Tube well Irrigation

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- What is tube well irrigation
- Advantages and disadvantages of tube well irrigation
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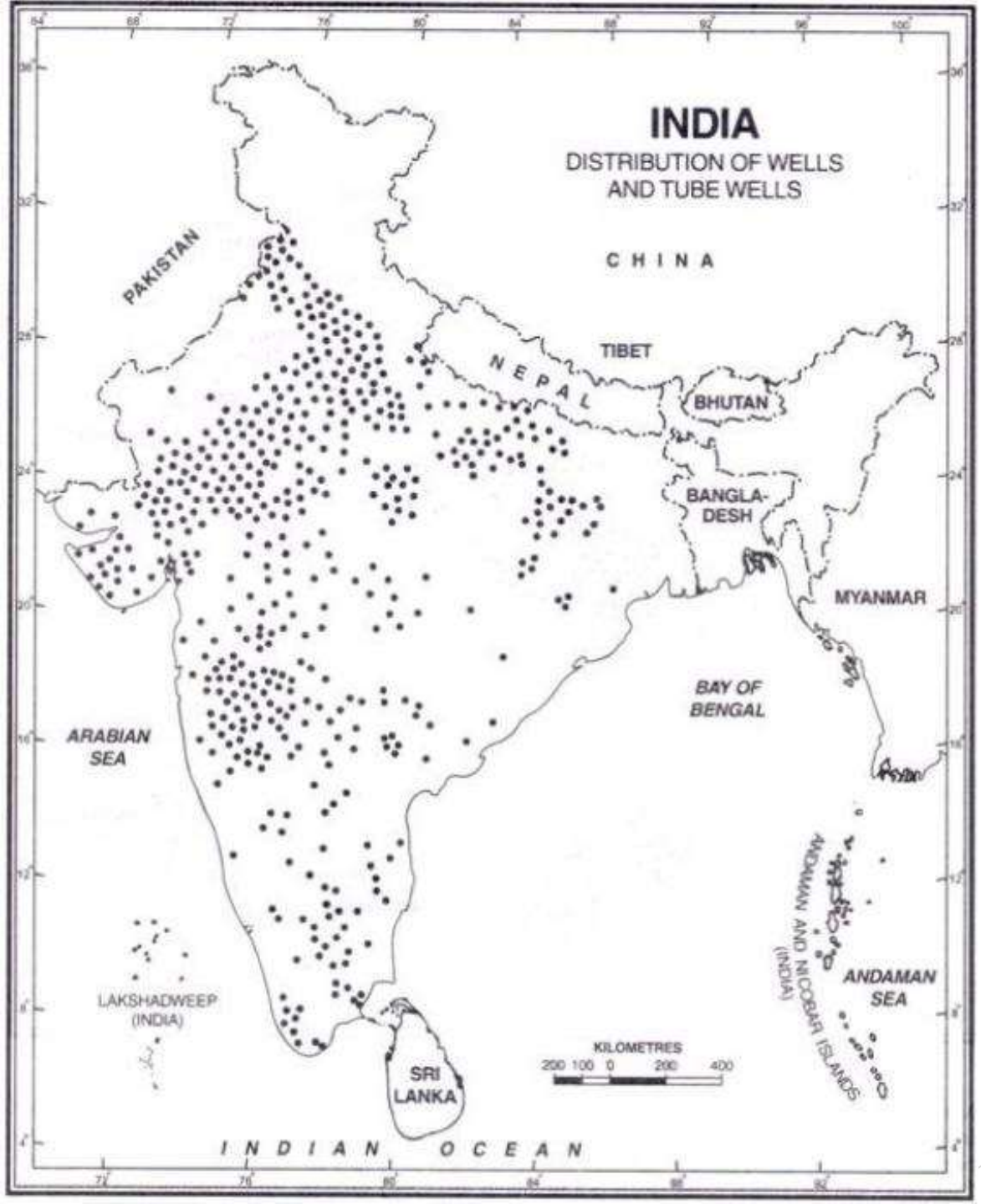
Introduction

- A well is a vertical hole dug in the ground for bringing the ground water to the surface for irrigation and drinking purposes is called well.
- It is a cheap, dependable and a popular source of irrigation in the country.
- Today there are more than 50 lakh tube wells operating in different parts of India.
- The first tube well was sunk in 1930 in Uttar Pradesh.
- Uttar Pradesh has the largest number of tube wells in the country.

- Well irrigation is widely practiced in those areas where sufficient groundwater is available
- Such areas are in Ganga Plain, the deltaic region of Mahanadi, Godavari, Krishna and Cauvery rivers, parts of Narmada and Tapi valleys
- Greater part of peninsular India is unfit due to hard rocky structure and shortage of underground water

- The wells are classified as-

1. Open well.
2. Tube well


INDIA
DISTRIBUTION OF WELLS
AND TUBE WELLS
CHINA
PAKISTAN
TIBET
NEPAL
BHUTAN
BANGLA-
DESH
MYANMAR
BAY OF
BENGAL
ARABIAN
SEA
LAKSHADWEEP
(INDIA)
SRI
LANKA
ANDAMAN AND NICOBAR ISLANDS
(INDIA)
ANDAMAN
SEA
KILOMETRES
200 100 0 200 400
INDIAN OCEAN

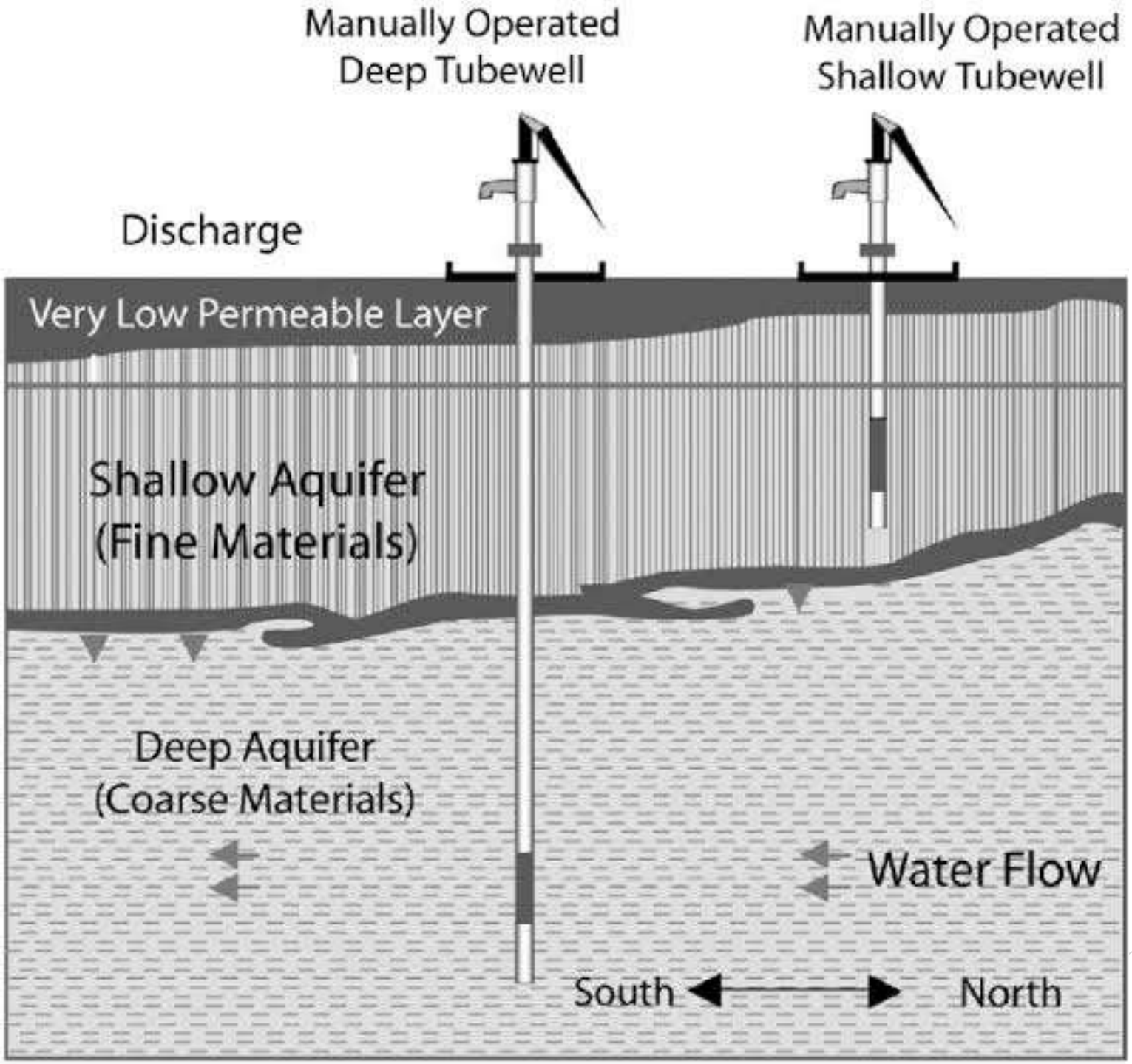
Open well

- Open wells are generally brick or stone masonry wells having bigger diameter say 2m to 9m.
- They are generally less than 20m in depth.
- These are suitable for low discharges say

  (1-5 litres/second)

Tube well

- A tube well is a type of water well in which a long 100-200mm diameter stainless steel pipe is bored into an underground aquifer.
- The lower end is fitted with a strainer and a pump is provided at top to lift water for irrigation.
- The irrigation done by using a tube well is called tube well irrigation.



Type of tube well:-

1). **Shallow tube well**
These are 20 to 70 m deep and tap water from only one aquifer.

2). **Deep tube well**
These are 70 to 300 m deep and tap water from one or more aquifer.

Advantages

- Tube well can be sunk at any place.
- It is not depend upon rainy season.
- It can irrigate the field throughout the year.
- Tube well gives a constant supply.
- Cost is low than flow irrigation.
- Do not require much space.
- It can be constructed quickly.
- Quality of water is good.

Disadvantages

- It is depend upon electricity.
- In this lifting devices are required.
- It leads to depletion of ground water reserve.
- Installation of costly submersible pump is required.

Comparison with canal irrigation

Canal irrigation

1. Losses of water is high.
2. Water flows due to gravity.
3. Wastage of water is more.
4. Water is available for short period.
5. Chances of water logging is more.
6. In this staff requirement is more.
7. It covers more area.

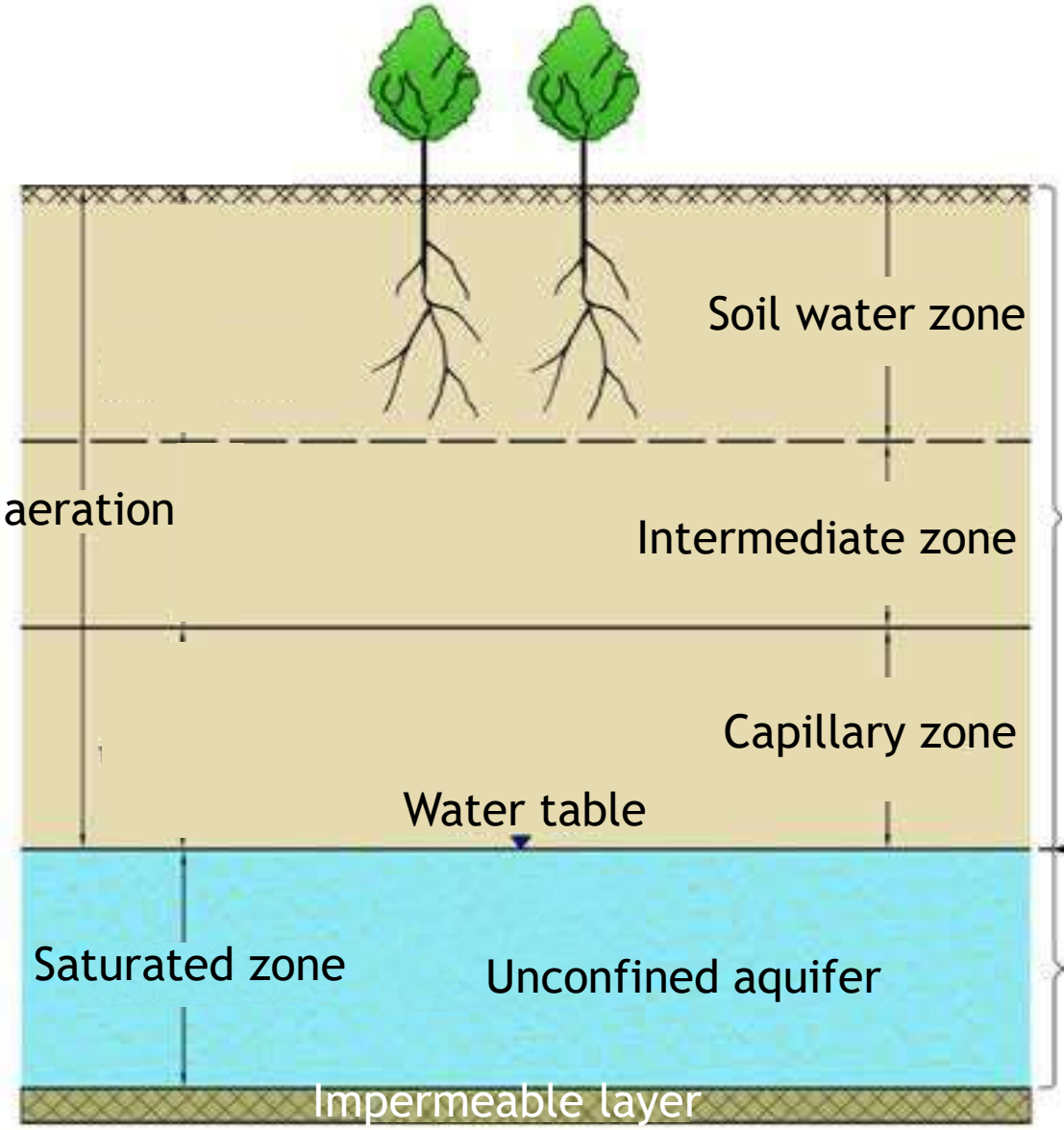
Tube well irrigation

1. Loss of water is less.
2. Water is lifted by pumps.
3. Wastage of water is less.
4. Water is available throughout the year.
5. There is no cahnces of water logging.
6. Staff requirement is less.
7. It covers small area.

Occurance of ground water

- The rainfall that percolates below the ground surface , passes through the voids of the rocks and joins the water table. These voids are generally interconnected, permitting the movement of ground water.
- The mode of occurance of ground water depends upon type of formation, porosity of rocks, permeability of rocks.

On the basis of occurance of ground water the sub surface of earth is classified as under:-



Water pressure<Atmospheric pressure

Water pressure=Atmospheric pressure

Water pressure>Atmospheric pressure

Zone of Aeration

- This zone is between water table and ground surface.
- In this zone,soil pores are partially saturated with water.
- It is divided into three sub-zones:-

1. Soil watee zone
2. Intermediate zone
3. Capillary fringe

Saturated zone

- It is the zone between water table and rock bed.
- In this zone,all soil pores are filled with water.
- It is also known as ground water zone.
- The different water bearing geological formations such as aquifer,aquiclude,aquifuge and aquitard lies in this zone.

Aquifer

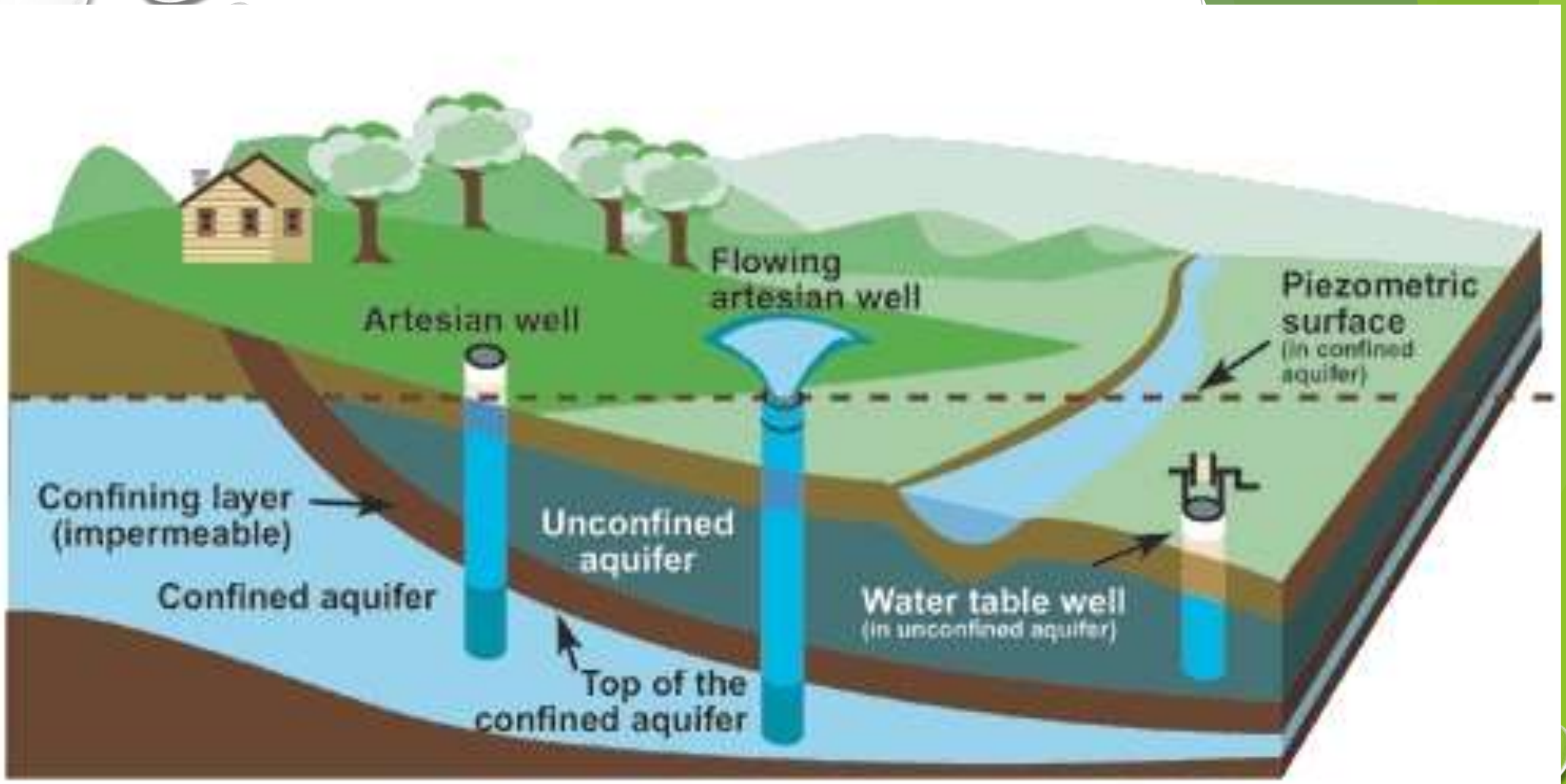
- It is a water bearing geological formation which not only store huge amount of water but also transmit that stored water in sufficient quantity for a long period of time.
- Ex. Sand,gravel

- Types of aquifer:-

1. Unconfined aquifer
2. Confined aquifer

Confined aquifer

- It is a type of aquifer which is confined between two impervious layers of aquifuge or aquiclude.
- It is also known as artesian aquifer.
- The water in this aquifer is subjected to very high pressure so the piezometric head will be more than the top level of aquifer.
- The thickness of confined aquifer is constant.


Flowing
artesian well
Artesian well
Piezometric
surface
(in confined
aquifer)
Confining layer
(impermeable)
Unconfined
aquifer
Confined aquifer
Water table well
(in unconfined aquifer)
Top of the
confined aquifer

Unconfined aquifer

- It is an aquifer which lying on an impervious layer.
- Its width is controlled by water table and is not constant.
- It is also known as water table aquifer.
- Recharge of this aquifer takes place due to infiltration of precipitated water.

Terms related to Tube well Irrigation

- Pumping water level

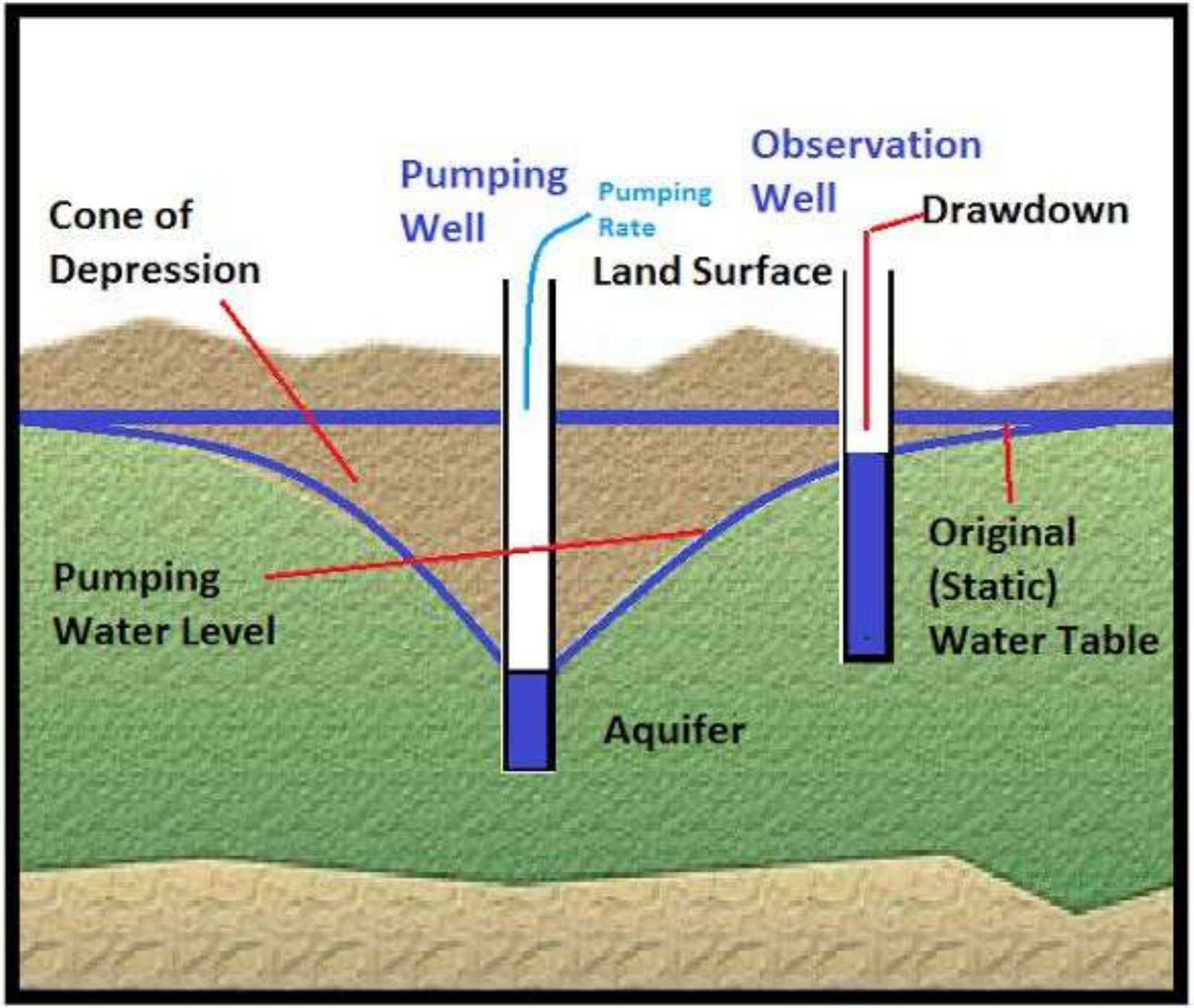
- It is defined as the level of water in aquifer during pumping.

- Static water level

- It is defined as the level of water into well before pumping commences.

- Drawdown

- It is defined as the difference between static water level and pumping water level at point of consideration.


Cone of
Depression
Pumping
Well
Pumping
Rate
Observation
Well
Drawdown
Land Surface
Pumping
Water Level
Original
(Static)
Water Table
Aquifer

Yield of well

- It is defined as the volume of water pumped per unit time.

Cone of depression

- Due to radial flow in well, the water table in aquifer converts from horizontal state to conical shape called as cone of depression.

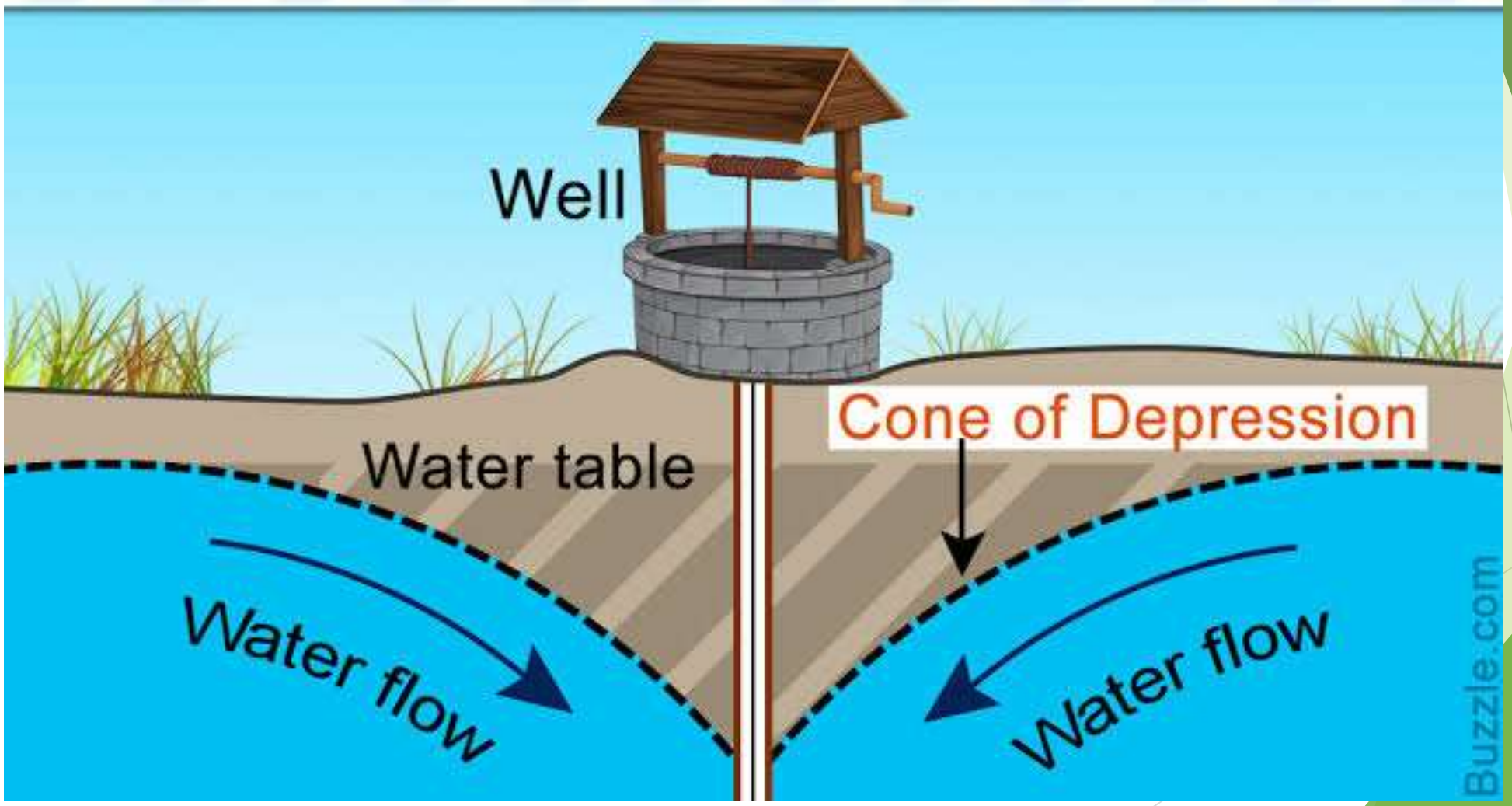
Radius of influence

- It is defined as the hirizontal distance between centre of well to the point where drawdown curve meets the static watar table.

Depression head

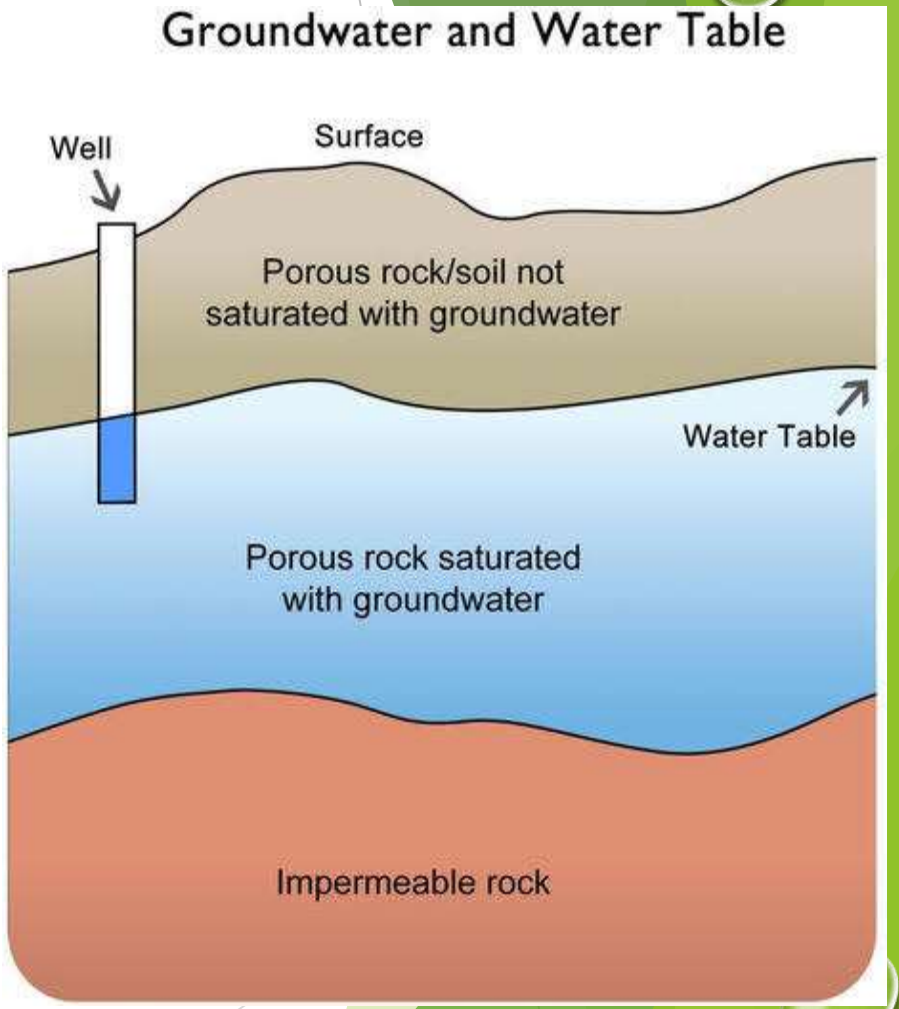
- The difference in water table elevation and water level inside the well is known as depression head.

Cone of Depression



Water table

- The level of underground water is called water table.
- It is the level of water in an unconfined aquifer below which ground is fully saturated with water.
- The static level of water in a well,drilled in unconfined aquifer indicates the level of water table at that point.
- Tne fluctuation in level of water table is due to discharge and recharge of ground water.



Types of Tube well

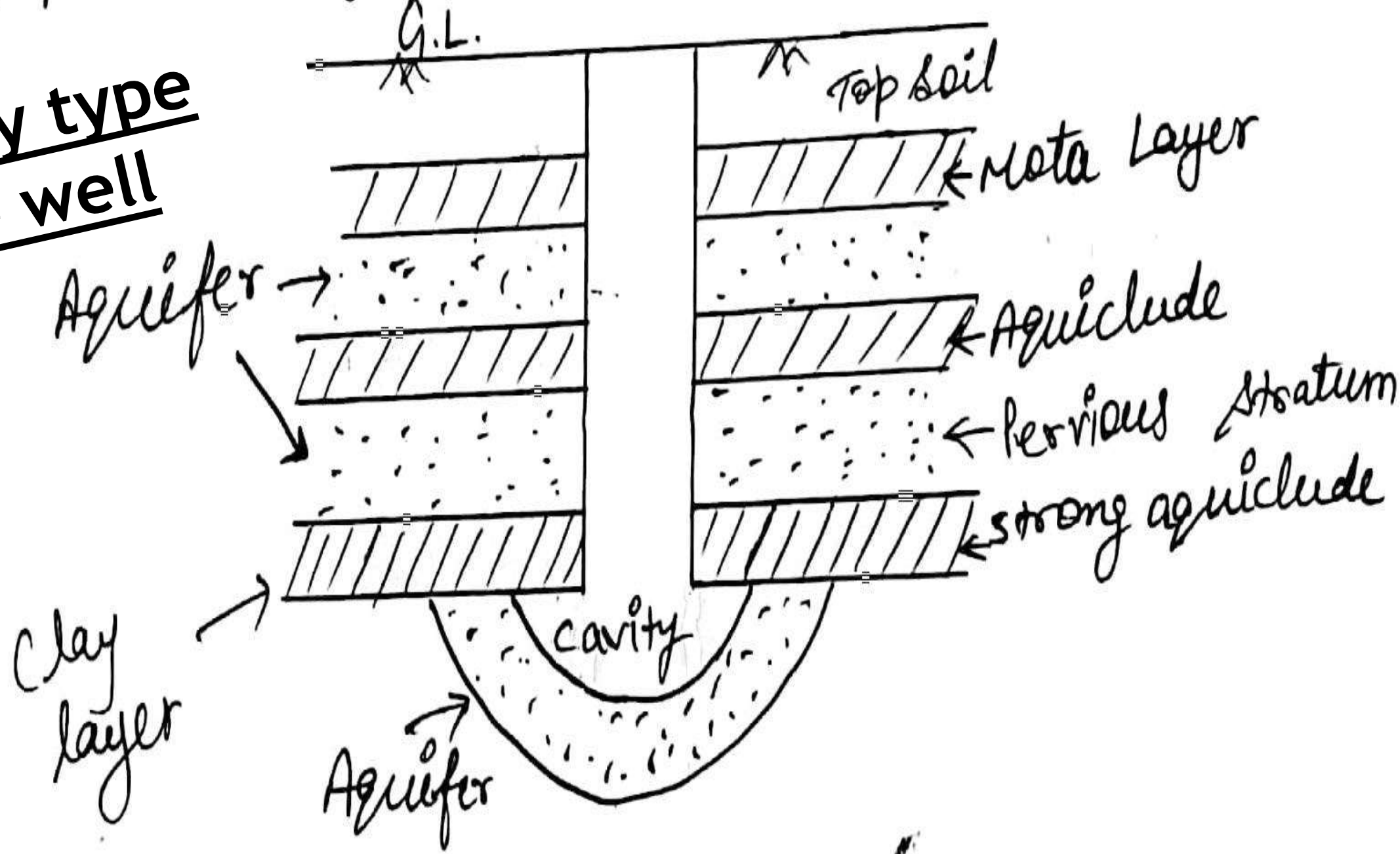
- Tubewells are classified as-

1. Cavity type tube well
2. Screen type tube well
- Strainer type tube well
- Slotted type tube well

Cavity type tube well

- A cavity type tube well consists of a pipe sunk into the ground and resting on the bottom of a strong clay layer.
- It draws its supplies from the bottom and not from the sides.
- In the initial stages of pumping fine sand comes out with water and consequently a cavity is formed at the bottom.
- The water from the aquifer enters the well pipe through this cavity.

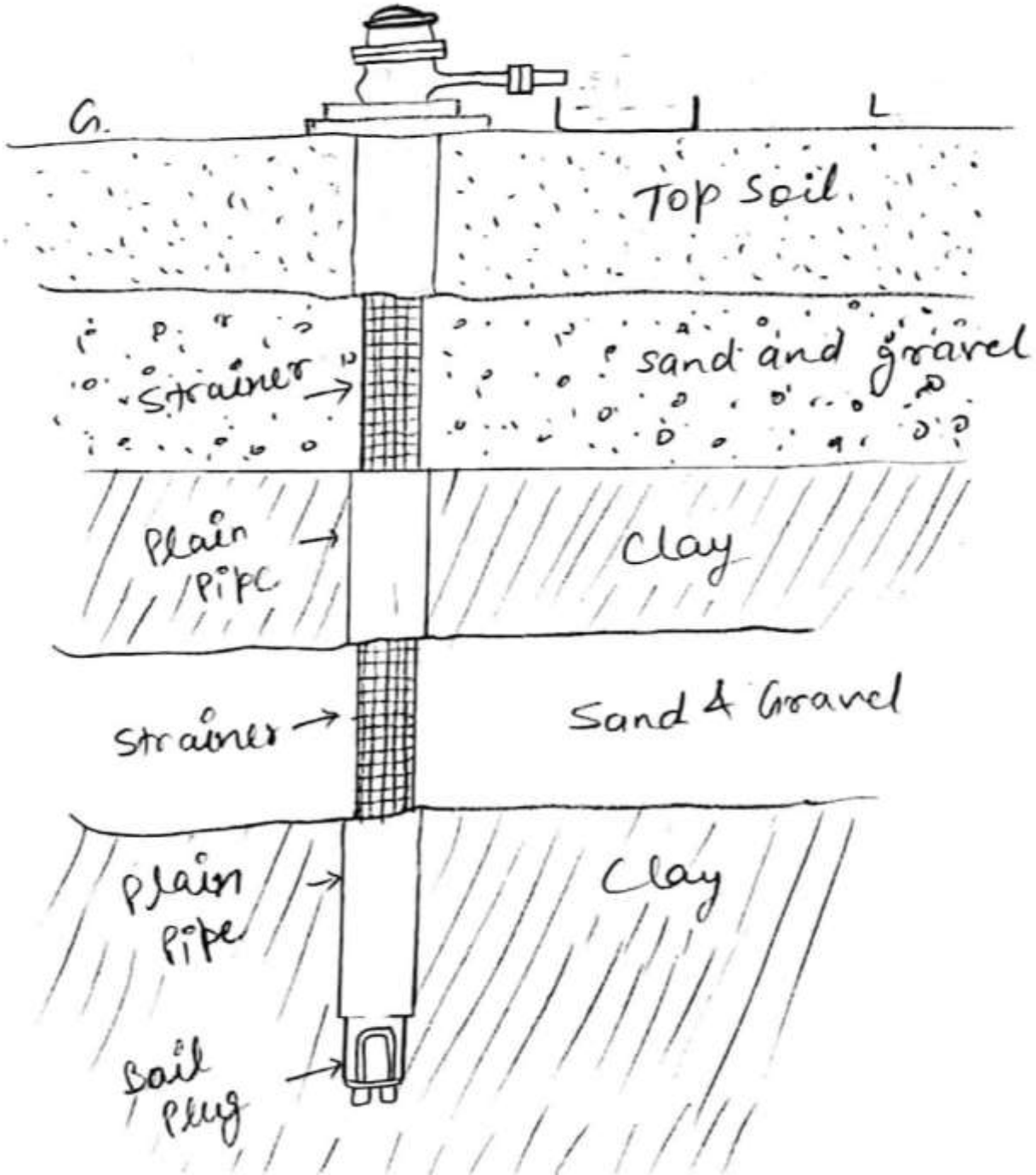
Cavity type Tube well



Strainer type tube well

- This type of tube well is consist of plain pipes and strainer.
- These pipes are lowered into the bore holes.
- The strainer pipes are located in water bearing strata whereas plain pipes are located in non water bearing strata.
- A bail plug is provided at the bottom.
- The water enters into the well through strainer.
- The strainer is consist of slotted pipe wrapped with a wire mesh to prevent sand particles from entering into the well.

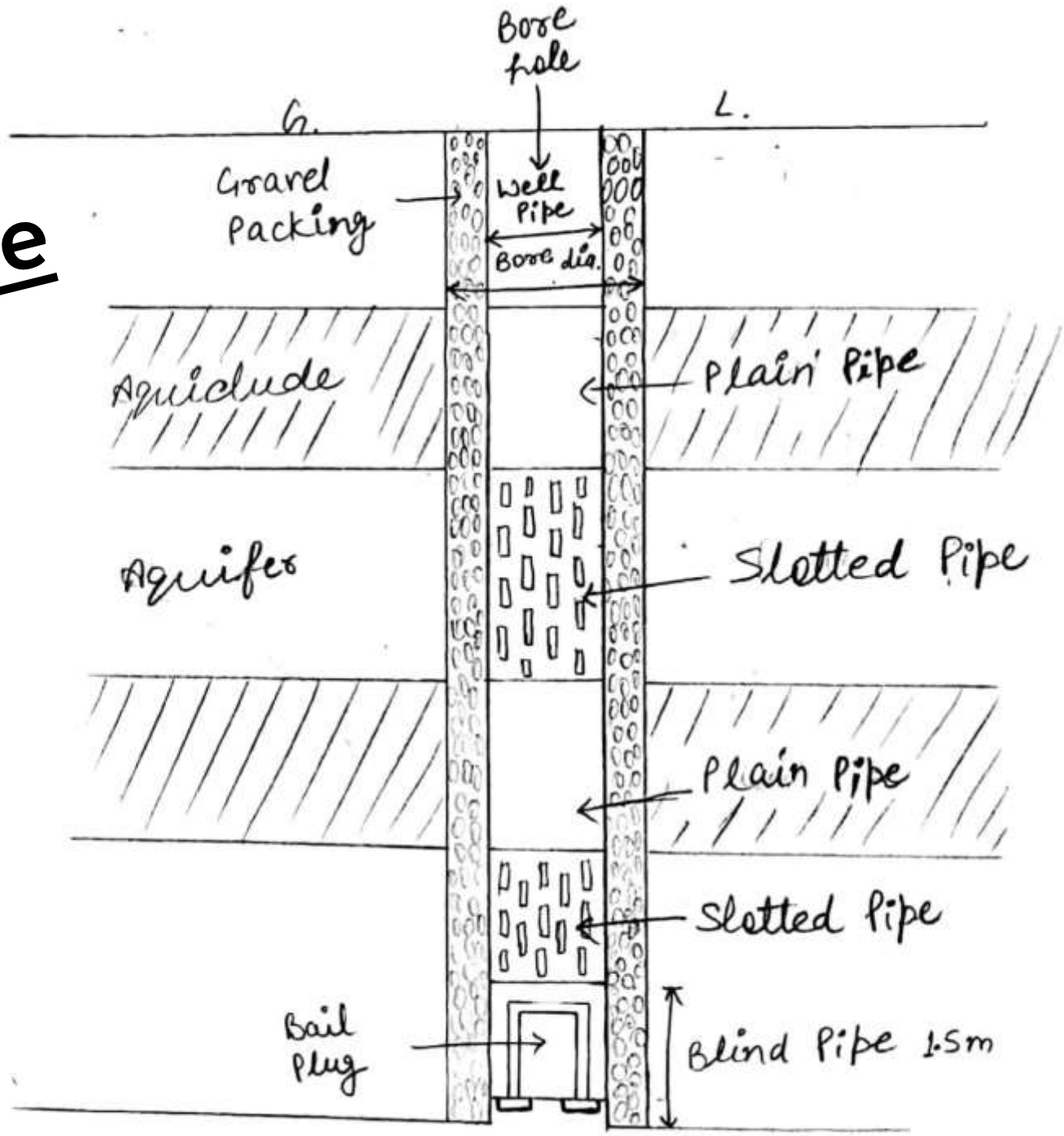
Strainer type Tube well



Slotted type Tube well

- It consist of a plain pipe and a slotted pipe without covered by wire mesh.
- These are lowered into the bore hole.
- The slotted pipe is located in water bearing strata. These slotted pipes are also known as screen pipes.
- After lowering of pipes, a mixture of bajri and gravels is poured into the hole between casing and well pipe.

Slotted type tube well



Boring

- It means drilling a hole in soil upto a specified depth.

- Methods of boring:-

1. Auger boring
2. Wash boring
3. Percussion boring
4. Rotary drilling

Auger boring

- This is a very simple method.
- In this method, drilling is made by a device called auger.
- The auger is placed on the soil vertically and rotated. When the auger is filled with soil, it is taken out and the soil is collected.
- The auger can be rotated manually or mechanically.
- This method is suitable for soft soil like cly, sand,etc.
- It is suitable for a depth upto 10m.

Wash boring

- Initially a hole is made by auger.
- Then a casing pipe is pushed in the hole and driven by hammer.
- A hollow drill bit is screwed to the hollow drill rod.
- This rod is connected to a pipe and lowered inside the casing.
- Water is forced inside the rod. This loosesns the soil at lower end by impact of jet and bit and slurry comes out from casing.
- The slurry is stored in a tank and sand settle downs here. Then clean water is again circulated.

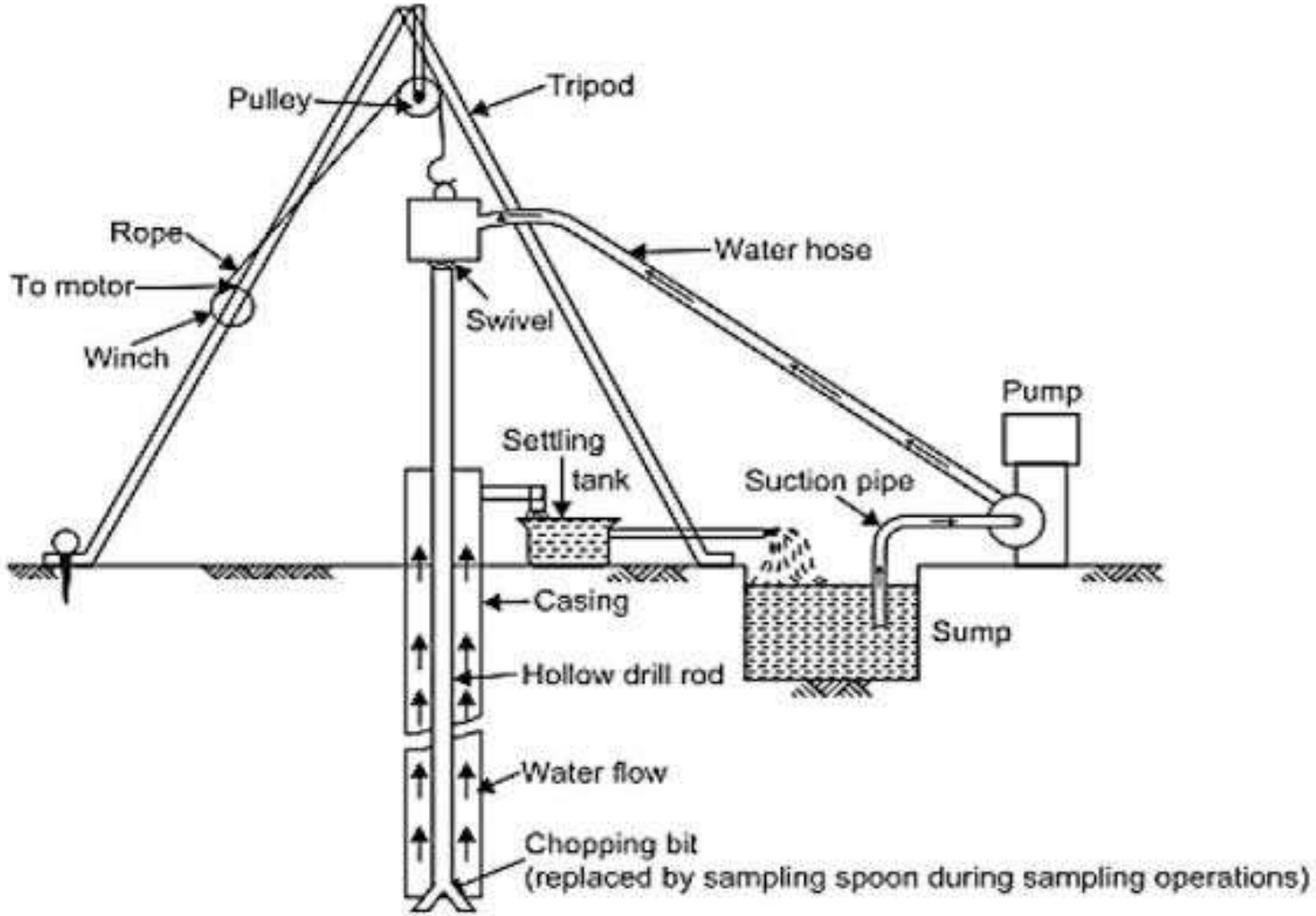
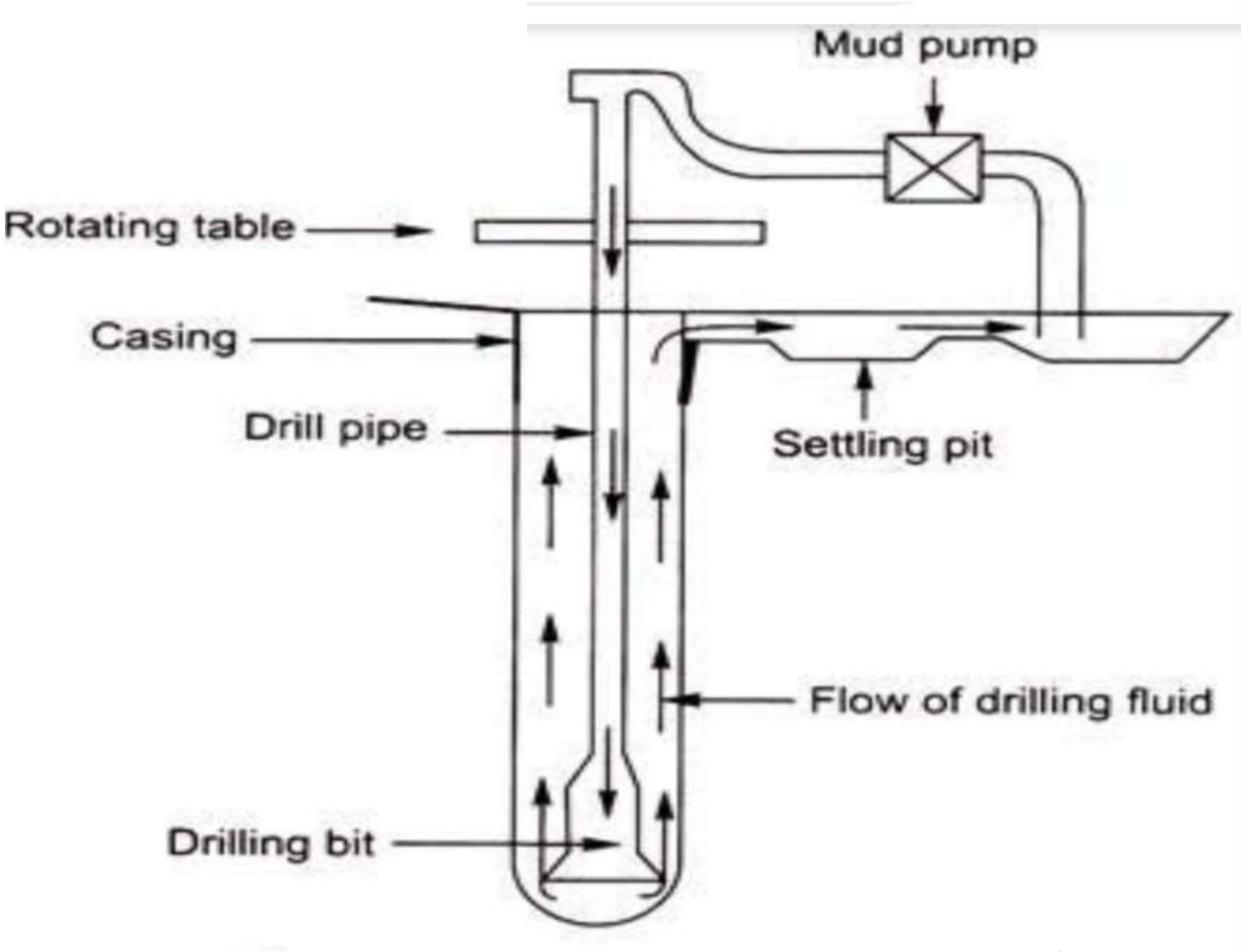


Fig 1.3: Wash boring

Rotary boring

- This method is similar to wash boring.
- This merhos is used to drill in hard rocks.
- A drill bit fixed to the lower end of a drill rod,is rotated.
- Bentonite slurry is used under pressure which brings up the cuttings to the surface.


Mud pump
Rotating table
Casing
Drill pipe
Settling pit
Flow of drilling fluid
Drilling bit

Percussion boring

- This method is used to make hole in all types of soil including boulders and rocks.
- In this a heavy drill bit is repeatedly raised and dropped.It breaks or loosesns the underlaying soil.
- Then water is added to form the slurry of cutting.
- This slurry is removed out of hole by sand pumps.

Water harvesting

- The process of collection of rain water for reuse before it reaches the aquifer. It can be used for watering of gardens, street washing and irrigation.

or

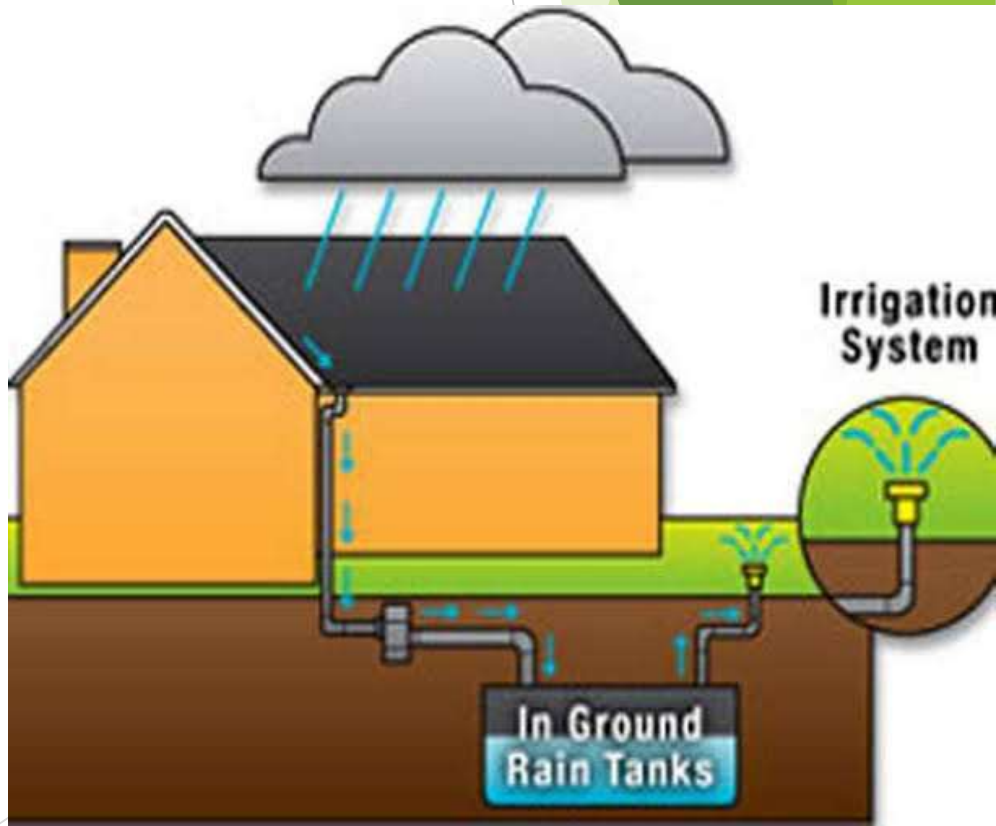
- Rainwater harvesting is the storing of rain water during the monsoon season for the purpose of using it during periods of water scarcity.

Need

- i. To overcome the inadequacy of surface water to meet our demands.
- ii. To arrest decline in ground water levels.
- iii. To improve ground water quality by dilution.
- iv. To increase agriculture production.
- v. To improve ecology of the area by increase in vegetation cover etc.

Water harvesting techniques

- *Surface runoff harvesting*
- *Roof top rainwater harvesting*



1. Surface runoff harvesting

- In urban area rainwater flows away as surface runoff. This runoff could be caught and used for recharging aquifers by adopting appropriate methods like recharge pit, recharge well.

2. Rooftop rainwater harvesting

- In rooftop harvesting, the roof becomes the catchments, and the rainwater is collected from the roof of the house/building. It can either be stored in a tank or diverted to artificial recharge system. This method is less expensive and very effective and if implemented properly helps in augmenting the groundwater level of the area.

Components of the Rooftop Rainwater Harvesting

The system mainly constitutes of following sub components:

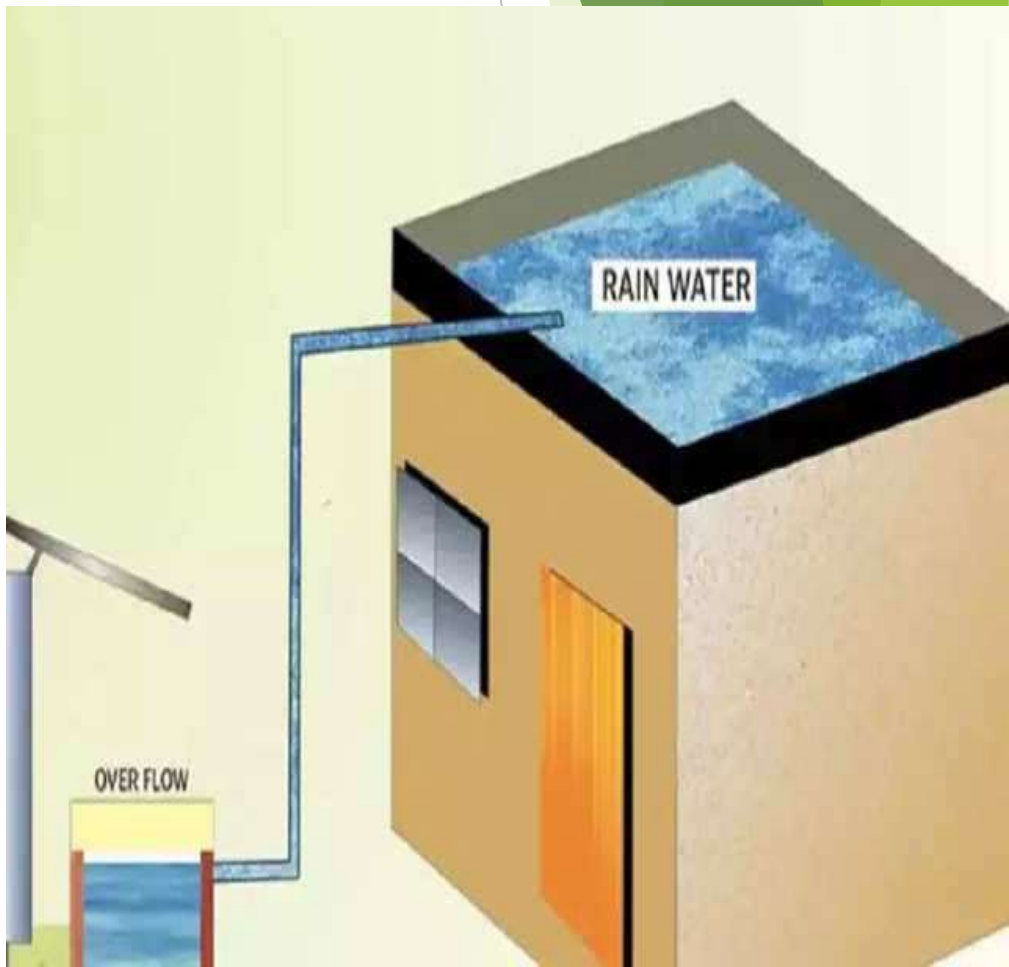
- Catchments
- Transportation
- First flush
- Filter
- Storage tank

Catchments

- The surface that receives rainfall directly is the catchment of rainwater harvesting system. It may be terrace, courtyard, or paved or unpaved open ground. The terrace may be flat RCC/stone roof or sloping roof.

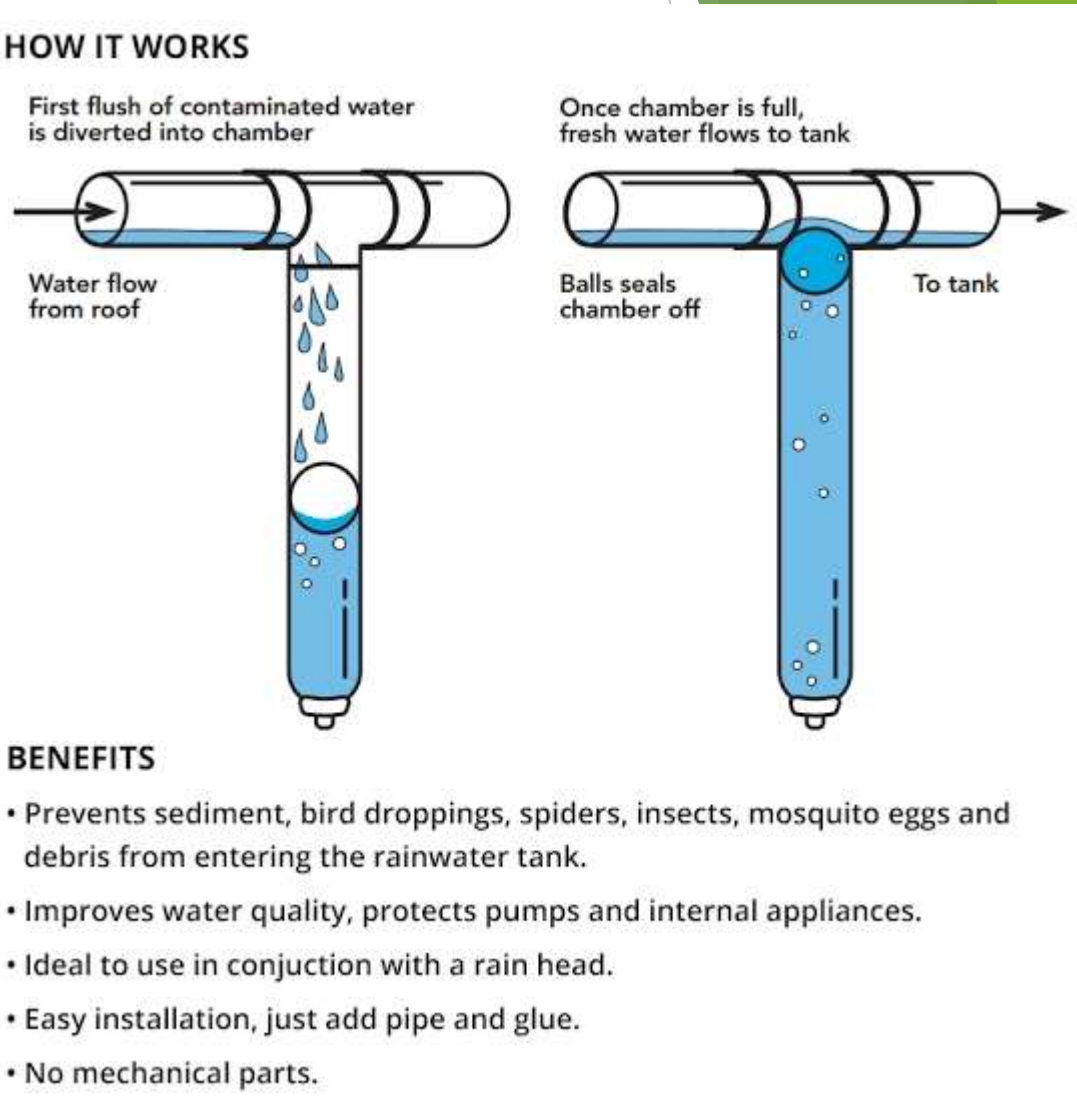
Transportation

- Rainwater from rooftop should be carried through drains to storage system.
- Water pipes should be UV resistant (ISI HDPE/PVC pipes) of required capacity.
- Water from sloping roofs could be caught through gutters and down take pipe.
- At terraces, mouth of the each drain should have wire mesh to restrict floating material.



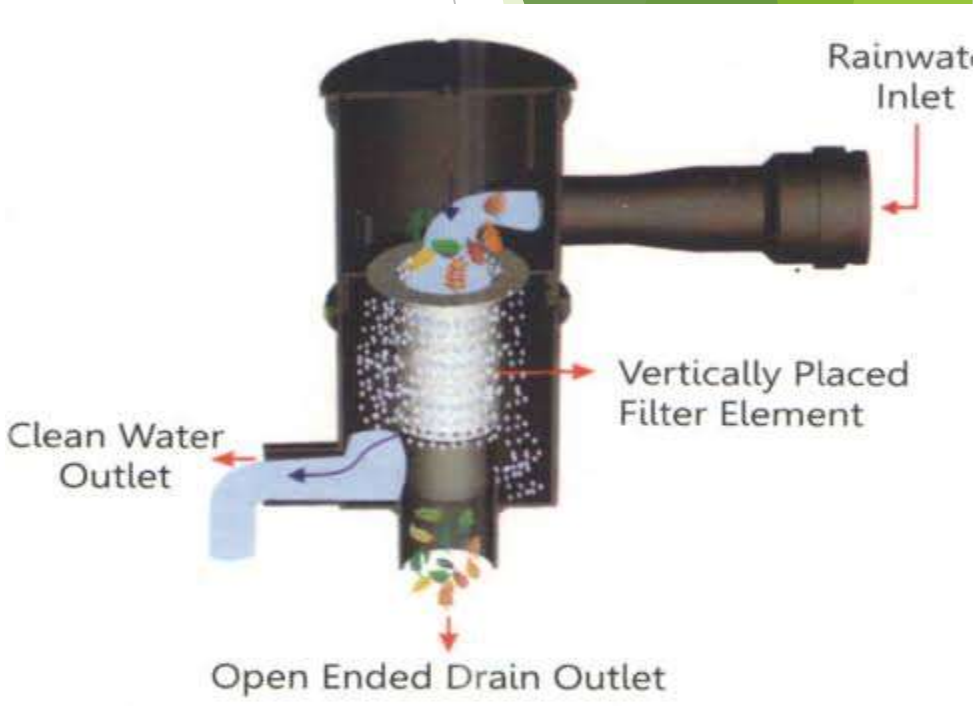
First Flush

First flush is a device used to flush off the water received in first shower. The first shower of rains needs to be flushed-off to avoid contamination of stored water.



Filter

- Filters are used for treatment of water to effectively remove turbidity, colour and microorganisms.
- It removes silt, dust, leaves and other organic matter from entering the storage tank.
- After first flushing of rainfall, water should pass through filters. A gravel, sand and mesh filter is designed and placed on top of the storage tank. This filter is very important in keeping the rainwater in the storage tank clean.



Storage tank

- After filtration of water, the clean water is stored in a tank.
- It may be placed on ground or it may be underground.
- It should be covered at the top.