

Water Supply & Sanitary Engineering (DI05006021)

Unit 1: Introduction to Water Supply Engineering
Lecture 2: Sources of Water: Suitability and Selection

GTU Diploma Engineering

Agenda

- Hydrological Cycle Overview
- Classification of Water Sources
- Surface Water Sources (Rivers, Lakes, Reservoirs)
- Subsurface/Groundwater Sources (Springs, Wells, Infiltration Galleries)
- Suitability of Sources: Quality and Quantity
- Criteria for Selection of a Source

The Hydrological Cycle

- All fresh water originates from precipitation (rain, snow).
- The hydrological cycle involves Evaporation, Condensation, Precipitation, and Runoff/Infiltration.
- Precipitation that flows over land forms Surface Sources (runoff).
- Precipitation that percolates into the ground forms Subsurface Sources (groundwater).

Classification of Water Sources

- Based on where the water is tapped, sources are broadly classified into two categories:
- 1. Surface Sources: Water available on the surface of the earth. Examples: Ponds, Lakes, Streams, Rivers, Storage Reservoirs.
- 2. Subsurface (Groundwater) Sources: Water available below the earth's surface. Examples: Springs, Wells, Tube wells, Infiltration galleries/wells.

Surface Water Sources: Ponds & Lakes

- Ponds: Natural depressions filled with rainwater. Small quantity, highly susceptible to pollution. Rarely used for large schemes.
- Lakes: Larger bodies of standing water. If situated in mountainous/catchment areas free from human habitation, the water can be of very high quality.
- Quantity is highly dependent on catchment area rainfall.
- Quality issues: Algae growth, silt accumulation, and stagnation can cause taste and odor problems.

Surface Water Sources: Rivers & Impounded Reservoirs

- Rivers & Streams: Most common source for large cities. Perennial rivers provide a continuous supply. Non-perennial dry up in summer.
- Impounded Reservoirs: Created by constructing a dam across a river valley. Stores monsoon runoff for use during dry periods.
- Quality: River water contains high suspended solids (turbidity), clay, and pathogenic bacteria due to surface runoff and wastewater discharge.
- Extensive treatment (coagulation, filtration, disinfection) is always required.

Subsurface Sources: Springs & Infiltration Galleries

- Springs: Natural outflow of groundwater to the surface. Good for small hilly towns, but yield is usually low and variable.
- Infiltration Galleries: Horizontal tunnels constructed at shallow depths along river banks to intercept groundwater flow.
- Infiltration Wells: Shallow wells sunk in riverbeds to tap the sub-surface water.
- Advantage: The surrounding soil acts as a natural filter, providing relatively clear water.

Subsurface Sources: Wells and Tube Wells

- Open Wells: Dug manually, tap shallow aquifers. Yield is limited, highly susceptible to surface contamination.
- Tube Wells: Deep pipes driven into the ground tapping one or more confined aquifers using strainers.
- Quantity: Deep tube wells can yield large, reliable quantities of water.
- Quality: Groundwater is naturally filtered, so it has low turbidity and bacteria. However, it often contains dissolved minerals (hardness, iron, fluoride).

Surface vs. Subsurface Sources

Concept 1

Concept 2

Quantity: Surface sources usually offer higher yields suitable for large cities. Subsurface is better for smaller towns or localized supplies.

Quality (Physical): Surface water is turbid; groundwater is clear.

Quality (Biological): Surface water is highly contaminated; groundwater is relatively safe.

Quality (Chemical): Surface water is softer; groundwater is often hard and may contain dissolved iron/fluorides.

Cost: Surface water requires expensive treatment plants; groundwater requires high pumping costs.

Suitability of a Source

- A source is considered suitable if it can reliably meet the requirements of both Quantity and Quality.
- Quantity Suitability: Must meet the peak demand during the driest months of the design period.
- Quality Suitability: The raw water must be treatable using standard, economically viable purification methods.
- Sources containing toxic chemicals, heavy metals, or radioactive substances should be rejected.

Criteria for Selection of a Source

- 1. Quantity available: Must satisfy present and future demand.
- 2. Quality of water: Determines the complexity and cost of the treatment plant.
- 3. Distance from the demand area: Longer distances require expensive transmission mains and high pumping costs.
- 4. Elevation of the source: A source located at a higher elevation allows for gravity flow, eliminating huge daily pumping costs.
- 5. Topography: Determines the feasibility of laying pipelines and constructing reservoirs.

Summary

- Water sources are primarily classified into surface (rivers, lakes) and subsurface (wells, springs).
- Surface water is abundant but requires extensive treatment for turbidity and pathogens.
- Groundwater is generally pure biologically but may require treatment for hardness or dissolved minerals.
- Selection of a source depends on quantity, treatability, distance, and elevation to minimize lifecycle costs.

Preview of Next Lecture

- How much water do we actually need?
- Types of water demands (Domestic, Industrial, Fire, etc.).
- Per capita demand and its calculations.
- Factors affecting the rate of water demand.