ENV 101: Environmental Issues in Real Estate

Topic 1: Water Supply System

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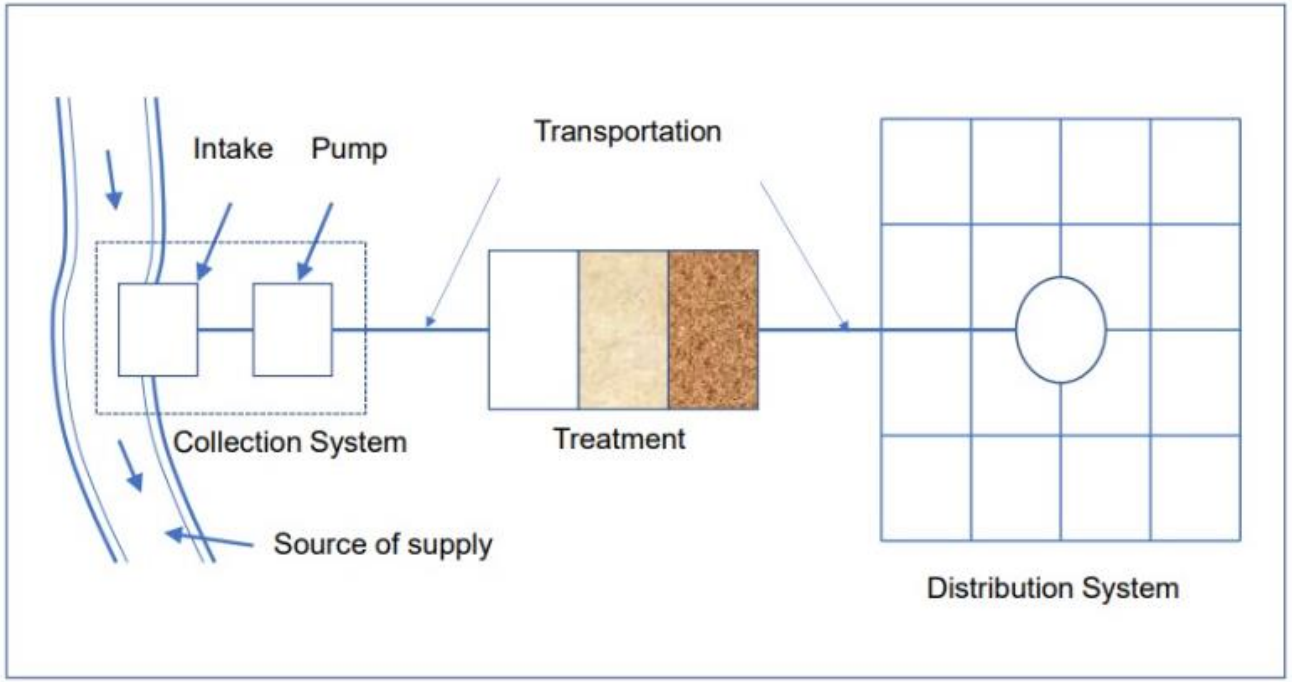
Goal of Water Supply System Planning

- Provide **potable water** to ensure public health
- Supply water in adequate **quantity** and pressure
- Make water **accessible** to users at a **reasonable cost**



Planning for Water Supply System

Factors that should be considered while planning water supply system of an area:

- Topography and land area
- Number of houses and population
- Water demand
- Other infrastructure like schools, hospitals, markets, parks, bus terminals, railway stations, fuel stations, etc.
- Fire fighting
- Available water source and it's quality
- Treatment requirement
- Distribution method
- Future expansion

World Trend in Water Demand

- USA: 600-900 l/p/d
- Australia: 300-500 l/p/d
- Developing countries: 150-200 l/p/d
- Remote areas: 100 l/p/d
- Sahara: people survive on 20-30 l/p/d

Factors influencing per capita water demand

- Climatic condition
- Lifestyle
- Household appliances
- Sanitation system
- Accessibility
- Water quality and pressure
- Water rates and metering

Fluctuation in Rate of Demand

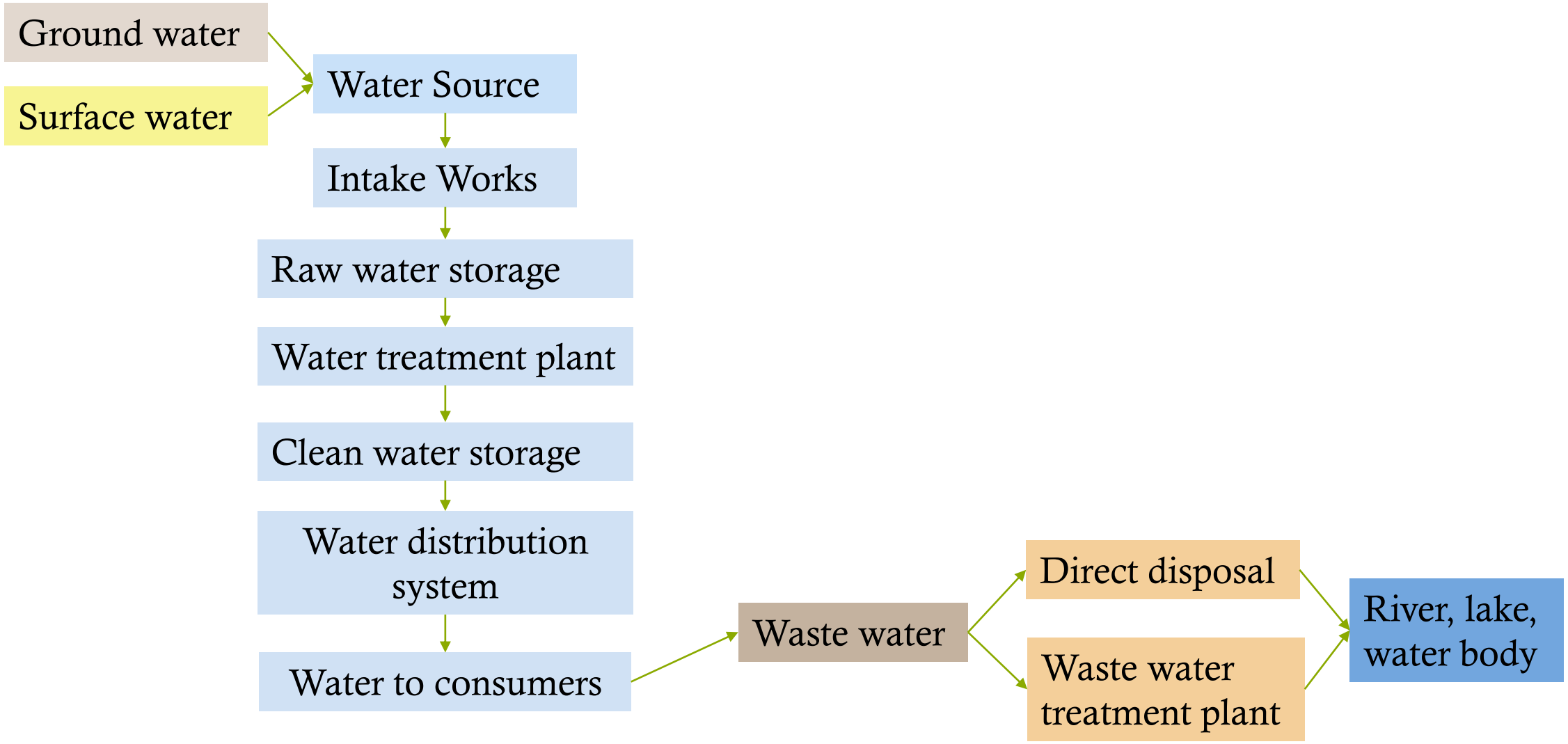
- ***Average Daily Per Capita Demand= Quantity required in 12 months/ (365 * Population)***
- If this average demand is supplied all the time, it will not be sufficient to meet the fluctuations.
- **Seasonal variation:** The demand peaks during summer, during heat waves.
- **Daily variation:** It depends on the level of activity. Such as during holidays and festivals the demand increases.
- **Hourly variation:** Water usage reaches its peak in the morning and also in the evening.
- Peak factors:

Population	Peak factor
Up to 5,000	3.0
5,000< population<20,000	2.5
Population>20,000	2

Design Period of Water Supply System

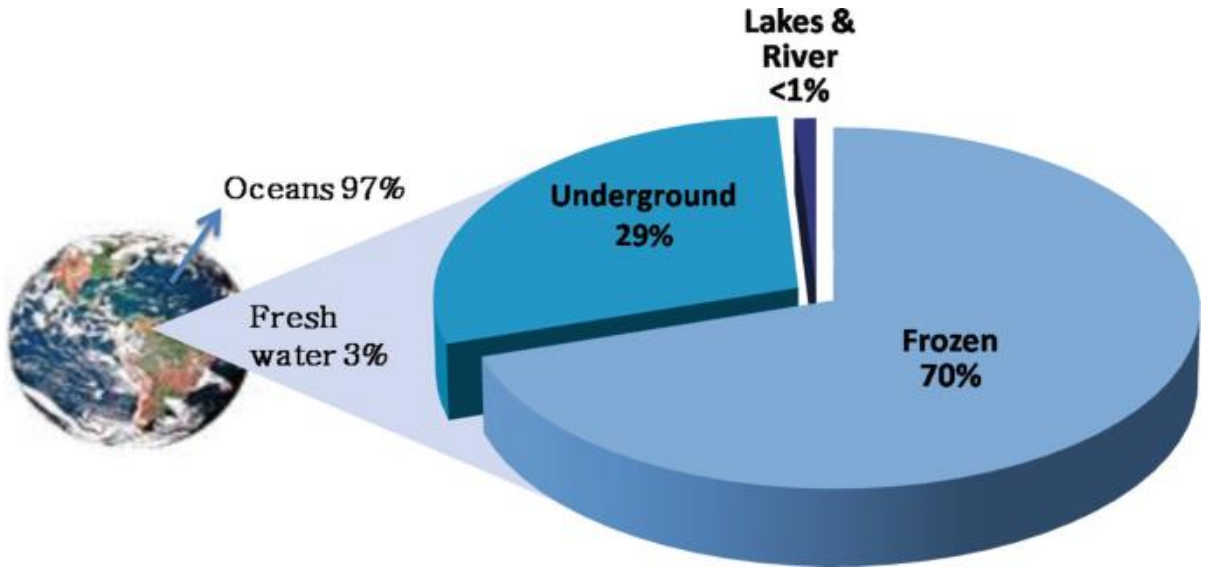
- The complete water supply project includes huge and costly constructions such as **reservoirs, treatment works and network of distribution pipelines.**
- These all works cannot be replaced easily or capacities cannot be increased conveniently for future expansions.
- Mostly water works are designed for design period of **20-30 years**

Urban Water Supply System



Water Source

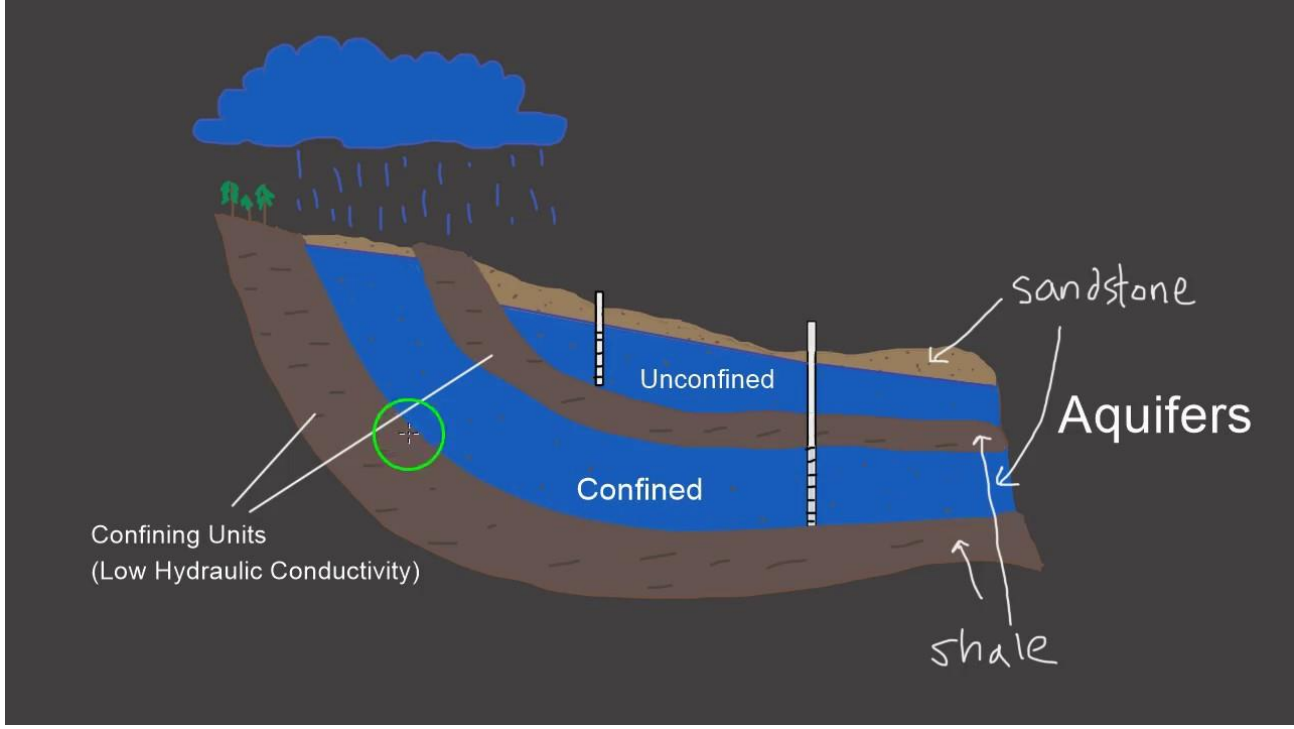
- Fresh water in lakes and rivers which are the main source of human water consumption, contains only **0.01%** of earth's total water!
- There are mainly 3 sources of water for supply:
  - Ground water
  - Surface water
  - Rain water
- The factors that should be considered for water source selection:
  - Quantity
  - Quality
  - Cost



Ground Water

The soil strata which contain the groundwater are called **Aquifers.**

- It is usually free from pathogens and impurities. It requires less treatment.
- Can be contaminated due to poorly sited latrines/wells.
- May contain metals (such as iron, manganese, etc.) or hydrogen sulfide.
- Yield can be too low for some areas and might be too deep to use economically.
- Well construction can be difficult and expensive.



Problems of GW in Bangladesh

- Arsenic in GW
- Excessive dissolved iron
- Salinity in coastal areas
- Rocky or Stoney layers in hilly areas
- Lowering of GW level

Surface Water

- **Abundant** surface water
- Mostly **polluted** by agriculture, industrial, and domestic sources.
- **Silt concentration** in very high in surface water during monsoon.
- **Algae growth** in dry season is also high.
- **Faecal coliform** concentration in most surface water is excessively high.
- Surface water requires **excessive treatment** (especially for drinking purposes)

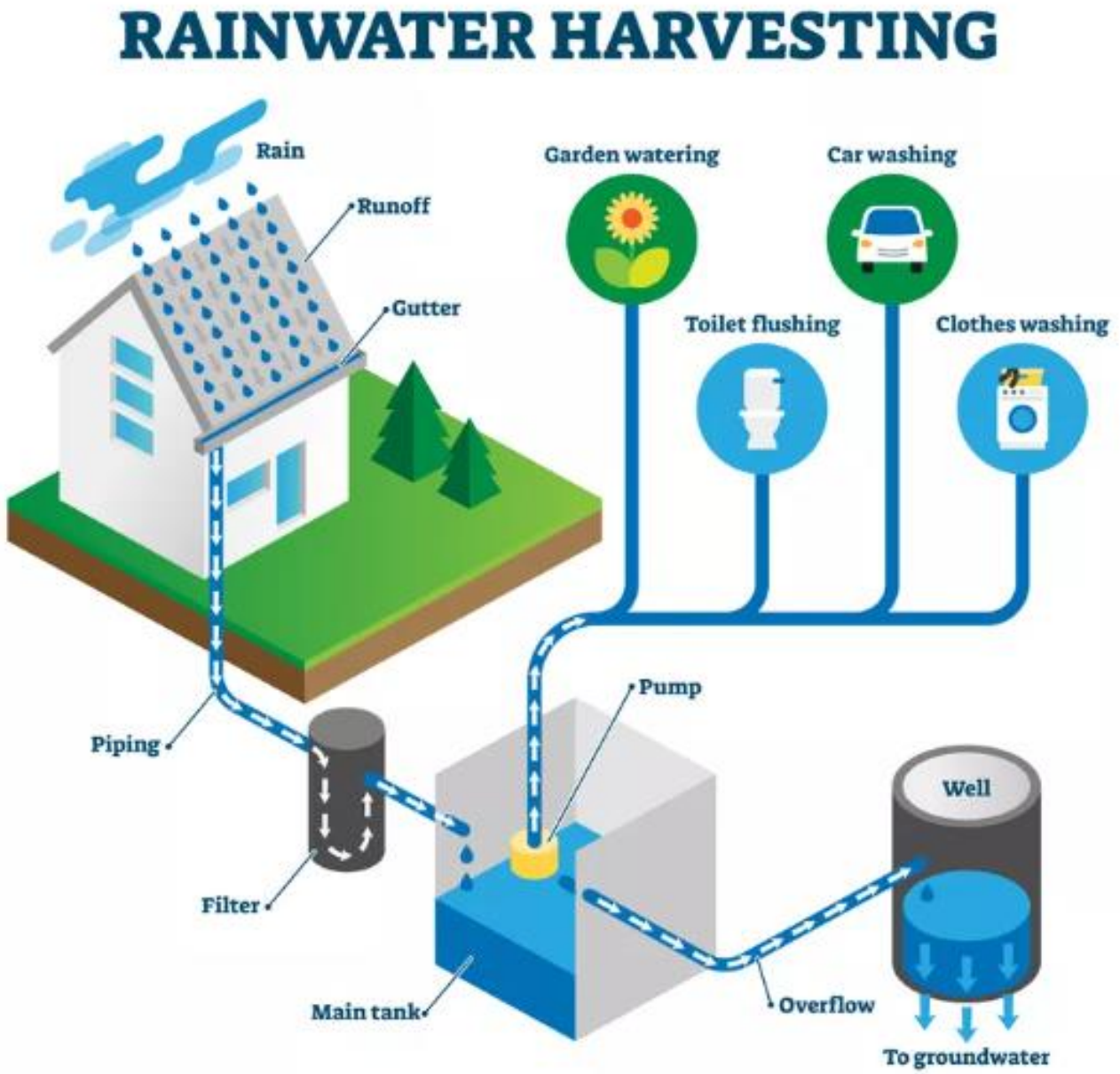
Surface water collection system: Intake

- Intake is a structure that withdraws water from the source. The intake must be located in the **purer zone** of the source. It must **never be located downstream** or near the **wastewater disposal site.** It should also be **near the treatment plant** to minimize cost.
- Intake should be able to draw water even in the **driest period** and should also be accessible **during flooding**.

Rain Water Harvesting

- Purest form of water, but hungry water.
- **Important factors for rainwater harvesting:** Size and type of catchment, rainfall and weather pattern, family size, alternative water sources, cost, etc.
- **Components:**
  - ➢Collection area (catchment)
  - ➢Conveyance system (consists pipes and gutters)
  - ➢Storage facility
  - ➢Delivery system consisting of tap or pump

Watch: https://youtu.be/pcjuXr8vQXA



Rain Water Harvesting: First Flush

- The first rain drains dust, bird droppings, leaves, etc. which are found on the roof surface. To prevent these pollutants from entering the storage tank, the first rainwater containing the debris should be diverted or flushed.
- Automatic devices that prevent first **20-25 litres of runoff** from being collected in the storage tank are recommended.
- **Screens** to retain larger debris such as leaves can be installed in the down pipe or at the tank inlet.

Rain Water Harvesting

Positive sides of rainwater harvesting:

- Relatively clean
- Owner-operated and promotes self-sufficiency
- Uses simple technology that is easy to maintain.
- Reduces stormwater runoff and pollution

Negative sides of rainwater harvesting

- Limited supply
- Uncertainty of rainfall
- Low storage capacity limits rainwater harvesting. On the other hand, increasing storage will increase the construction and operation costs.
- Health risk if it is not treated before using as a drinking water source.

Water Quality

- Should be free from pathogenic micro-organisms and bacteria
- Contain no element that has an adverse effect on human health
- It should be colorless and odor-free
- Not be saline
- It should not cause corrosion, scale formation, or discoloration
- Should have dissolved oxygen

Water Quality

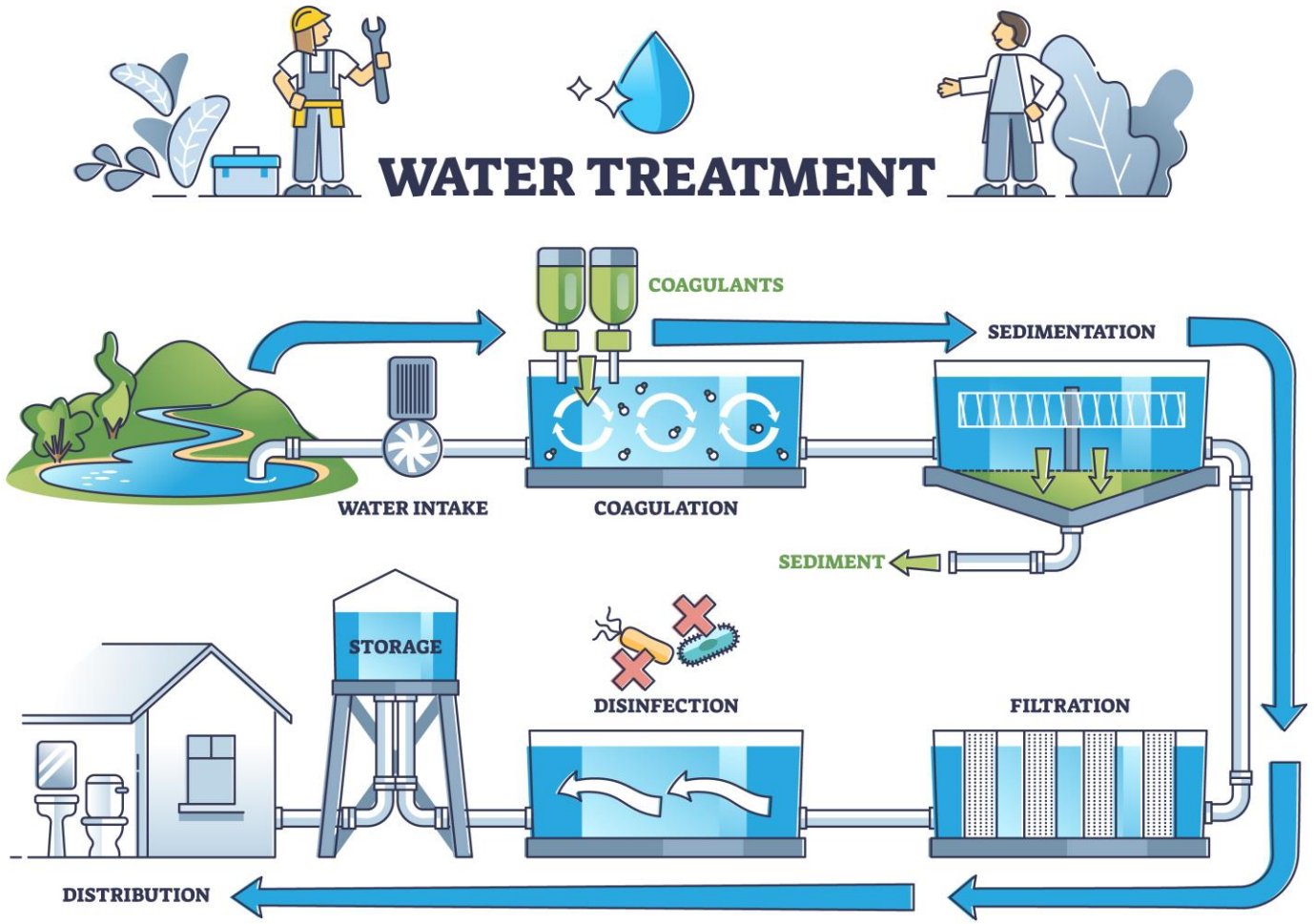
No.	Parameters	Bangladesh standards (BDS) (mg/L)	World Health Organization (WHO) guidelines (mg/L)	Determination Methods/ Apparatus
1	pH	6.5-8.5	6.5-8.5	Multi-parameter analyzer (DZB-718)
2	Turbidity	10 NTU	5 NTU	Turbidity meter
3	Carbon-dioxide	0 - 8	-	Titrimetric Analysis
4	Hardness as CaCO3	200-500	-	Titrimetric Analysis
5	Iron Content	0.3-1.0	-	AAS
6	Manganese	0.1	0.4; 0.1*	AAS
7	Nitrate-Nitrogen	10	50.0 as N	Spectrophotometer
8	Total Alkalinity	20-200	-	Titrimetric Analysis
9	Fluoride	1	1.5	Spectrophotometer
10	Chloride	150-600	250	Titrimetric
11	Arsenic	0.05	0.01	AAS
12	Temperature	20-30°C		Thermometer
13	Odour	Odourless	-	Threshold Method
14	Taste	-	-	Threshold Method
15	Fluoride	1	1.5	UV-VIS
16	Carbon dioxide	0-8	-	Titrimetric

**Value designated for aesthetical purposes*

Water Treatment

Common water treatment methods:
- Coagulation and Flocculation
- Sedimentation
- Filtration
- Disinfection

Specific treatment methods:
- Waster softening
- Arsenic removal
- Iron removal
- Demineralization
- Fluoridation/ defluorination
- Desalinization



Water Treatment

Coagulation and Flocculation: This process helps to increase the particle size. During coagulation, a chemical is added to neutralize the charges and ensure contact. Flocculation is the process of slow mixing that increases the particle size (floc size).

Sedimentation: It is a physical water treatment process using gravity to remove suspended particles from water. A higher surface area of the settling tank ensures more sedimentation.

Filtration: It is the process of separating the solids from the liquid by passing it through a permeable filter media (usually sand and gravel).

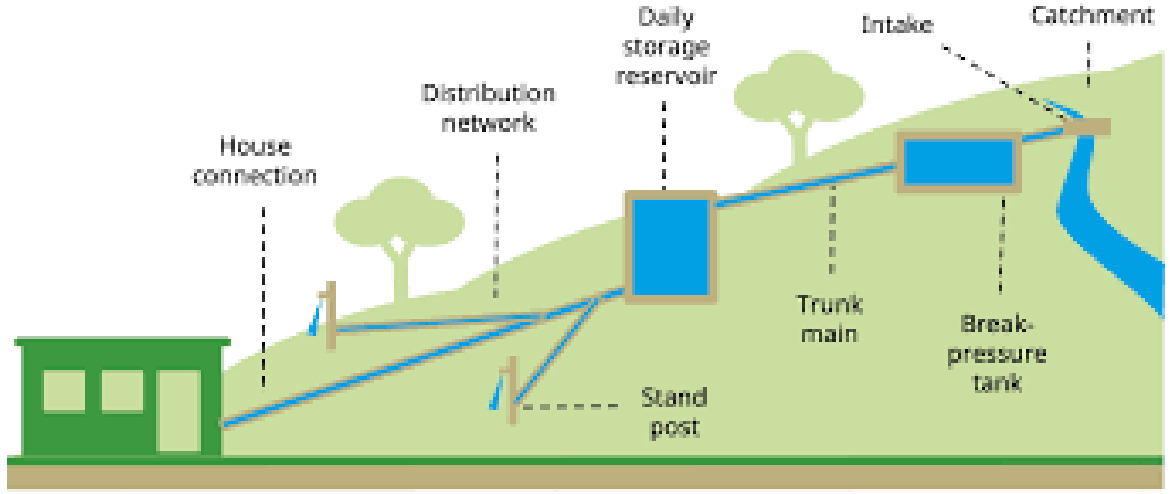
Disinfection: This is the process of destruction or inactivation of all pathogenic organisms present in water. Boiling, UV rays, Sunlight, Chlorination, etc. are methods of disinfection.

https://youtu.be/89I9e4f381Q?feature=shared

Water Distribution System

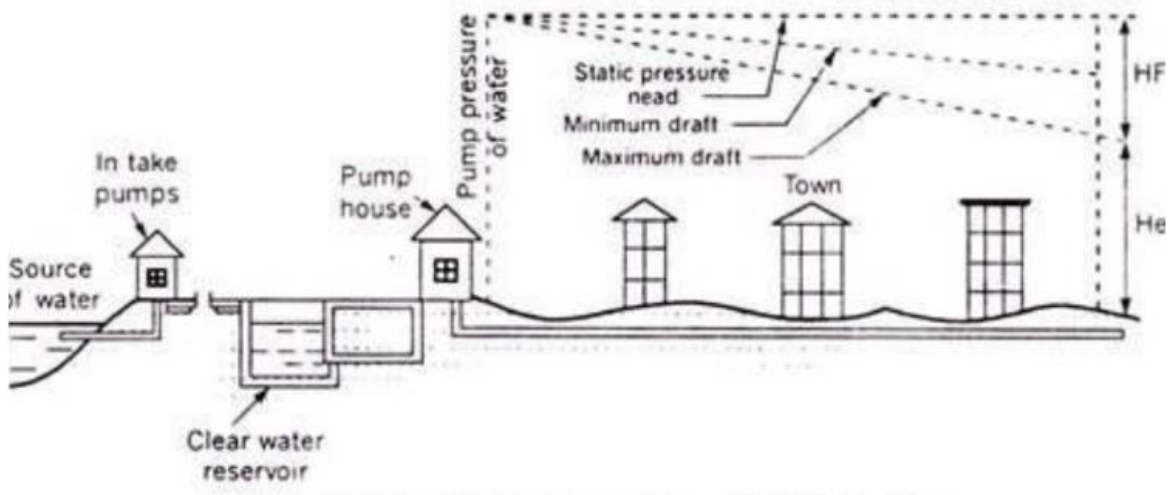
Gravity:

- Suitable when source at sufficient height, not applicable in flat area
- No pump required, but water loss by leakage is high due to high pressure.



Pumping System:

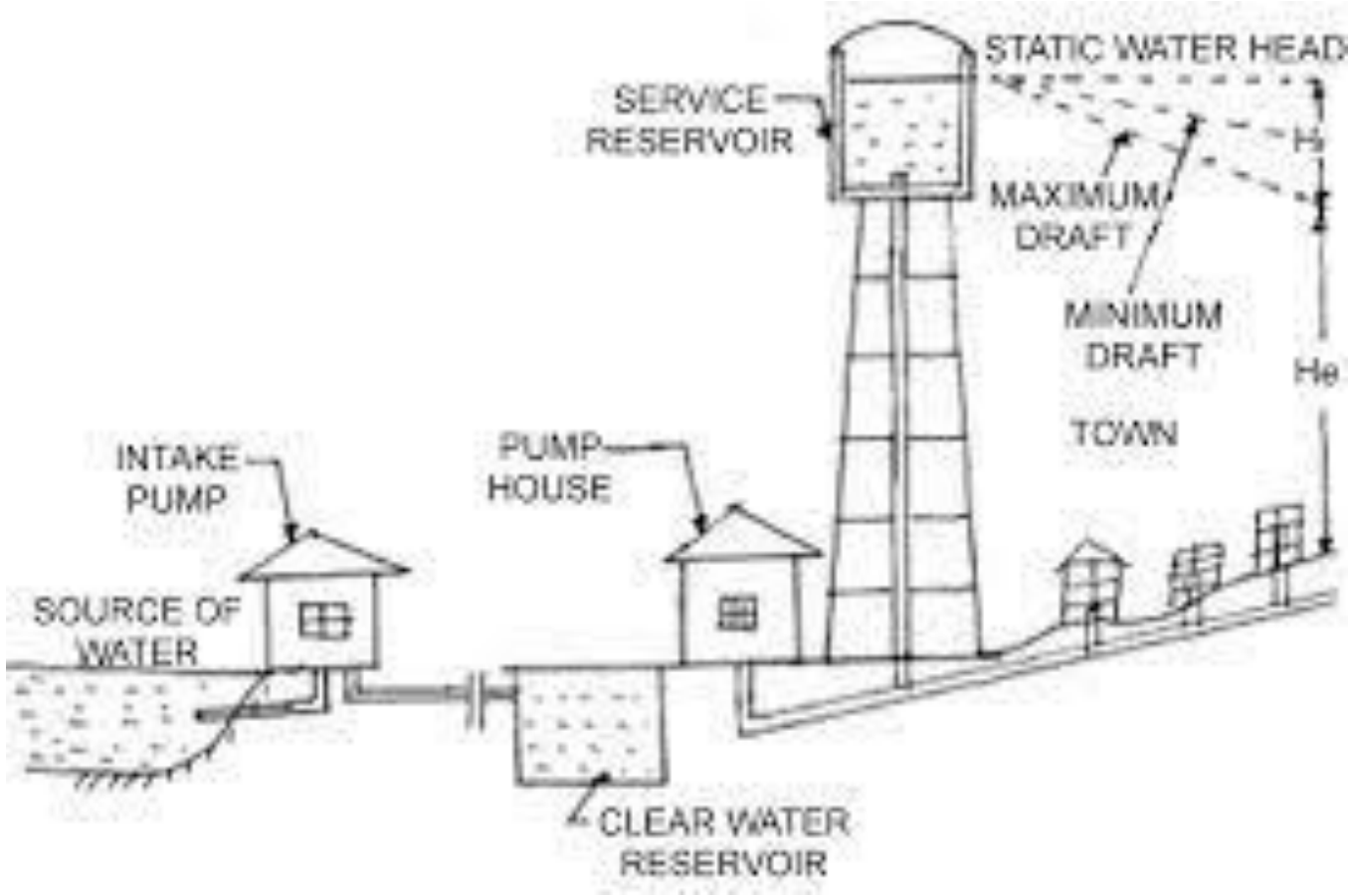
- Treated water is directly pumped into distribution network without storing.
- Power failure means complete stoppage of water
- Low water loss, but operation cost high
- Cannot meet varying water demand and required pressure



Water Distribution System

Combined System:

- Water is stored in elevated tower (reservoir) by pumping and then distributed by gravity. It is the most common method.
- Economical, efficient, and reliable.
- Higher initial cost
- Can support during short time power disruption.



THANK YOU!

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