Lab 9: Groundwater

Introduction

The amount of freshwater stored beneath the surface of the Earth is very large. It constitutes an invaluable natural resource. In the United States as a whole, it provides over 40% of the country's freshwater needs, and a much larger percentage in the more arid western states.

Water underground is stored in openings or interstices of varying size and shape in Earth materials. Any underground body of Earth material that is sufficiently permeable to allow water to flow through it easily is known as an aquifer. Some materials, however, transmit water so slowly that they do not qualify as aquifers. We call such materials aquitards.

The Water Table

Immediately below the surface of the land we find a zone that may contain some moisture but that is far from being saturated with water. This is called the zone of aeration and through it water moves downward to a zone that is completely saturated with water, the zone of saturation.

The contact between the zone of aeration and the zone of saturation is called the water table, and would be the level to which water rises on its own (without pumping) in a well. The water table is a surface that mimics the overlying topography, but has gentler slopes. Within the zone of saturation, water flows from areas of higher water table to areas of lower water table. When the water table is higher than the land surface, a stream or lake result. Groundwater divides separate water flowing in different directions.

Mapping the water table

Figure 1 is a map on which several groundwater wells are located which indicate the elevation of the water table (the water table is the top surface of the zone of saturation). The water table is a surface and, therefore, can be represented by contours.

Contour the water table on Figure 1 using an interval of 10 feet.

Also, water in the zone of saturation (water beneath the water table) flows at right angles to the contours. Draw arrows indicating the direction of groundwater flow across the map area.

The direction groundwater is flowing in map area is to the ____________________________.
Flow of pollutants

The second figure of your handout has the contours of the water table in the area of study already drawn for you. In addition, the movement of the groundwater is shown by long arrows (‘flow lines’) that are always at right angles to the contours.

Draw flow lines going through points F, E, G, A and B.

The boxed ‘x’ on the map shows the position of an injection well a factory is using to dispose of fluid toxic waste. When the residents of the neighboring towns (R, S, and T) found out about this, they wanted to know if they would be affected.

Based on your flow lines, which town is at greater risk of having its groundwater contaminated? (Explain your answer)

Fifty days after the injection began, well C recorded contamination by the factory’s waste fluid.

What is the speed of the groundwater (in meters per day)?

At this rate of flow, how long will it take for town R’s well to be contaminated? (Show your calculations)
Figure 1. Water table elevations (above sea level) measured in groundwater wells.

- Contour the water table using a contour interval of 10 feet. Indicate the direction of groundwater flow with arrows.

EXPLANATION

- Location of well and altitude of water table above sea level, in feet
- Water table contour shows altitude of water table, contour interval 10 feet
- Ground-water flow line
Figure 2

Map Scale: 0 250 500 750 1,000 Meters

Water table contour interval = 25m