	At the intake point of the river, water quality should be maintained at the following levels to get safe water round the year: • PH 6.5 to 8.5 • Turbidity 100 NTU • TDS 500 mg/liter • Fecal coliform 500/100 milliliter • Nitrite 50 mg/liter • COD 200 mg/liter • BOD 40 mg/liter • DO 6 mg/liter	Water being pumped from groundwater should meet the following standards: • Arsenic 0.05 mg/liter • Iron 1.00 mg/liter • Manganese 0.40 mg/liter • Chloride 600 mg/liter • Nitrite 50 mg/liter • Boron 1.00 mg/liter)
Measures to be taken to maintain water quality	✓ River water quality must be tested at intake point. ✓ Turbidity should be tested on weekly basis and total dissolved solids (TDS), fecal coliforms, pH and nitrate should be tested monthly. As turbidity levels increase the quantity of alum or other coagulant will have to be increased. If TDS increase and harmful chemicals are found in the water, abstraction of water from the river will have to stop and higher authority must be informed. ✓ Report or data from the lab tests should be recorded in a record book.	✓ The quality of water will have to be tested using either field test kits or lab tests ✓ Arsenic should be tested every six months. If arsenic, iron or chloride is found above the acceptable limits, then it will have to be brought to acceptable limit or pumping from that area will have to be stopped. ✓ Tests for other chemicals must be done at the time of installation of well.

3.1.4 Monitoring checklists for abstracting surface and pumping groundwater

Checklists should be completed for the intake point or pump at least once in a month to observe its continued suitability for water abstraction. During inspection the two checklists below must be used.

- ✓ Monitoring checklist for visual inspections at the source of water
- ✓ Monitoring checklist for water quality testing

A. Monitoring checklist for visual inspections at the source of surface water

If the answer to any question is 'Yes' then action is required.

S.N.	Observation issue	Yes	No
1	Are hyacinth, lichen, and waste seen around the intake point?		
2	Is there movement of vessels around the intake point?		
3	Is untreated sewage discharged near the intake point?		
4	Is untreated industrial waste discharged near the intake point?		
5	Do humans or animals take bath around the intake point?		

B. Monitoring checklist for surface water quality testing

If the answer to any question is 'No' then action is required.

S.N.	Observation issue	Yes	No	No Comments
1	Has turbidity been tested every week and have steps been taken as per test result?			
2	Has TDS been tested each month and have steps been taken as per test result?			
3	Have fecal coliforms been tested each month and have steps has been taken as per test result?			
4	Has pH been tested each month and have steps has been taken as per test result?			
5	Has nitrate been tested each month and have steps been taken as per test result?			

C. Monitoring checklist for visual inspections at the source of groundwater

If the answer to any question is 'Yes' then action is required.

S.N.	Observation issue	Yes	No
1	Is there a pit latrine or septic pit within 30 feet of the pump house?		
2	Is there any waste or cob-webs around the pump house?		
3	Is the boundary wall/ fence missing/damaged around the pump house?		
4	Are covers/seals missing?		
5	Is the non-return valve nonfunctional?		
6	Is there any spilling down of water in the borehole?		

D. Monitoring checklist of groundwater quality testing

If the answer to any question is 'No' then action is required.

S.N.	Observation issue	Yes	No	No Comments
1	Has arsenic been tested every six months and have steps been taken as per test result?			
2	Have iron, manganese, chloride and nitrate been tested every year and have steps been taken as per test result?			

3.2 Water safety plan activities during water treatment (Stage 2)

3.2.1 Risks of water contamination during treatment of surface water and risk control measures

The risks of water contamination and the measures to control the risks during treatment are shown below.

Source and risk of water contamination	Measures to control risk
	
• Mud or waste can collect at the base of the sedimentation tank	• Clean the base of the sedimentation tanks regularly
• Alum may not always be used	• Always use alum as needed as per turbidity test results of Intake water
• Vegetation like hyacinth and lichen may grow and toddler and fish exist	• Clean regularly if you see hyacinth, lichen, or toddlers.
• Height of the boundary wall of pre-sedimentation pond is low	• Raise boundary wall of pre-sedimentation pond.

- Backwashing is not done regularly in the sand-gravel filter
- Cracks and mud-balls are found in filter

- Do proper backwashing of sand filter regularly. Increase frequency of backwashing when turbidity is high according to O&M manual.

- Replacement of sand is not done at certain interval
- Reservoir or filter chamber is not cleaned properly and regularly

- Replace sand and gravel when it is required.
- Clean reservoir tank or chamber properly and regularly according to O&M manual.

- Chlorine dosing is not done based on residual chlorine and amount of water to be disinfected.

- Calculate chlorine dose based on quantity of water in the reservoir and the residual chlorine (0.2 mg/liter) level at the furthest stand post.

3.2.2 Measures to be taken to maintain water quality during treatment of surface and groundwater

It is necessary to assess the level of microorganisms and chemicals in the raw water to do treatment correctly. Operators need to know when and what type of water quality test is required. Some water tests and water quality standards are discussed below.

	Surface water and ground water
Water quality standards	• Turbidity of water entering sand-gravel filter should be <20 NTU. • Chlorine in distribution should be enough to maintain residual chlorine at end of pipeline at 0.2 mg/litre.
Measures to take to maintain water quality	• Test turbidity of inlet water regularly. If turbidity is not less than 20 NTU the quantity of alum need to be adjusted for water treatment. • Test chlorine at reservoir outlet and at the end of the pipeline. If the level of residual chlorine is less or much higher than 0.2 mg/litter then the quantity of bleaching powder should be reduced or increased to maintain 0.2 mg/litre residue.
	• Groundwater should have acceptable limits of arsenic, chloride, iron, manganese and nitrite.

3.2.3 Water treatment monitoring checklist for both surface and groundwater

Use the checklists shown here to know if the treatment process is running properly.

- ✓ Monitoring checklist for visual inspections of treatment process
- ✓ Monitoring checklist for water quality testing of treatment process

A. Monitoring checklist for visual inspection of surface water treatment process
If the answer to any question is 'Yes' then action is required.

S.N.	Observation issue	Yes	No
1	Is protection wall for sedimentation pond too low?		
2	Are there any latrines within 30 feet of sedimentation pond?		
3	Are there any waste dumped around sedimentation pond?		
4	Is the sedimentation pond dirty or is lichen present in it?		
5	Is backwash not done regularly and is filter bed dirty?		
6	Is the pump house dirty?		

B. Monitoring checklist for water quality testing of surface water treatment process

If the answer to any question is 'No' then action is required.

S.N.	Observation issue	Yes	No	No Comments
1	Has the filter inlet water turbidity been tested regularly and have steps been taken according to the results?			
2	Has residual chlorine of storage tank outlet and end of pipeline been tested and have steps been taken according to the results?			
3	Have water at outlet of storage tank and at tapstands been tested for fecal coliforms and have steps been taken according to the results?			

C. Monitoring checklist for water quality testing of groundwater treatment process

If the answer to any question is 'No' then action is required.

S.N.	Observation issue	Yes	No	No Comments
1	Is arsenic tested according to schedule and are steps taken as per result?			
2	Is iron tested according to schedule and are steps taken as per result?			
3	Is chloride tested according to schedule and are steps taken as per result?			
4	Are fecal coliforms tested according to schedule and are steps taken as per result?			
5	Is chlorine mixed according to requirement following a schedule and are steps taken based on quantity of residual chlorine?			

3.3 Water safety plan activities during water storage and distribution (Stages 3 & 4)

3.3.1 Risks of water contamination during storage and distribution of treated water and risk control measures

Water is supplied in two ways, through pipeline from overhead tank or directly pumped. The main risks of water contamination and control measures of both ways are shown below.

Source and risk of water contamination	Measures to control risk
	
• If the underground or overhead tank is not cleaned regularly, lichen can grow, cobwebs gather and water become infested with mosquitos and water becomes contaminated.	• The tank must be cleaned regularly (at least every three months) so that no lichen, cobwebs or insects can get into the tank.
	
• If tank is without a cover or the cover becomes dirty then dirty water around may spill inside the tank.	• The access point to the tank should be covered with a clean cover. The cover of an overhead tank should be at least 4 to 6 inches above tank roof to stop inflow from the roof.

Source and risk of water contamination	Measures to control risks
	
• Water can be contaminated if the tank is cracked or has holes.	• Cracks or holes must be repaired.
	
• Contaminated water may leak inside the tank if the connection is done badly by unskilled technician	• Connection to be made by skilled technician.
• If low quality materials are used for connections they can be damaged easily. This causes water to leak inside the tank resulting in water contamination.	• Proper connection with quality materials.
• For illegal connections, pipes are drilled into resulting in dirty water leaking in causing contamination.	• Give legal connections. Find leaks due to illegal connection and inform the authority.
• Earth around distribution pipes may be moved exposing the pipes.	• Replace the earth to cover the pipe in the case of displacement.
• If no thrust block is used at the time of pipeline diversion, water may be contaminated though leakage.	• When diverting distribution line, you must use thrust block behind the bent pipeline to stop leakage due to excessive pressure of water.
• Number of leakages increases as pipes wear out.	• Old pipes should be replaced with new ones.

Source and risk of water contamination	Measures to control risks
	
• If line over bridge or culvert is not high enough it may be flooded with dirty water in rainy season. • If pipes laid over bridges or culverts have joints or are damaged dirty water may ingress into the pipes.	• Highest flood level should be considered while taking pipeline over canal. Pipeline is required to be kept erected firmly. • No joints to be done at the crossing of bridge or culvert. If required, very high quality materials should be used so that no dirty water can ingress inside.
	
• If the pipeline passes beside sewerage or dirty drain,	• Line should not be taken along the side of the sewerage or dirty drain. In case of tight situation, sand should be put around the pipe.

Source and risk of water contamination	Measures to control risk
	
• Sluice valve chamber may fill with dirty water	• The sluice valve chamber is required to be kept intact. In case of any leakages, it must be repaired. If not possible, sand should be used in the chamber for filtration of dirty water.
	
• There may be feces nearby and surrounding area of the stand post may be dirty.	• Surrounding areas of the stand post must be cleaned.
• There may be latrines/urinals near the stand post.	• Latrines should be moved from stand post or stand post moved.
• If stand post platform is broken and the drainage system is not proper, dirty water accumulates around and may ingress into the leaking pipes.	• The stand post platform must be sealed with cement and repaired if damaged. Proper drainage should be maintained.
• Bamboo pieces might be used in place of the stand post bibcock.	• No bamboo pieces should be used instead of tap/ bibcock.

- Water may be collected by people from shallow pits near the pipeline if there is no water pressure in the pipe to supply the taps.

- Discourage people from digging open pits. Try to make sure that pipe is kept under the ground. Try to increase water pressure so that water can be collected from tap.

3.3.2 Measures to maintain water quality during storage and distribution of surface and ground water

Technology operator should have a clear idea what monitoring and testing should be done and when required in storage and distribution of treated water. Water quality standards and different water tests parameters are discussed below.

	Surface water/Groundwater
Water quality standards	The level of residual chlorine should be 0.2 mg/litre and fecal coliforms should be zero at the reservoirs and end points of the network.
Measures to maintain quality	To identify pollution source and associated risk and take measures to prevent those.

3.3.3 Storage and distribution monitoring checklists

Two checklists should be used to ensure that storage and distribution of treated water is done properly.

- ✓ Monitoring checklist for visual inspections of storage and distribution process
- ✓ Monitoring checklist for water quality testing of storage and distribution process

A. Monitoring checklist for visual inspection of storage distribution of purified water

If the answer to any question is 'Yes' then action is required.

S.N.	Observation issue	Yes	No
1	Is the reservoir or storage tank dirty inside and outside?		
2	Does dirty water stagnate inside the sluice valve chamber?		
3	Is pipeline placed wrongly over drain or canal crossing?		
4	Is there no tap with the stand posts, is the condition of platform bad and dirty, is drainage condition bad?		
5	Are the pipe joints weak?		

B. Monitoring checklist of data obtained from water quality test during storage & distribution of purified water

If the answer to any question is 'No' then action is required.

S.N.	Observation issue	Yes	No	No Comments
1	Has residual chlorine of storage tank water been tested properly and have steps have been taken according to the results?			
2	Has residual chlorine been tested properly at the farthest end of pipeline and have steps been taken according to the results?			

3.3.4 Consumer level monitoring system (to control household level risks to water quality and to inspire consumers to maintain social responsibility)

[NB: Water safety plan activities during collection, preservation and uses of water have been described in a separate booklet for consumers.]

	To control risks of water contamination	To inspire to perform social responsibilities
Expectation	• Water supplied through pipeline to the home should not be contaminated due to water in the underground reservoir. • Water should not be contaminated if there is overhead tank on house roof top. • Water will not contaminated if there is good quality water point • Water should not be contaminated by containers used to collect water	• Consumer will abide by the water risk management system and will encourage others to abide by the same • Nobody will misuse water at the time of use and collection • Consumers will pay water bill regularly and will encourage will others to pay regularly

Monitoring checklist at consumer level

If the answer to any question is 'No' then action is required.

S.N.	Observation issue	Yes	No
1	Is the outlet of reservoir placed at higher position from the floor and covered with clean lid?		
2	Is there tap at the water point and its platform in good condition?		
3	Are both hands and the container are washed with soap and clean water before collecting water and is the container covered properly?		
4	Is there no wastage of water during collection and use?		
5	Is water bill paid regularly?		
6	Is there initiative by local people in case of leakage in the pipeline or nonfunctional/missing water tap at the stand post?		

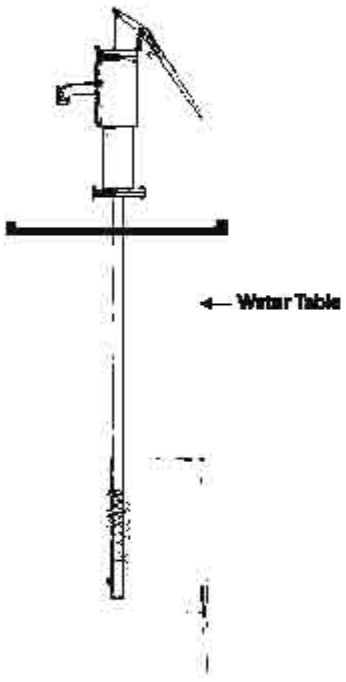
Complain Management

If the users do not get safe water in required quantities regularly, they should make complain

- Water is not supplied properly or in less quantity or there is defect in the pipeline or dirty water is supplied – in all these cases complain may be lodged
- Complain may be lodged with mayor/councilor office over telephone
- In each water supply there would be a designated person who will received complains, will note down the same and will take necessary action

4 (Four)
Tubewell water supply technologies

Tubewell is the most popular water supply technology in the rural areas and small towns of Bangladesh. This is because safe water can be pumped from groundwater easily through this technology. Water is free from bacteria and so safer.



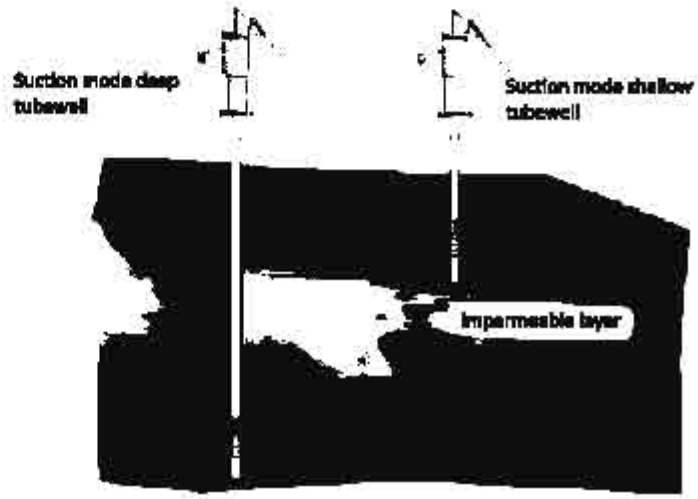
Pic: Suction Mode Tubewell

Tubewell is a technology in which vacuum is created inside the pipe and water is lifted by atmospheric pressure. Groundwater table is an important factor in this regard. The geological layer from which water is abstracted is known as aqulfer.

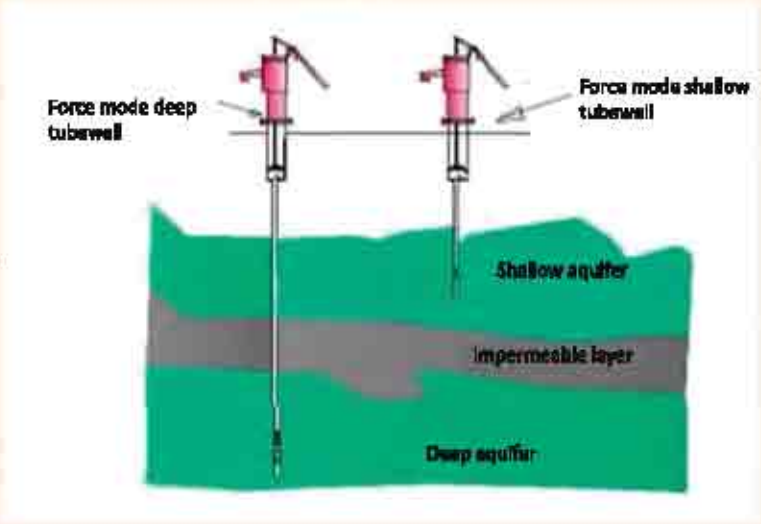
There are two types of tubewell depending mainly on which aquifer they pump from

- Shallow tubewell
- Deep tubewell

Shallow tubewells and deep tubewells can be suction or force mode based on the groundwater table. If the groundwater level is very low then suction mode tubewell cannot lift water. In that case force mode tubewell is needed.



Suction mode tubewells (6 no. tube well) may be used where water table is within 22 feet. Force mode tubewells (Modified 6 no. tube well, Tara, Tara dev, etc.) should be sued when water table goes below 22 feet.



Deep/Shallow 6 no. tube well (suction mode)

Deep/Shallow (suction mode)

Deep/Shallow (force mode)

Though tube well water seems safer, in reality not all water from all tubewells is safe as groundwater in different locations may be contaminated by different types of chemical like arsenic and iron. To bring these parameters to below acceptable limits, iron or arsenic filters may be connected. Tubewell water may also be contaminated by bacteria. So a clear idea about the areas of contamination and risk, and ways to prevent contamination, is needed to keep tube well water safe.

4.2 Sources and risks of contamination of Tubewell water and measures to control risks

Sources and risks of contamination	Measures to control risks

Arsenic in groundwater

Arsenic and/or iron removal filters/plants

Latrines less than 30 feet from tubewell

Latrines more than 30 feet from tubewell

No platform or platform is damaged. Surrounding area of the platform is unclean with waste and dirty water around

Platform is in good condition: drainage system is good, surrounding is neat and clean that means no waste and dirty water exist

No sanitary seal, cloth/bottle is fastened at the mouth of pump

Sanitary seal exists and cloth/bottle is not fastened at the mouth of the pump

No lid on the top of the pump

Lid on the top of the pump

The tubewell water may be contaminated if dirty water is used during repair or reconnection of check valve and lifting of water at the time of repair.

4.3 Sanitary Inspection form (for tubewell)

A. General information

1. Name of the institution.....
2. District:.....Upazila:.....Union/Ward:.....
   Village/Para:..... Caretaker of tubewell:.....
3. Tube well code no.:.....Type:.....Depth(Feet/meter).....
4. Name of Inspector:.....Inspection Date:.....
5. Place of collecting water sample.....Sample No.....
6. Result of test:.....

B. Monitoring checklist for visual inspection of tubewell

If the answer to any question is 'No' then action is required.

S.N.	Observation Issue	Yes	No
1	Is the area within 30 feet of tubewell free of latrines or human feces?		
2	Is the platform in good condition, clean and is drainage system in good condition with no standing water around?		
3	Is the platform free from lichen and the pump surroundings free from stangnant water?		
4	Is the sanitary seal of the tubewell exist?		
5	Is the spout of the pump free from any dirty materials (e.g. clothes, bottle etc.)?		

C. Comments and Recommendations

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5 (Five)
Pond sand filter technologies

5.1 Description of pond-sand filter

In many areas groundwater cannot be abstracted due to excessive levels of arsenic and salt. In these areas, people drink surface (pond) water and are exposed to many waterborne diseases. Pond sand filter (PSF) is built to filter pond water at minimum cost to make it drinkable.

The main feature of this technology is that water from the pond is lifted through pipe and passed through filter made of sand, brick chips and pebbles. Mud, dirt and other hazardous elements like bacteria are removed as water passes through the filter so pond water becomes safer.

Pond sand Filter

To get safe water from PSF, proper idea regarding the possible sources and risks of contamination and measures to control the risks is needed so that action can be taken timely to get safe water for all.

5.2 Sources and risks of contamination of PSF water and measures to control the risks

Sources and risks of contamination in pond	Measures to control risks

- Dirty or flood water flows inside the pond due to lower boundary level of the pond
- Pet animals are kept or can walk near the pond
- Waste or animal dung near the pond
- Bathing, washing clothes and utensils or washing pet animals in the pond
- Latrines are near the pond or there is connection of latrine waste with the pond

- Boundary of the pond should be high enough to prevent flow of dirty or flood water inside
- There should be fencing or thorn plants to prevent encroachment of cattle.
- Nobody should be allowed to take bath or wash clothes, utensils or pet animals. Villagers should be informed.
- Latrines within 30 feet of the pond should be moved.
- Any branches from trees that are hanging over the pond should be cut. No cultivation of vegetables inside the boundary or on the pond water.
- If hyacinth and lichen grow they should be removed regularly

- Application of fertilizer or fish feed for aquaculture happens.

- Aquaculture should be stopped with no additions of fertilizer or fish feed

Sources and risks of contamination in PSF	Measures to control risks
	
• No lid or cover on PSF or cover is damaged or unclean.	• Place clean cover over the PSF
 	
• Platform is broken and garbage exists around the platform • Area surrounding filter and platform is unclean (garbage and water has piled up) • Unless pond water is extracted by using the hand pump the sand filter will dry up and useful molecules will die.	• There should a clean and efficient drainage system • The platform should be clean with no garbage and stagnant water. • Water should extracted by hand pump during each collection of water so that filter bed does not dry up.
	
• The tap spout may be damaged or closed with bamboo strip. • Unless the filter bed (sand, brick chips, and stone) is cleaned regularly, the expected amount of water will not be treated. • Saline water enters the pond.	• Tap should be fixed if spout is damaged • The filter bed (sand, brick chips and stone) is to be cleaned regularly and fresh material added if necessary. • Outlets draining saline water from surrounding area must be sealed.

5.3: Sanitary inspection form for PSF

A. General information

1. Name of the institution .....
2. District: ..... Upazila:..... Union/Ward:.....
   Village/Para:..... Caretaker of PSF:.....
3. PSF code no. :.....
4. Name of Inspector:..... Inspection Date:.....
5. Place of collecting water sample..... Sample No.....
6. Result of test :.....

B. Monitoring checklist for visual inspection of PSF

If the answer to any question is 'Yes' then action is required

S.N.	Observation issue	Presence of risk	
		Yes	No
1	Is the pond NOT kept in good condition (good boundary, surrounded fencing, dirty water does not flow into the pond and cattle do not encroach near the pond)?		
2	Is there any latrine or human/animals feces within 30 feet of the pond?		
3	Is the pond used for fish cultivation, washing or bathing?		
4	Is there any crack on the chamber of filter or any lichen inside and outside the chamber?		
5	Is the filter material dry?		
6	Is the platform and drainage system in bad condition and/or is the tap damaged?		

C. Comments and Recommendations

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6 (Six)
Rainwater harvesting technologies

6.1 Description of rainwater harvesting

Our country's rainwater is free from harmful chemicals and bacteria. That is why in areas with arsenic and saline groundwater rainwater is used. Besides, for a long time coastal belt people have been using rainwater. But during harvesting of rain water, it may be contaminated if necessary steps are not taken.

To harvest safe rainwater, one should be aware of possible sources of contamination and about measures that can be taken to control the risks of contamination so that timely steps can be taken to ensure safe water supply for all.

6.2 Sources and risks of contamination for rainwater harvesting technologies and measures to control those risks

Sources and risks of contamination	Measure to control risks
 	 
• Tree branches extended over the roof	• Cutting overhanging tree branches regularly
• The roof C.I sheet is rusted	• Replace rusted sheet - there should be no rust on the C.I sheet shade
• Surface of the tank in unclean or lichen has grown on it.	• Tank should be cleaned to get rid of lichen.
	
• If tank and C.I sheet shade is not cleaned at first rain at the beginning of rainy season.	• Tank and C.I sheet roof top should be cleaned with detergent powder at the time of first rain in the rainy season. Rainwater should not be collected for 15 minutes at the beginning of the rainy season so that the roof shade become clean
• If rain water is collected from the asbestos made house roof shade.	• Not collecting rainwater though asbestos roof shade.

- Waste, dust and lichen gathers and stagnates in the gutter

- Regularly clean waste, dust and lichen out of the gutter.

6.3: Sanitary inspection form for rainwater harvesting

A. General information

1. Name of the institution .....
2. District: ..... Upazila:..... Union/Ward:.....
   Village/Para:.....
3. Name of Inspector:..... Inspection Date:.....
4. Place of collecting water sample..... Sample No.....
5. Result of test :.....

B. Monitoring checklist for visual inspection of rainwater harvesting

If the answer to any question is 'Yes' then action is required

S.N.	Observation Issue	Presence of risk	
		Yes	No
1	Is there any waste, dust or tree branches on the roof catchment? Is there any rust on the top of the roof?		
2	Did you forget to clean the roof by first flush water of rain?		
3	Is the tap of the RWH tank is in bad condition and/or is the water collection pipe from the roof broken?		
4	Is there any waste or dirty materials inside the tank or are there any cracks or damage to the tank?		

C. Comments and Recommendations

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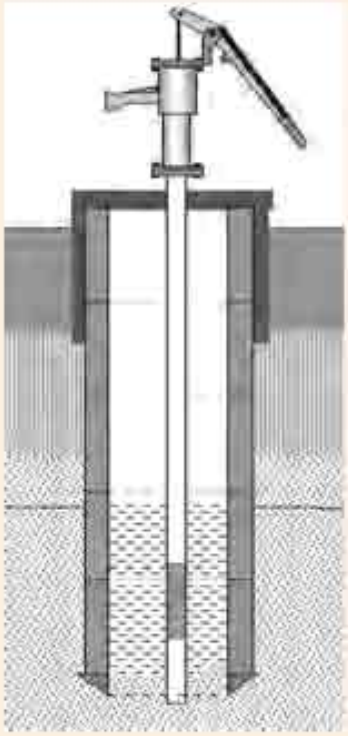
7 (Seven)
Ring well technologies

7.1 Description of ring well

Water used to be lifted from a dug well with rope. Now water is lifted from dug well through a very shallow type of tubewell called a ring well. In many areas normal tubewells cannot be sunk due to arsenic contamination and the nature of the soil. However, water can be lifted in those areas using a ring well.



7.2 Sources and risks of contamination for ring well and measures to control those risks

Source and risk of water contamination	Measures to control risks
 	
• No cover on top of the ring well or cover is damaged	• Ensure that there is cover on the ring well and that it is not damaged
 	
• No platform or dirty water stagnates around the platform • Lifting of water is done by rope • There are latrines within 30 feet of ring well	• Ensure there is platform and no dirty water around platform • Try to ensure pumped lifting instead of rope • Latrines must be more than 30 feet from the ring well

7.3 Sanitary inspection form for ring well

A. General information

1. Name of the institution .....
2. District: ..... Upazila:..... Union/Ward:.....
   Village/Para:..... Caretaker of ring well:.....
3. Ring well code no. :..... Type :.....Depth(Feet/meter).....
4. Name of Inspector:..... Inspection Date:.....
5. Place of collecting water sample..... Sample No.....
6. Result of test :.....

B. Monitoring checklist for visual inspection of rainwater harvesting

If the answer to any question is 'Yes' then action is required

S.N.	Observation issue	Presence of risk	
		Yes	No
1	Is there a latrine or human feces within 30 feet of ring well?		
2	Is the platform of the ring well damaged or dirty and/or is there stagnant water around the well?		
3	Is the cover of the ring well absent?		
4	Is the body of the ring well, the pipes and the pump dirty?		

C. Comments and Recommendations

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