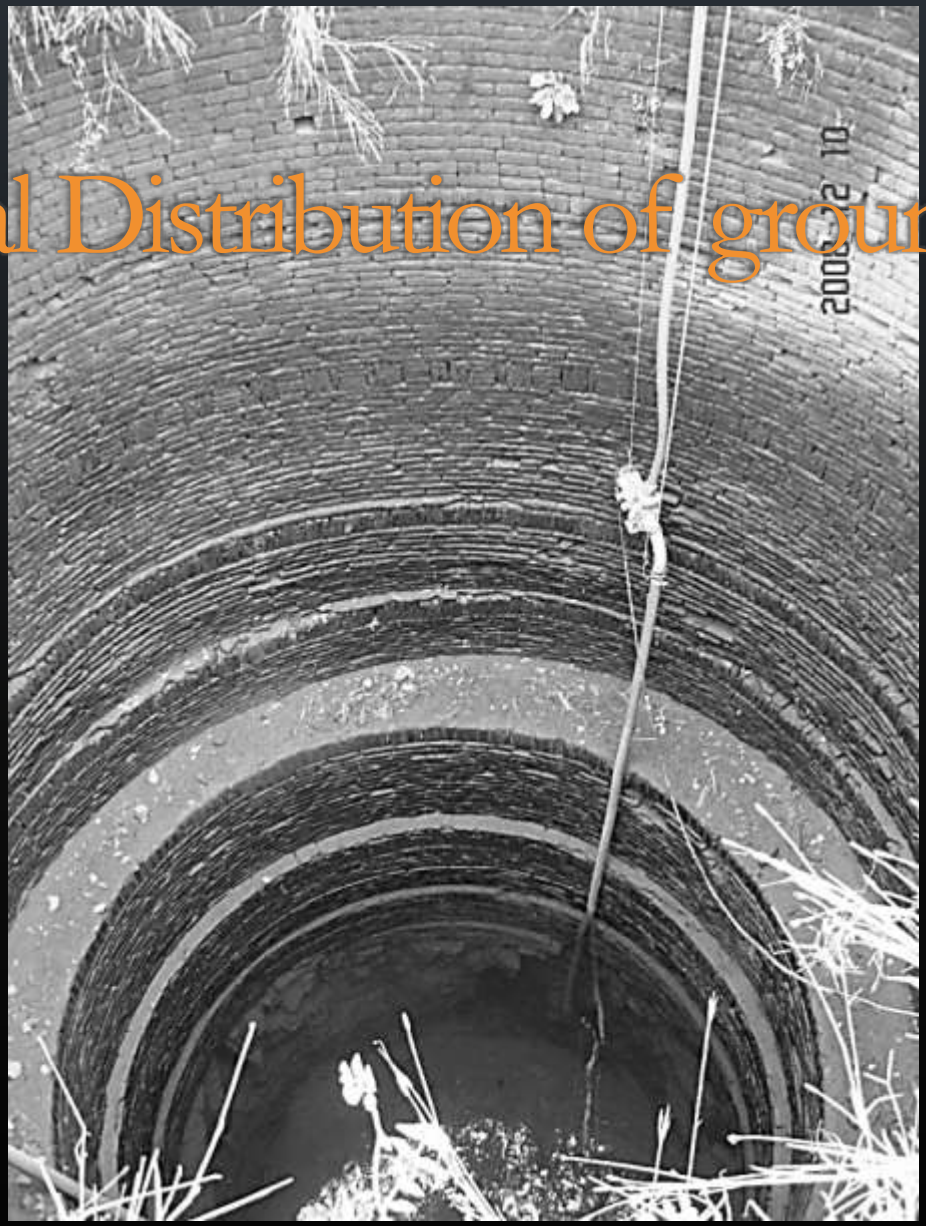
Vertical Distribution of groundwater



ADVANCED CENTER FOR WATER RESOURCES DEVELOPMENT AND MANAGEMENT (ACWADAM)

www.acwadam.org / acwadam@vsnl.net

Openings in rocks

Some portions of rocks in the subsurface contain different types of openings such as

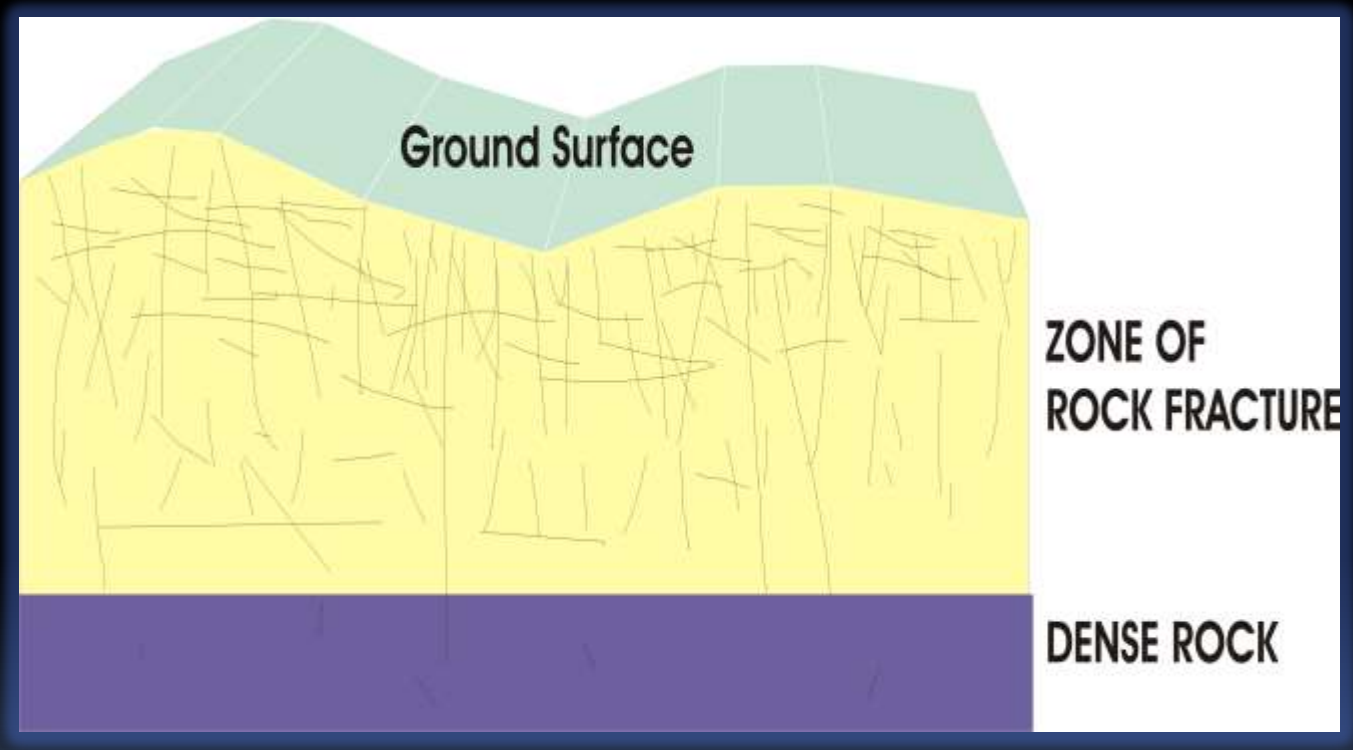
-intergranular openings
-vesicles in volcanic rock
-joints and fractures
-solution cavities

Such portions of the rock are called the ZONE OF ROCK FRACTURE

The portion of rock below the zone of rock fracture is very dense and may contain isolated openings. It generally has no openings that can hold significant quantities of water.

This zone is called the ZONE OF DENSE ROCK

Zones of the subsurface

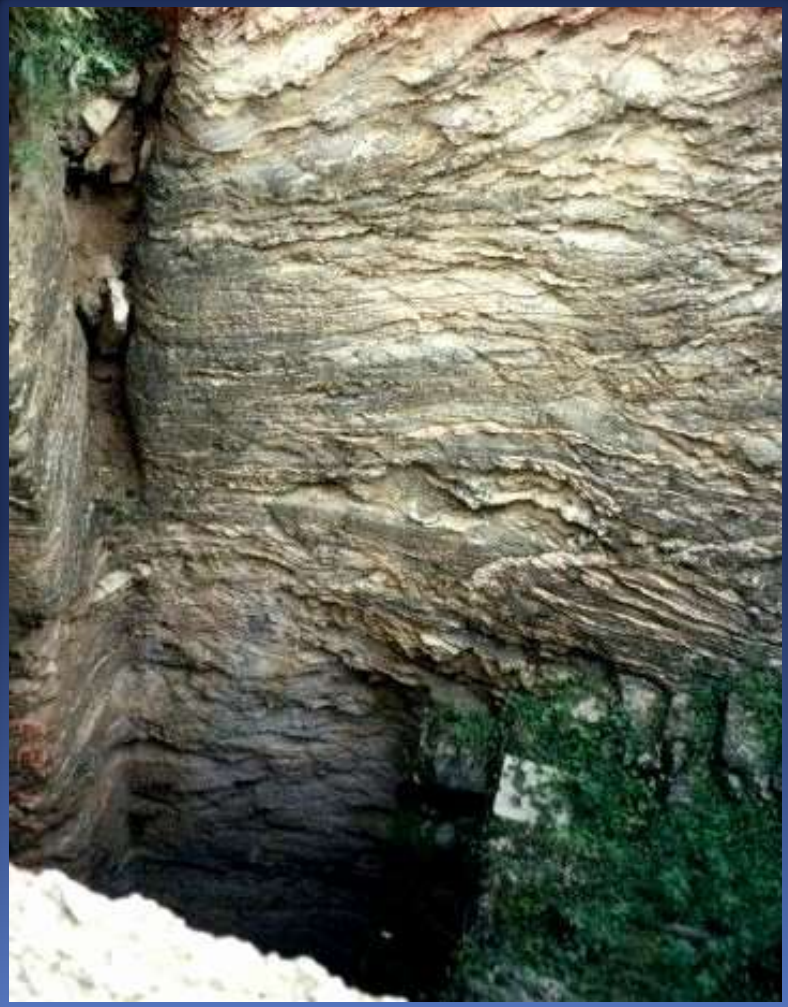


The ZONE OF ROCK FRACTURE shows variable thickness.

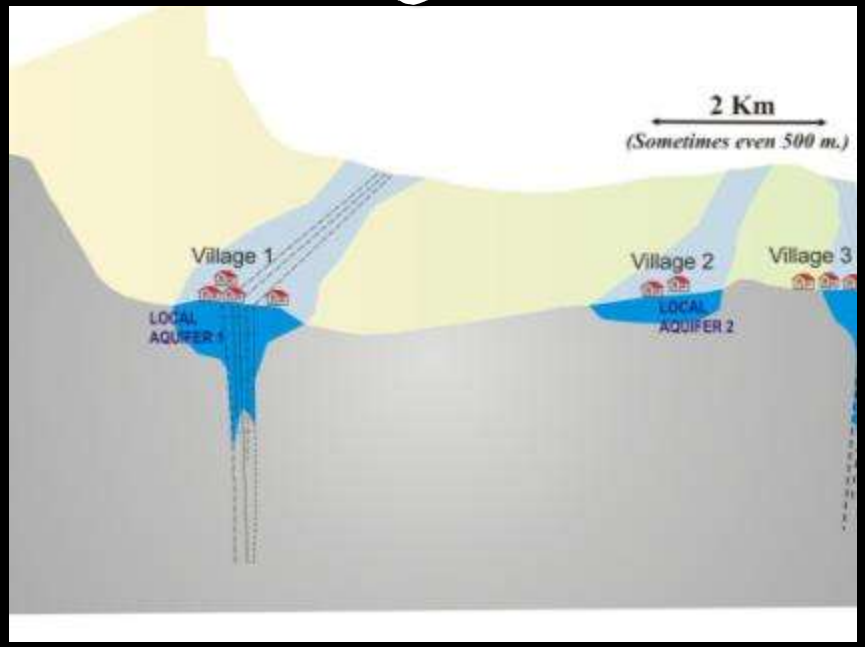
This thickness depends upon:

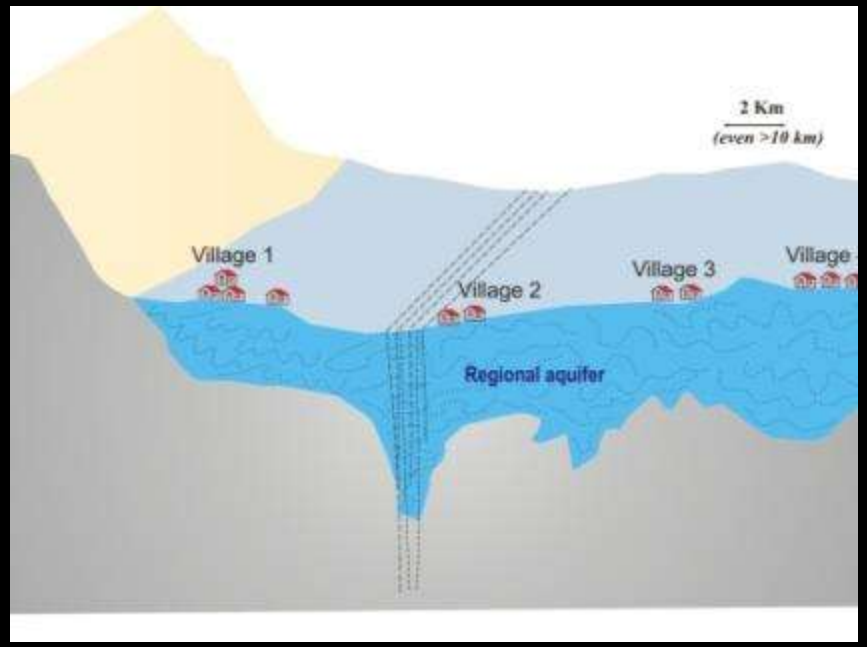
-Type of rock.
-Geological conditions within a single rock type.

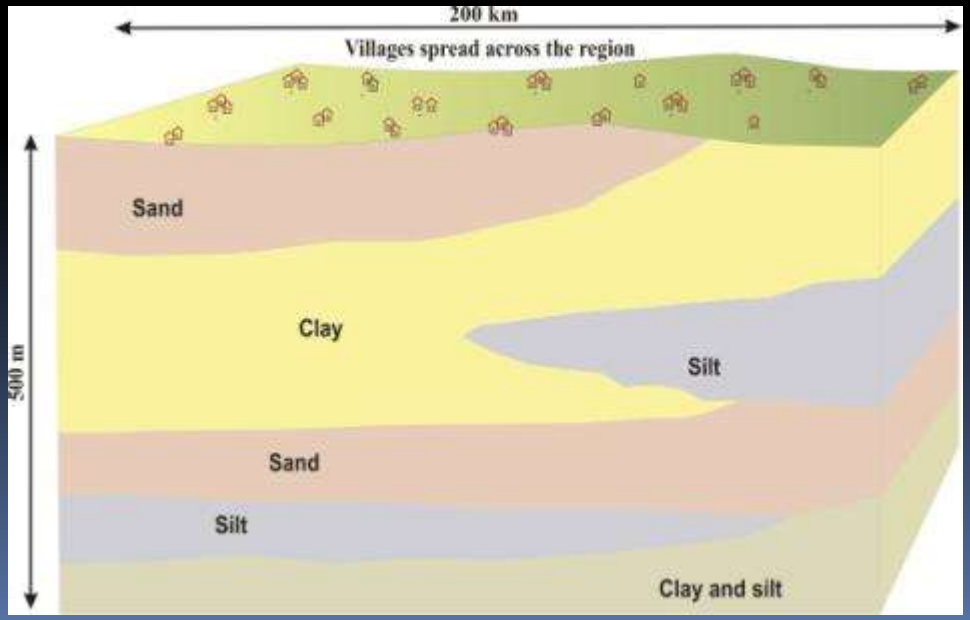
The thickness of this zone varies from a few metres to a few 100s of metres



Variability...







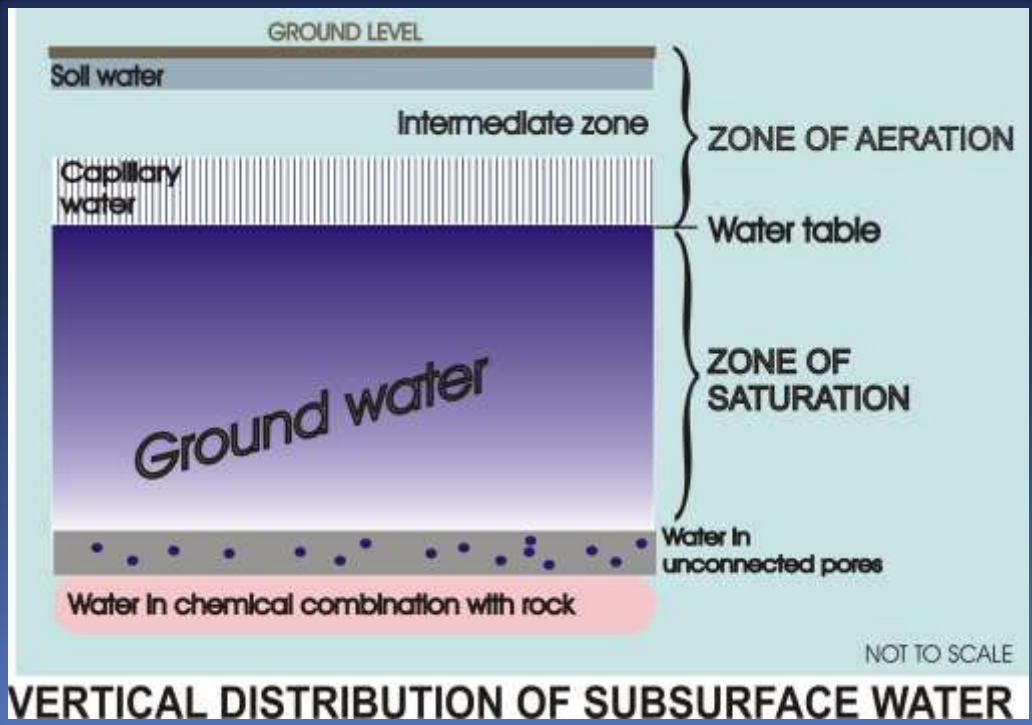
Zone of rock fracture

Infiltrating rainwater occupies various
openings within the zone of rock fracture.

The zone of rock fracture filled with water can be divided into:

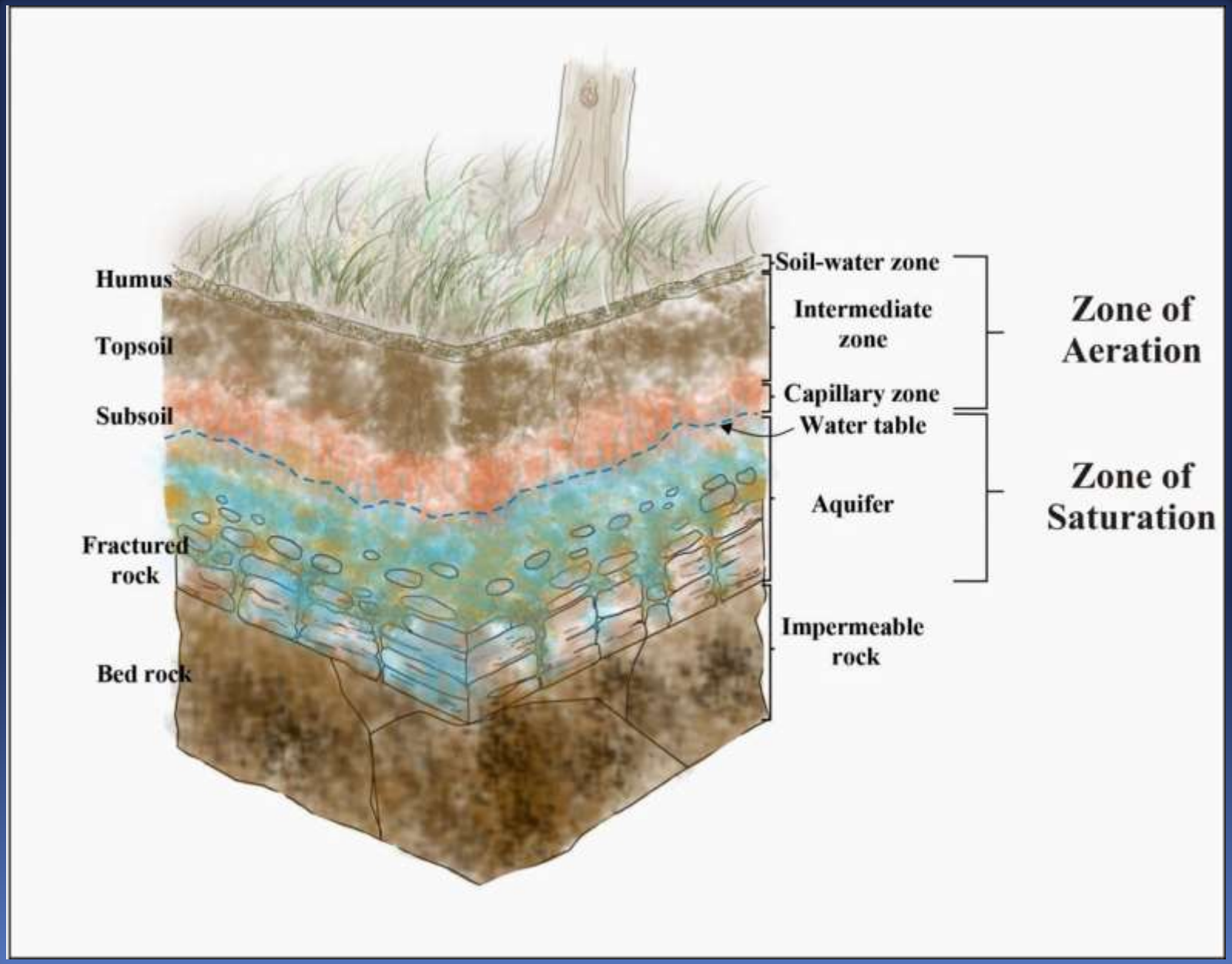
Zone of aeration

Zone of saturation



VERTICAL DISTRIBUTION OF SUBSURFACE WATER

Zone of rock fracture



Zone of aeration

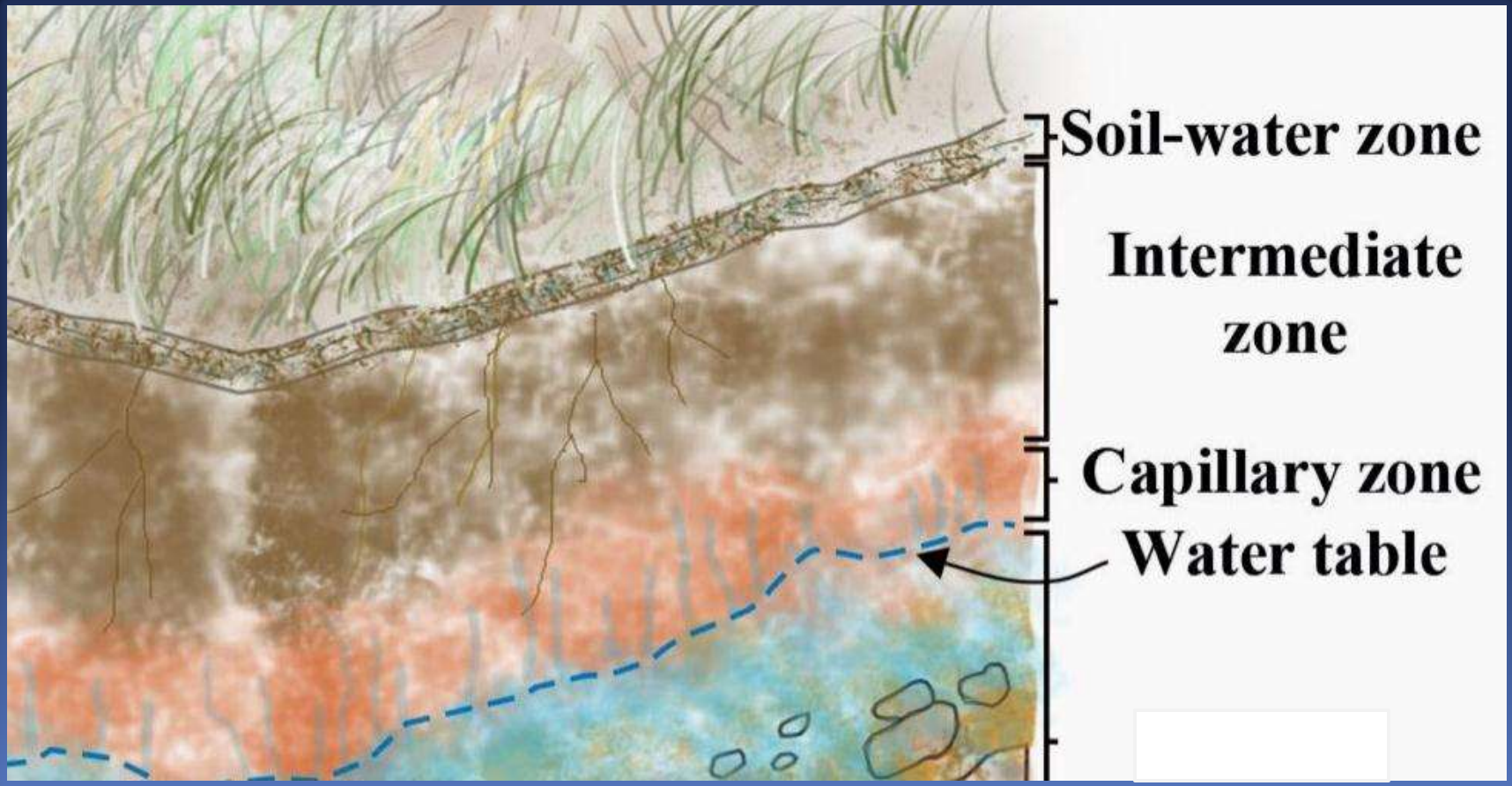
-Openings partly filled with air and partly with water.

Zone further divided into:

-Soil water belt: supports vegetation (root zone)

-Intermediate belt

-Capillary belt: water from the water table rises by capillary pressure in this zone



Zone of aeration – forces at work

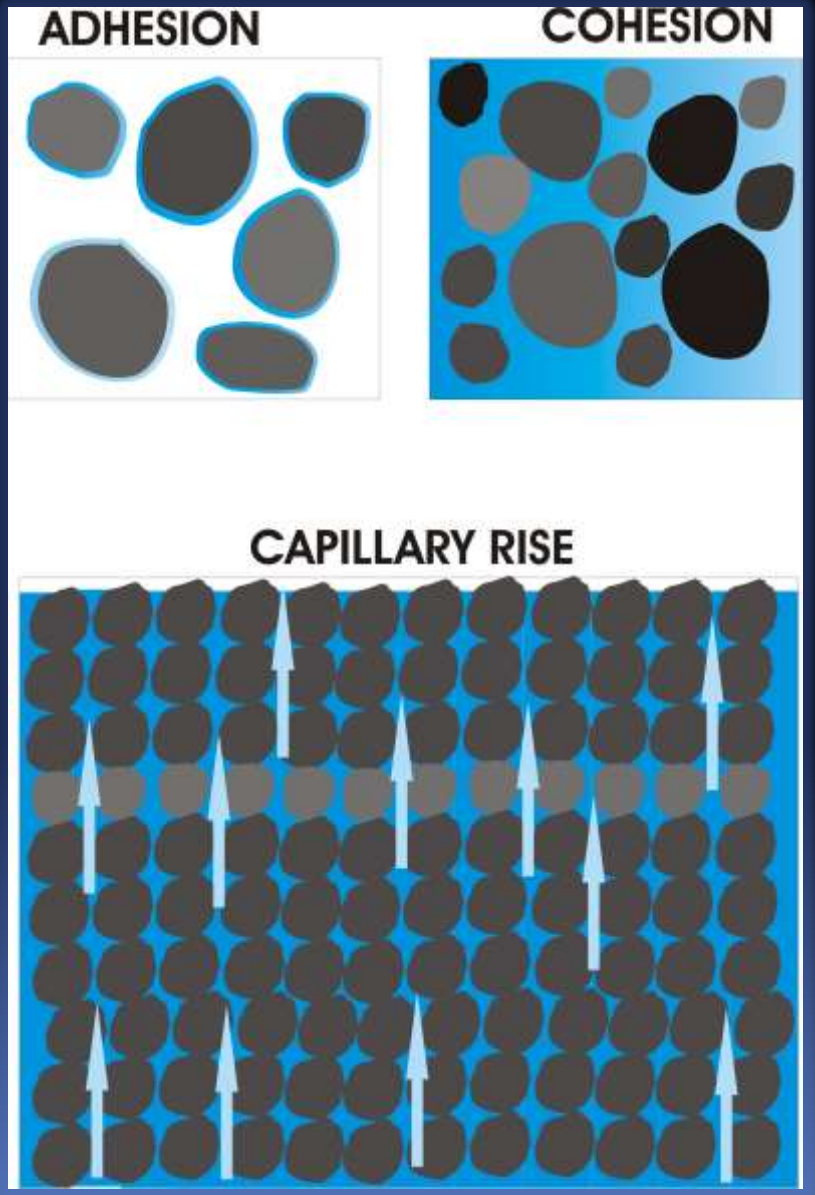
Water within the zone of aeration is in the form of:

-Thin film of water around grains of rock material – ADHESION.

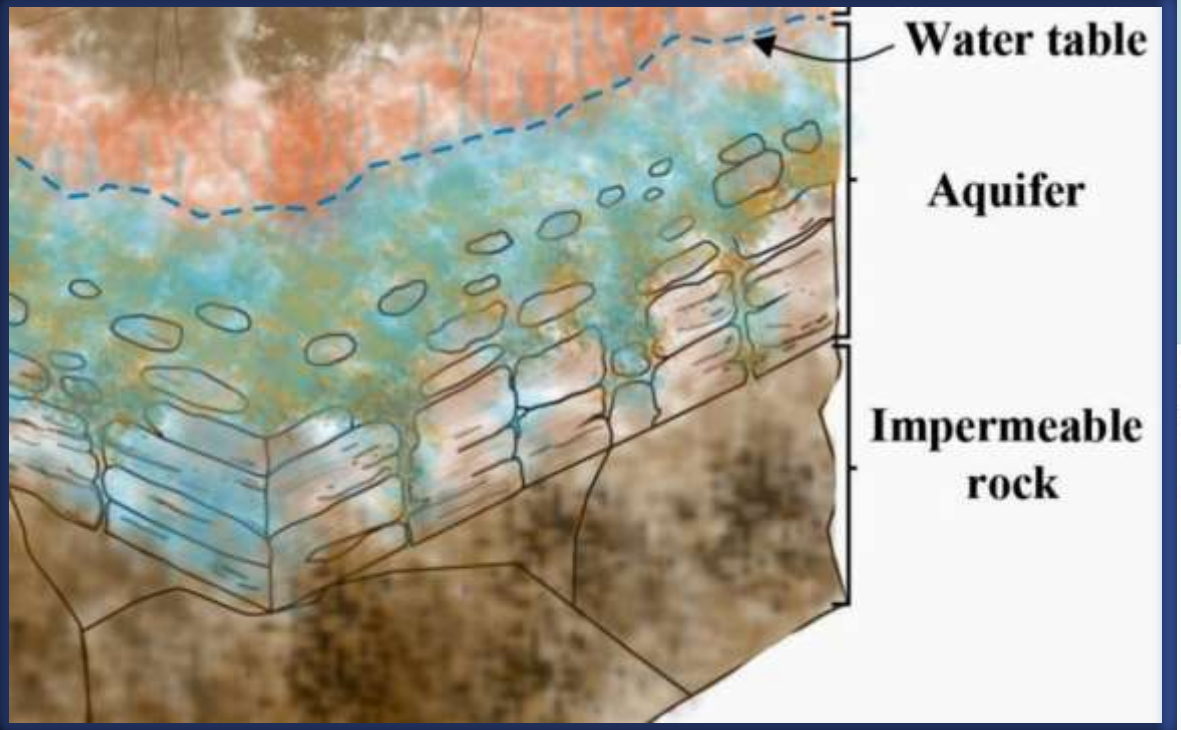
-Within intergranular pores in the rock – COHESION.

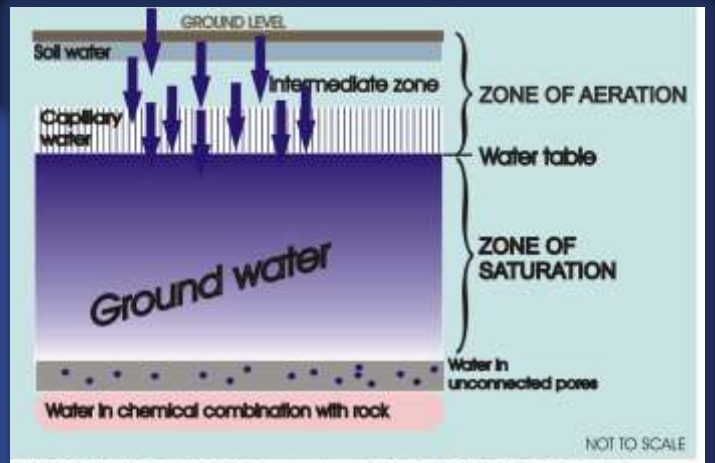
-Within irregularly shaped capillary tubes formed by joining of the intergranular openings – CAPILLARY ACTION.

Water in the zone of aeration exerts a pressure that is less than the overlying atmospheric pressure.

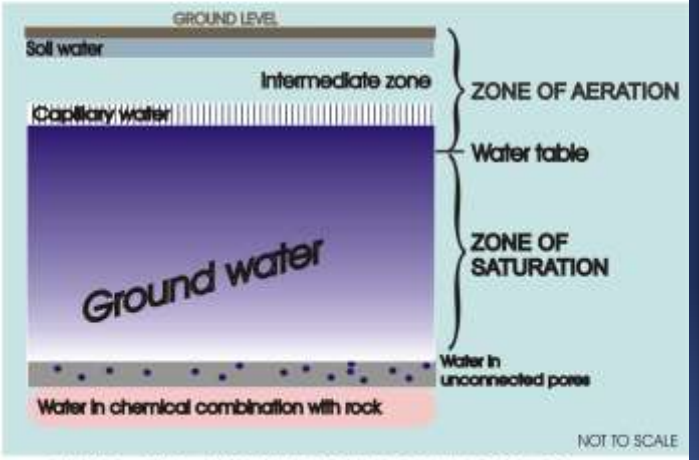


Zone of saturation





INFILTRATION OCCURS THROUGH THE ZONE OF AERATION...



...AND THE WATER TABLE RISES

All openings are completely filled with water.

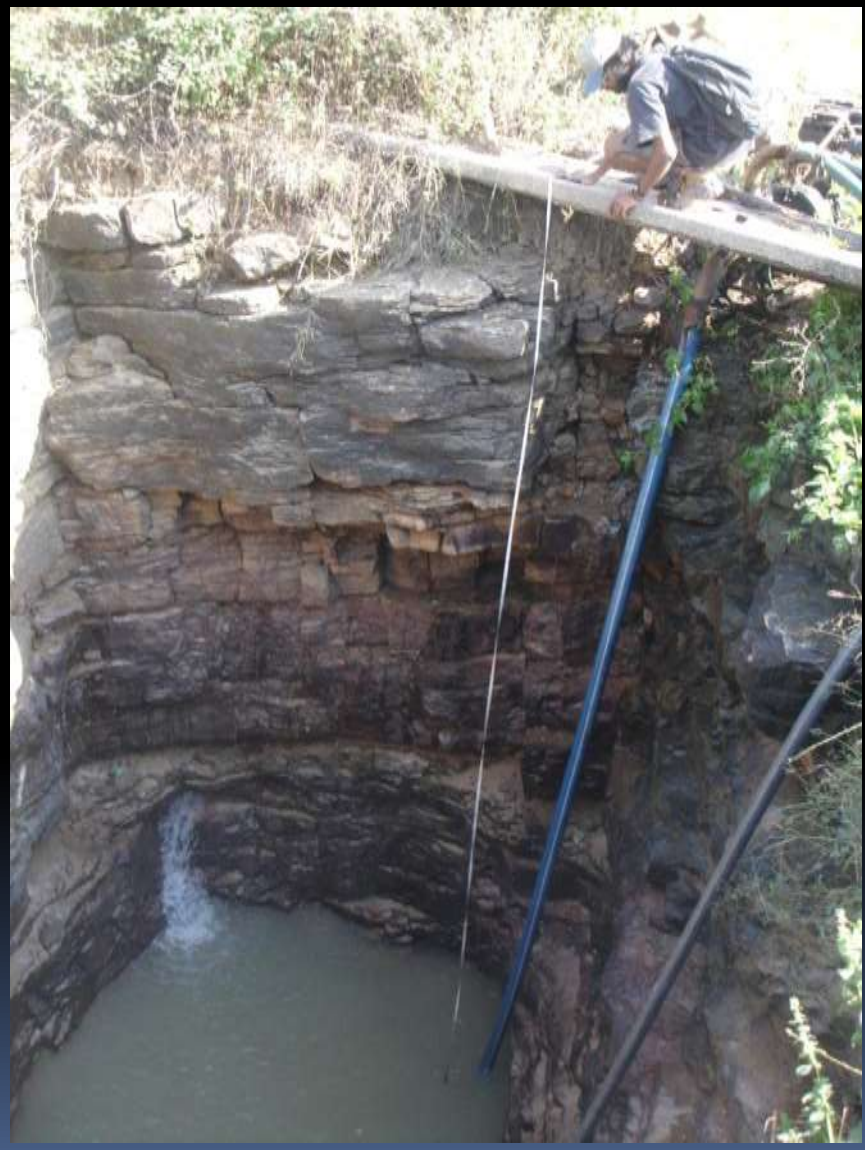
When the soil water belt and intermediate belt are completely filled to their full capacity, the infiltrating water moves downward and begins accumulating over the impermeable zone of dense rock.

Zone of saturation and the water in a shallow dug well

Water in the zone of saturation exerts pressure greater than the overlying atmospheric pressure.

This pressure makes water flow into a well, when it is dug into the zone of saturation.

The well penetrates the zone of aeration also, but its lower than atmospheric pressure implies that water from the zone of aeration does not flow into the well (not enough release of pressure).



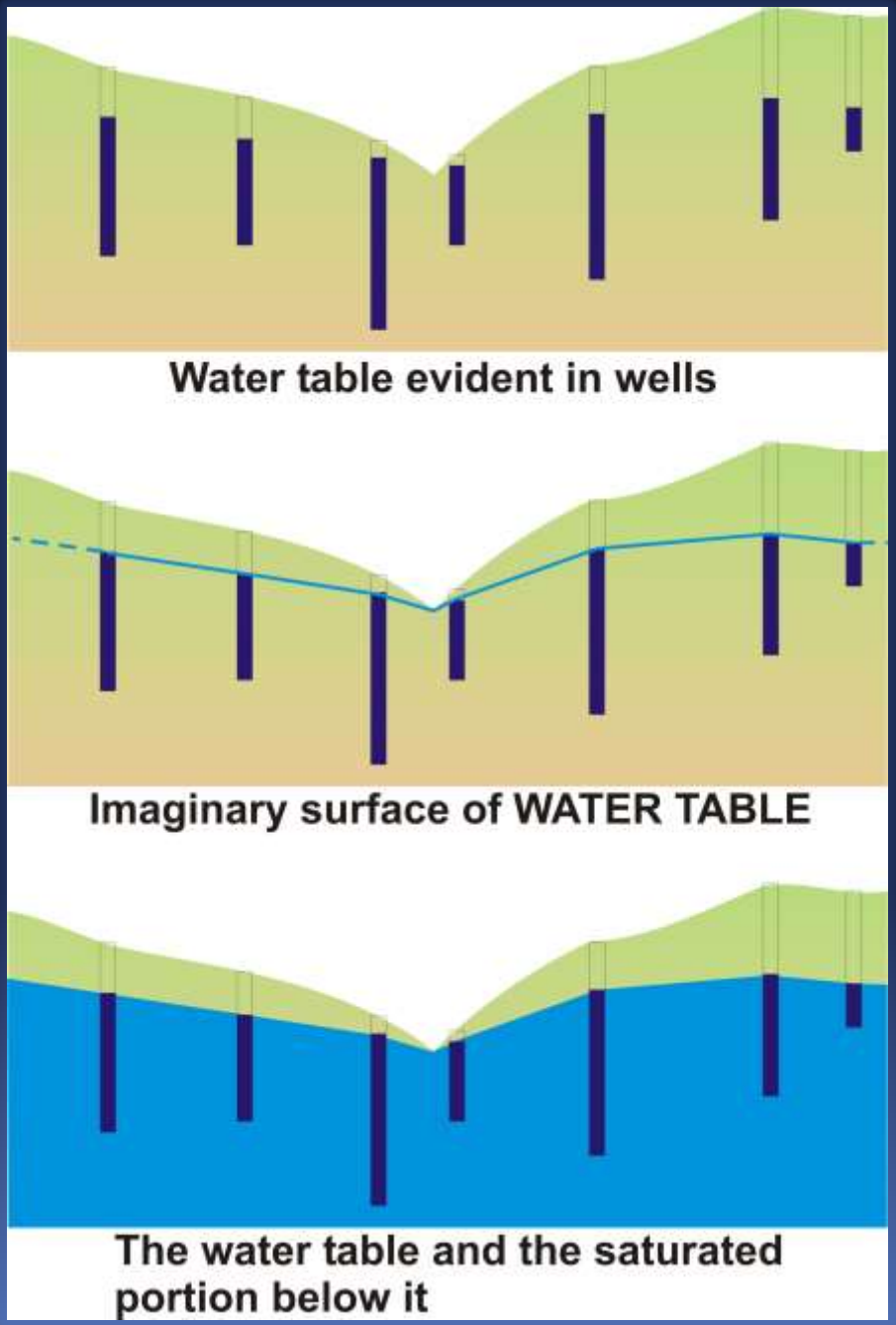
Zone of saturation and the water table

- The uppermost surface of the zone of saturation is called the WATER TABLE.

- The level of water in a well (shallow dug well) penetrating the zone of saturation is the visible manifestation of the water table.

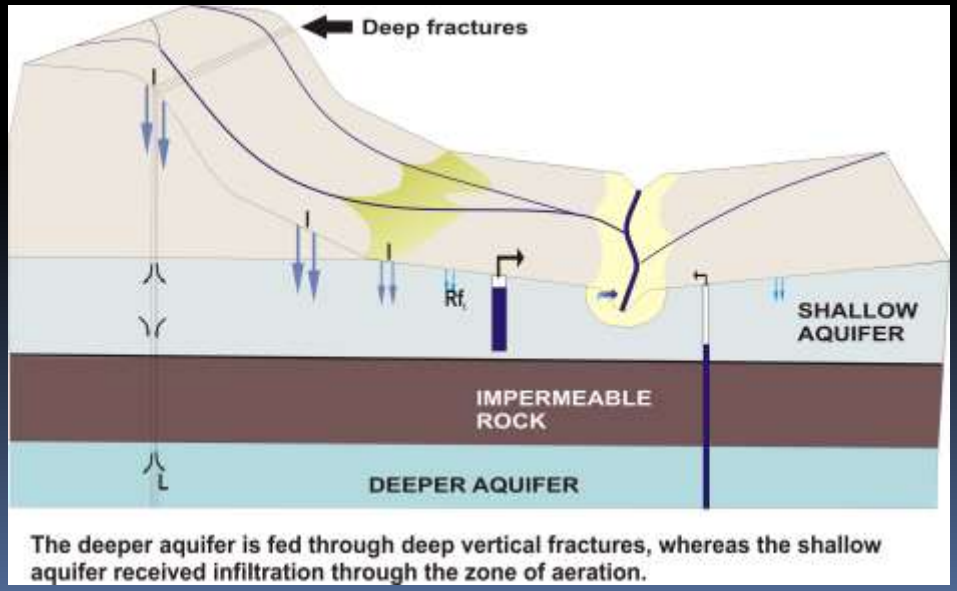
The water table

- Joining the water levels in shallow dug wells helps us trace the imaginary surface of the water table in an area.
- The water stored in the saturated zone can be readily augmented through wells and is commonly referred to as GROUNDWATER.
- The capillary fringe is an upward extension from the water table.
- The height of the capillary fringe will be greater in fine grained material such as clay.



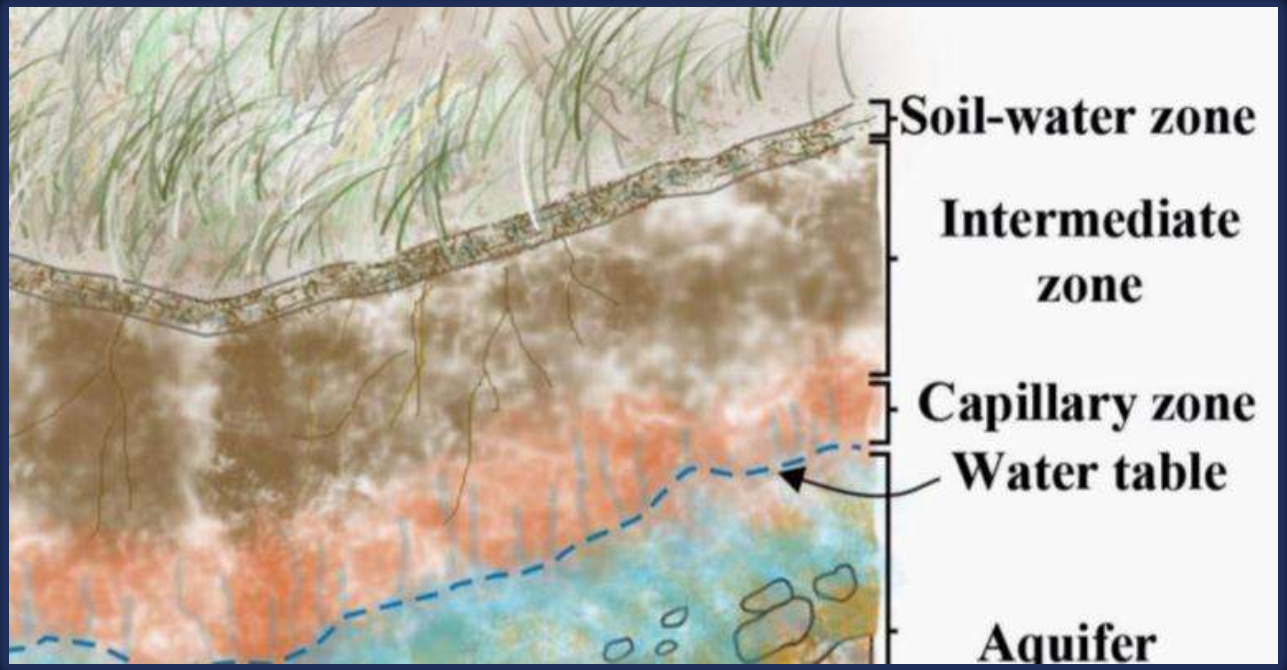
Deeper groundwater

- Rocks are often layered.
- They are also folded and fractured, allowing percolation of water to deeper levels.
- Water at depths (variable, depending upon the geologic conditions) is under pressure exerted by the overlying and underlying rocks.
- Water at depth is confined and is at pressures that are different from atmospheric pressure at the surface.



The deeper aquifer is fed through deep vertical fractures, whereas the shallow aquifer received infiltration through the zone of aeration.

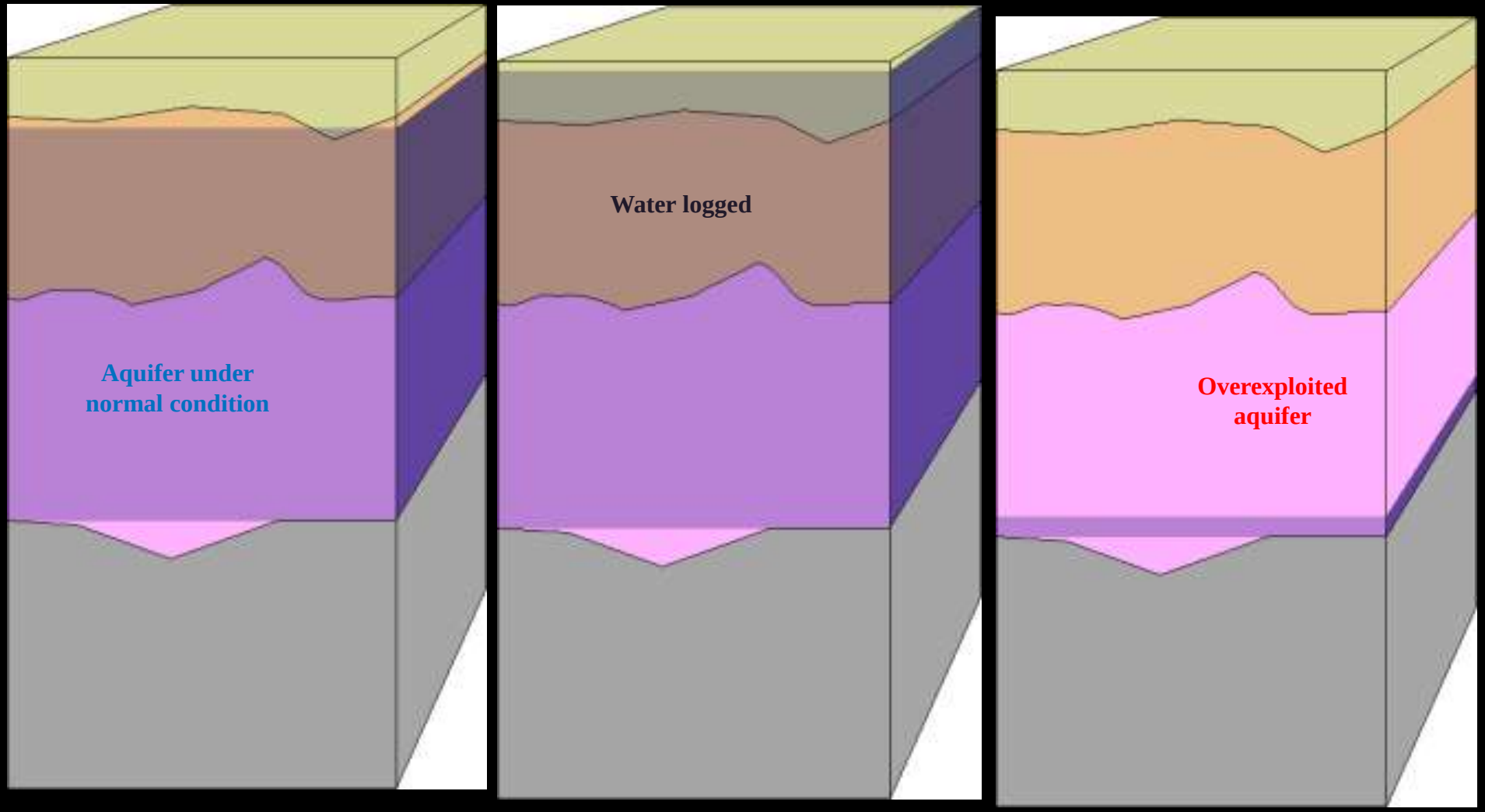
Vadose Hydrology



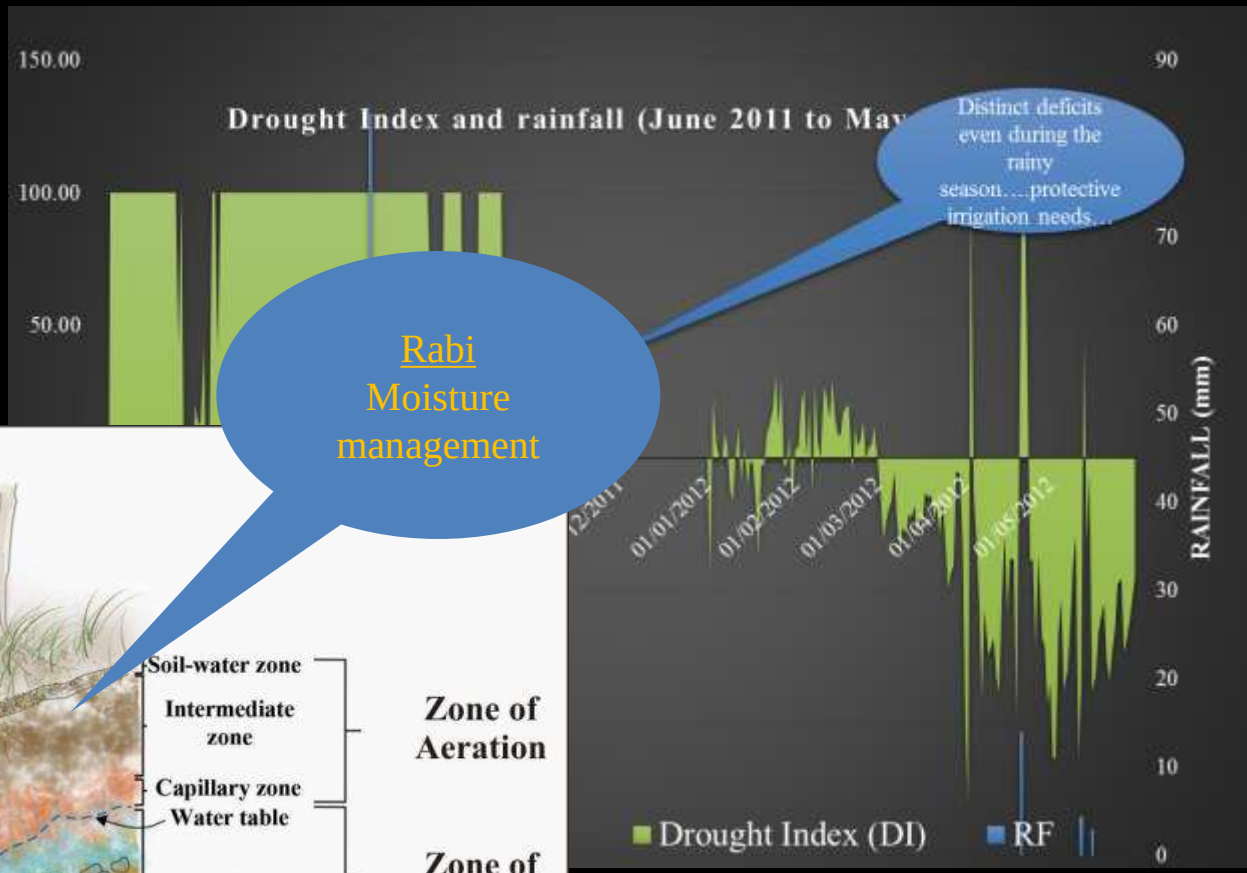
- It occurs above the water table and above the capillary fringe
- The soil pores are only partially filled with water; the moisture content is less than the porosity
- The fluid pressure is less than the atmospheric

Vadose Hydrology

- Controls interrelationships between precipitation, infiltration, surface runoff, evapotranspiration and groundwater recharge
- The vadose zone regulates the transfer of water from the land surface to groundwater and vice versa
- Provides protection, screening, filtering, transfer and attenuation of potential groundwater contaminants

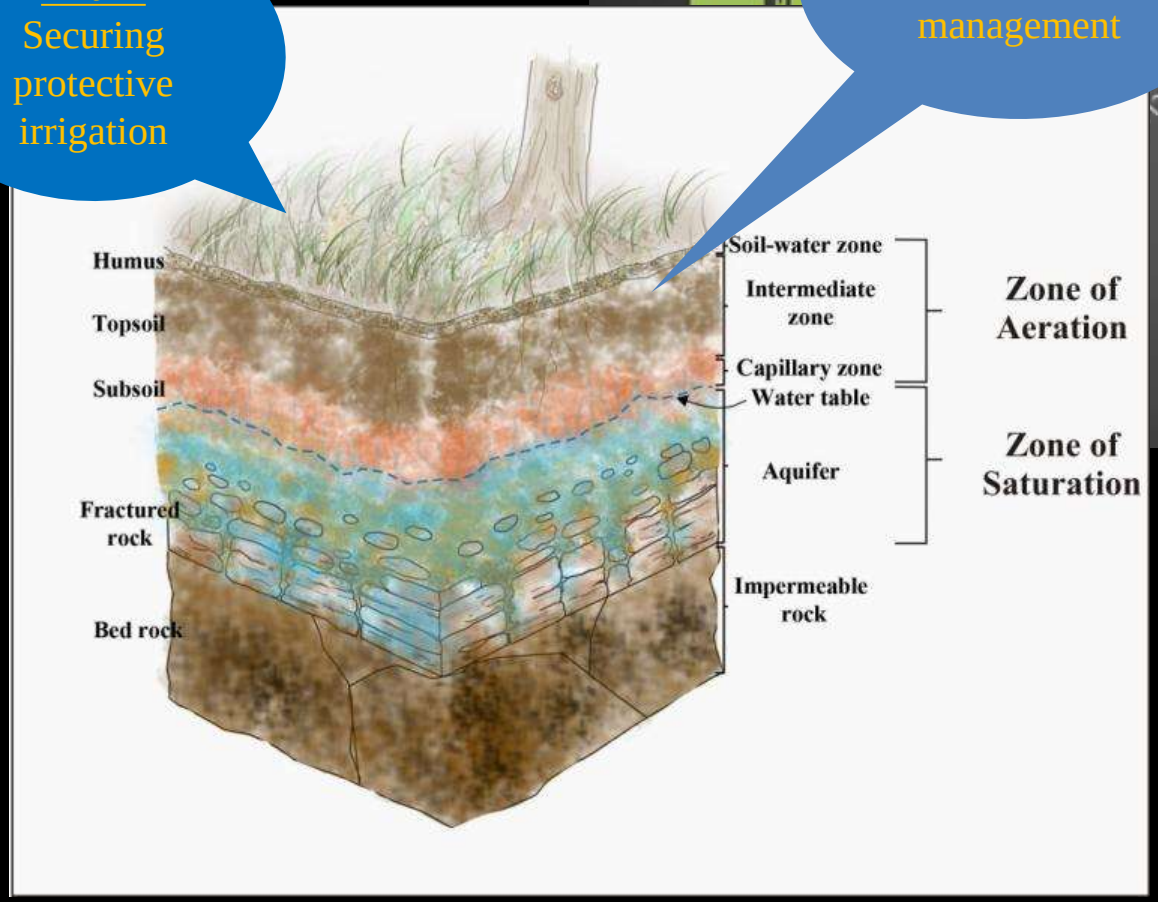

Aquifer under
normal condition
Water logged
Overexploited
aquifer

Vadose zone hydrology



Kharif
Securing protective irrigation

Rabi
Moisture management




Thank you
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