

GROUND WATER HYDROLOGY

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Definition

Ground water hydrology may be defined as the science that deals with the study of the properties, distribution and behavior of water in nature as it occurs underneath the surface of the earth.

Aquifer

Any underground rock formation containing water is called **aquifer**. The rock of an aquifer must be porous and permeable so that it can absorb water. Aquifers are an important source of fresh water.

On the basis of saturation of cracks and pores between soil particles and rocks by water, the underground section is divided into two zones –

- i) Unsaturated zone
- ii) Saturated zone.

Structure of Aquifer

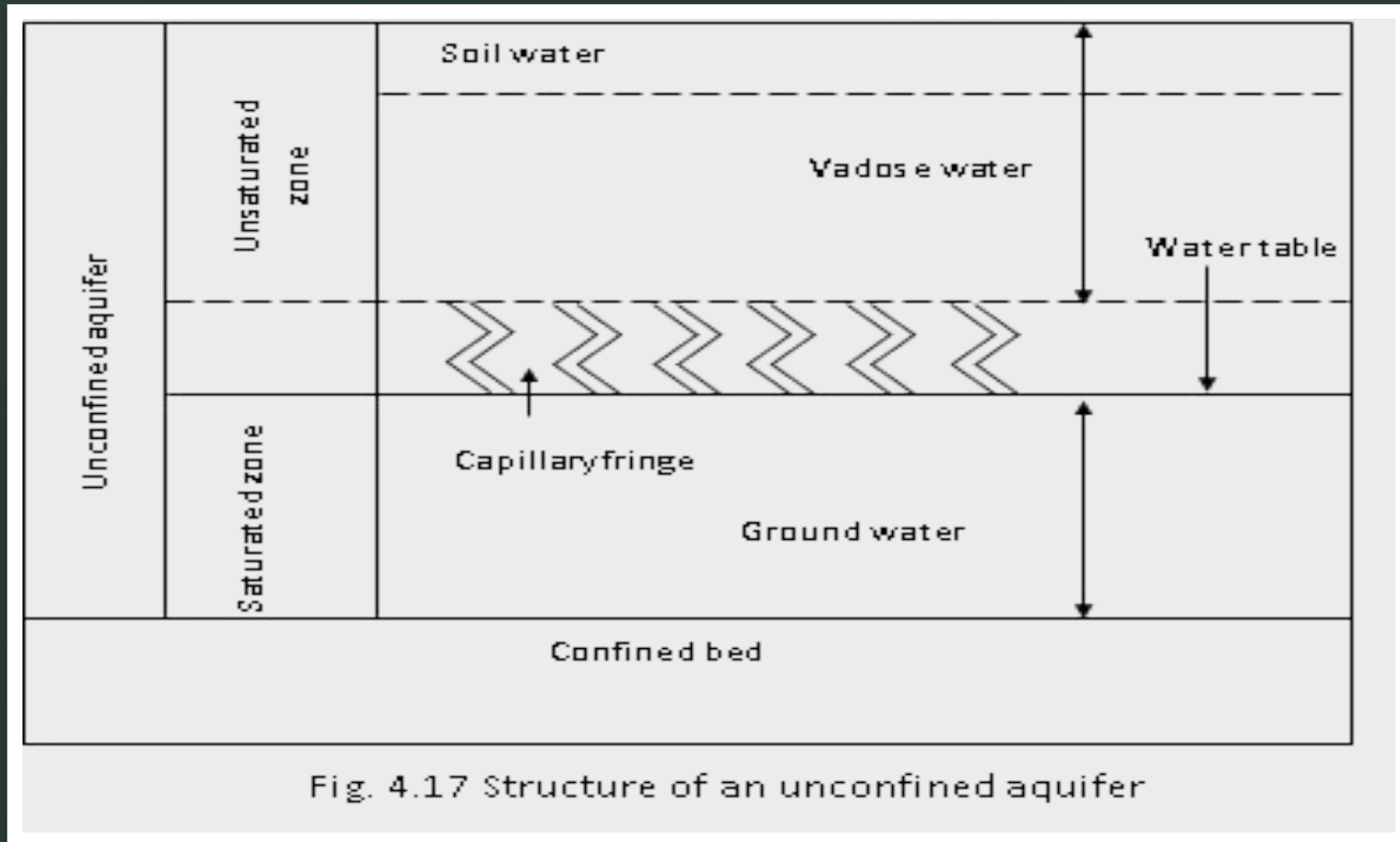


Fig. 4.17 Structure of an unconfined aquifer

Hydraulic Gradient

In an unconfined aquifer, the slope of the water table, measured in the direction of the steepest rate of change is called **hydraulic gradient**. It is important because ground water flow is in the direction of the gradient and also proportional to it.

The vertical distance from the reference plane, i.e., Datum plane (usually sea level) to water table is called **hydraulic head**.

If we imagine two wells directly in line with the ground water flow, the gradient would be simply the difference in head divided by the horizontal distance between them.

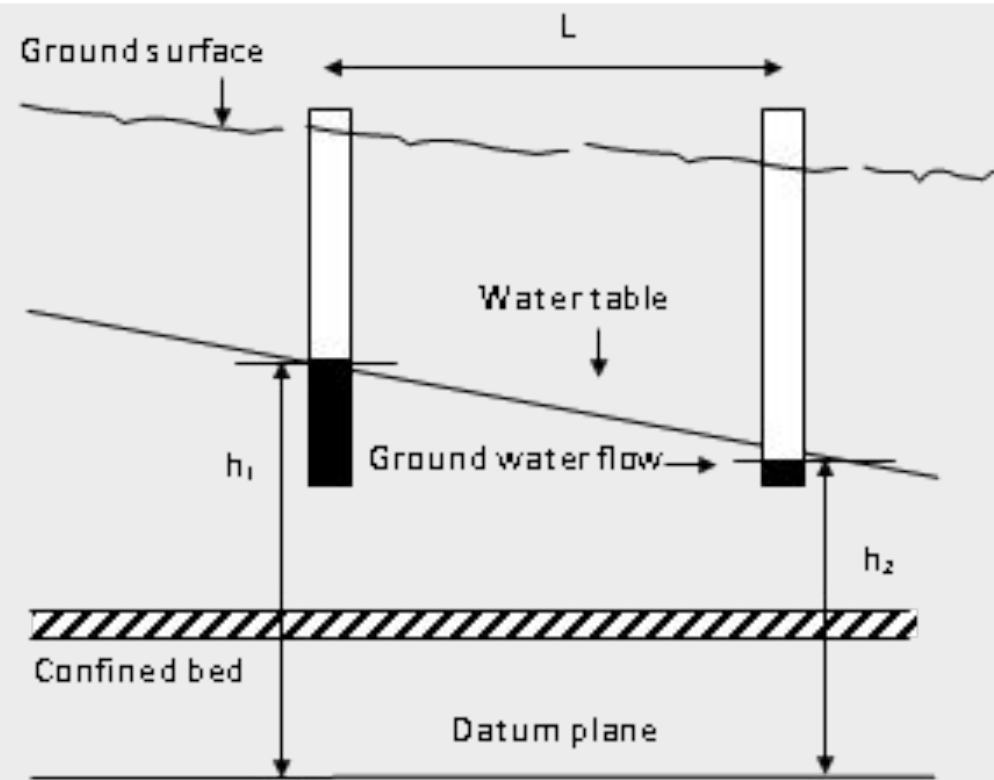


Fig. 4.18 Showing head and gradient in an unconfined aquifer


Ground Water Flow & Darcy's Law

The rate of flow of ground water is first time formulated by Henry Darcy. According to him, the flow rate (q) is directly proportional to the cross sectional area(A) and hydraulic gradient


Equation of Hydraulic Gradient and Darcy's Law

$$i = \frac{h_1 - h_2}{L}$$

$$\& \quad q = K \cdot \frac{h_1 - h_2}{L} \cdot A$$



Here, K is proportionality constant and its value depends on the nature of the soil through which water is flowing. Sometime it is also called as **hydraulic conductivity**. Aquifers that have same hydraulic conductivity throughout are said to be **homogeneous** and when hydraulic conductivity differs from place to place is called **heterogeneous**.



Ground Water contamination

Once a ground water is contaminated, it is very difficult for it to be restored. There are several ways that an aquifer can be contaminated: Through a legally or illegally constructed hazardous waste landfill or old sanitary landfill as well as new, injection wells, impoundments and illegal dumping grounds.