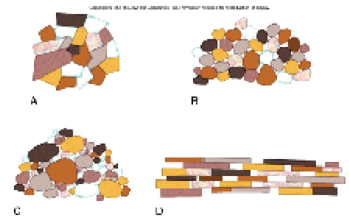
GEOL 106 Writing Assignment: Groundwater Name _KEY______________________

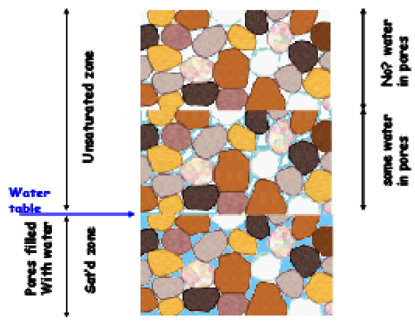
What's the effect of grain shape on porosity?

Rounded particles of equal size provide maximum porosity. Angular grains decrease porosity. Flat clays grains stack to produce low porosity. Interlocking grains in ign, metamorphic, and some chemical sedimentary rocks produce low porosity. Poor sorting lowers porosity because pores are filled with small grains.

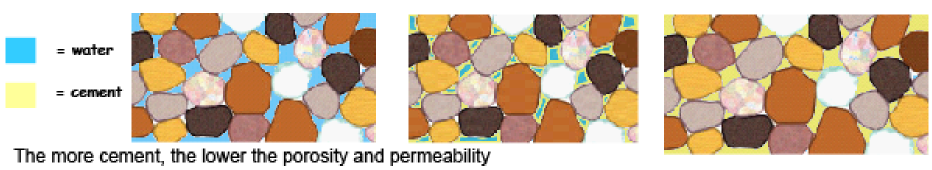


Use arrows and label the sediment column with:

sat'd zone
unsat'd zone
water table
no? water in pores
some water in pores
pores filled with water

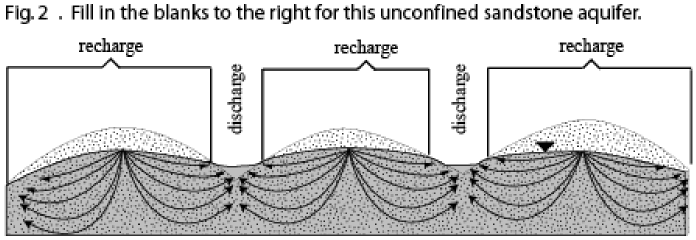


What's the effect of amount of cement on porosity and permeability?



The more cement, the lower the porosity and permeability

Fig. 2 . Fill in the blanks to the right for this unconfined sandstone aquifer.



→ = Flow lines = flow paths of groundwater

zone of aeration

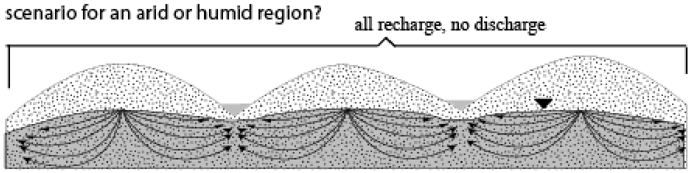
zone of saturation

▼ = water table

Cross-sectional view looks up or down the rivers.
Gaining or effluent streams because groundwater flows into the stream from below
More typical of humid regions (water table is high)
Rivers can continue to flow because they are supplied from below by stored groundwater

Fig. 3. For this unconfined sandstone aquifer:

Are these gaining (effluent) or losing (influent) streams? Is this a more likely scenario for an arid or humid region?



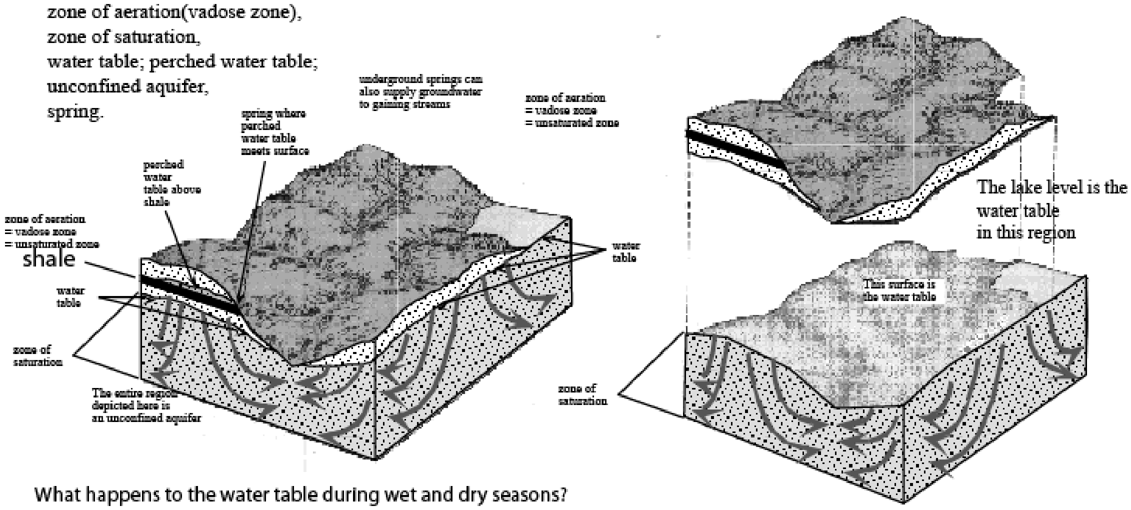
Cross-sectional view looks up or down the rivers.

losing or influent streams because water from the stream can infiltrate down to the water table (water table is low)

more typical of arid regions (water table is low)

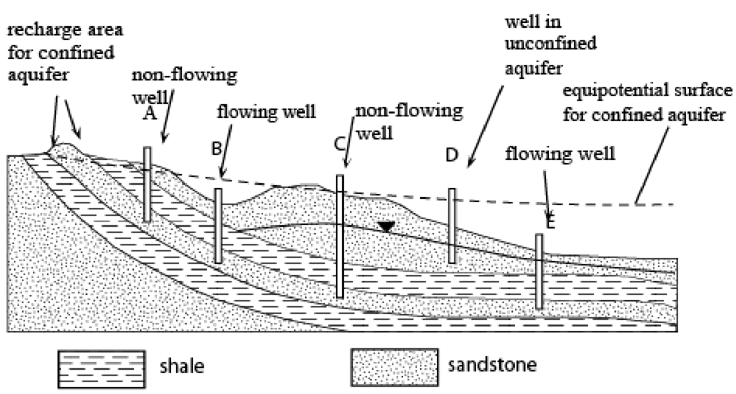
Fig. 1. Label the following:
zone of aeration(vadose zone),
zone of saturation,
water table; perched water table;
unconfined aquifer,
spring.

How does the lake relate to the water table?



What happens to the water table during wet and dry seasons?
Water table goes up during wet periods, down during dry seasons.

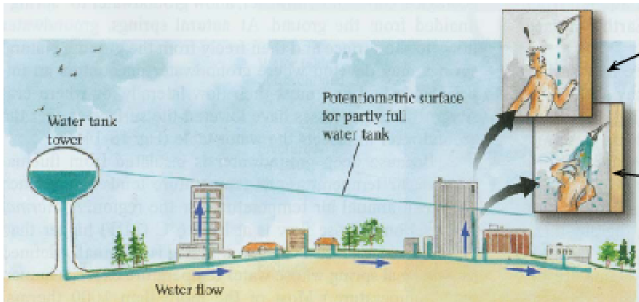
Fig. 4.
Label the following:
- recharge area for confined aquifer
- equipotential (potentiometric) surface for confined aquifer
- water table for unconfined aquifer
- flowing wells
- non-flowing wells



What conditions are necessary to produce an artesian well?
Artesian springs occur where the equipotential surface is higher than ground surface, and water can flow onto the ground.

Water in well D could rise to the equipotential surface

Draw in another well in an unconfined aquifer.
How high could water potentially rise in well E if the well casing extended very high into the air?

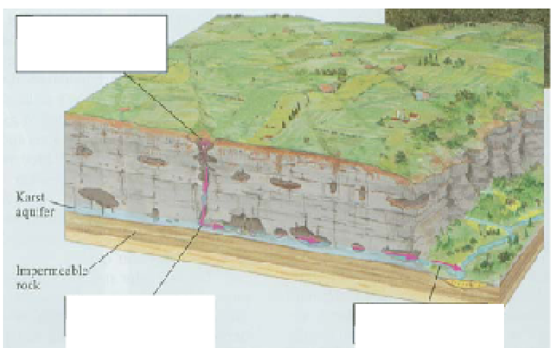


He's above the equipotential surface, so no flow.

below equipotential surface, so water flows.

Fig. 5 . Explain why the guy in the upper floor shower is upset.

Fig. 6 Explain groundwater flow in karst terrain.



Sandstones have high to moderate permeability; i.e., water moves more rapidly than in granites and shales, (low permeability. If granite or shale is fractured (joints or faults), then water can flow more quickly because the entire body of rock can have relatively high permeability, even though individual pieces of the rock have low permeability. Caves & passages develop in carbonate rock due to the dissolution of calcite & dolomite along bedding and fracture planes. Cave roofs collapse when they can no longer support their own weight, causing sinkholes to form. Karst systems are sort of like Swiss cheese, with interconnected passages that allow rapid water flow underground, and surface water rapidly infiltrates into ground water.
Chemical spills in karst can contaminate large portions of an aquifer, and the water can quickly make its way into rivers. Water moves much slower thru sandstones and shales, allowing for the possibility of containment & treatment of the contaminant.

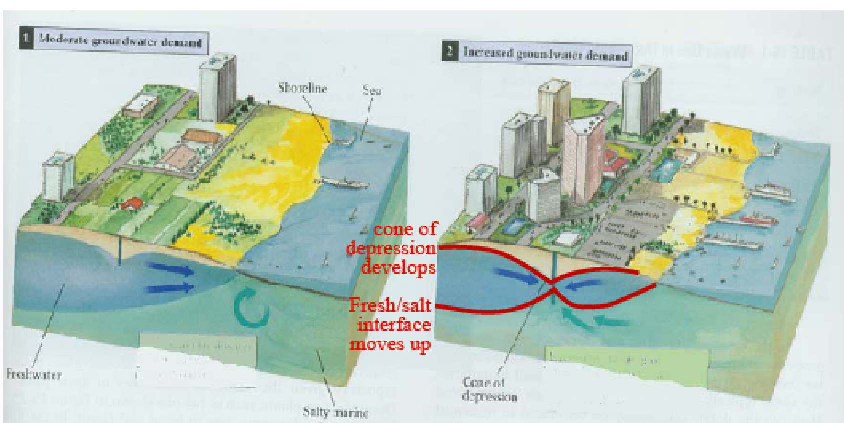


Fig. 7. Explain the likely effect of increasing development on water supplies along an ocean shoreline. Why does fresh water "float" on top of salty water?

Increasing development results in increasingly rapid water use. Rapid withdrawal results in 1) a cone of depression and, 2) upward migration of the salt water/fresh water interface. #1 results in wells beginning to go dry. #2 results in wells beginning to draw in salty water.

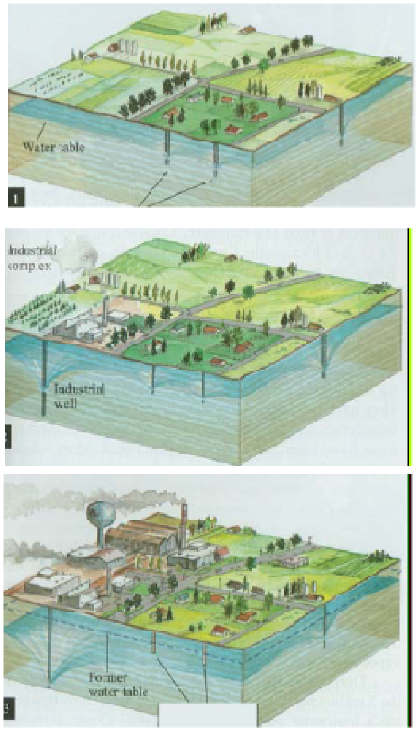


Fig. 8 . Explain how the development increasing with time affects the groundwater in these figures. The area to the left of the diagram is agricultural, as in Fig 5.1, and it appears that agriculture has little impact on groundwater. Give a scenario in which agricultural use might lower the water table.

A deep, fast-pumping industrial well pumps ground water out faster than it can be replenished, causing a cone of depression which lowers the local water table, drying up shallower wells. If an agricultural complex irrigates using ground water, a cone of depression can also develop, thus agriculture in an arid region may have the same effect as an industrial complex. Agricultural and industrial (esp. electrical power generation) uses are usually much greater than residential water uses.

Why does a cone of depression form in groundwater?

A cone of depression is a lowering of the water table in a cone shape near a pumping well. It develops because unlike an open pond, the water must take a tortuous path around sediment or rock grains to get to the well as the well is being pumped.

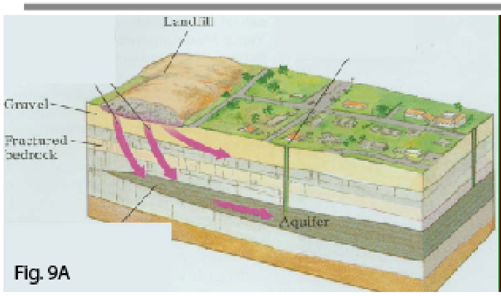


Fig. 9A

Fig. 9 Explain the 2 scenarios depicted here in terms of impact on groundwater supplies.

In 9A, landfill leachate can migrate through the gravel and fractured bedrock, quickly contaminating the aquifer below.

In 9B, leachate cannot easily migrate through the low permeability layer that directly underlies the landfill, thus the aquifer is protected.

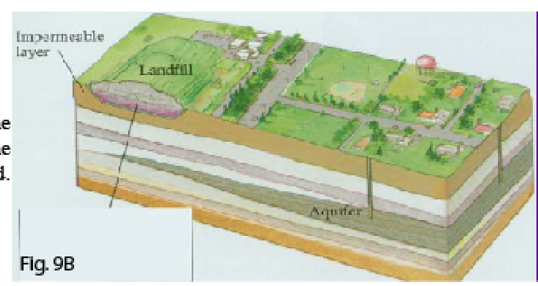


Fig. 9B

Fig. 11.11 Explain the concept of groundwater "mining".

The Ogallala Aquifer, e.g., is an unconfined aquifer that received a lot of recharge after the Pleistocene when glaciers withdrew, but now recieves very slow recharge in an arid climate. Water is pumped out much faster than it can be replenished, so we can think of this as "mining" very old groundwater.