Hydrology

July 26th, 2021

What Happens to Precipitation?

1. **Evaporation** from the ground back to the atmosphere
2. **Transpiration:** Drawn up by plant roots and eventually loss through the leaves (evapotranspiration)

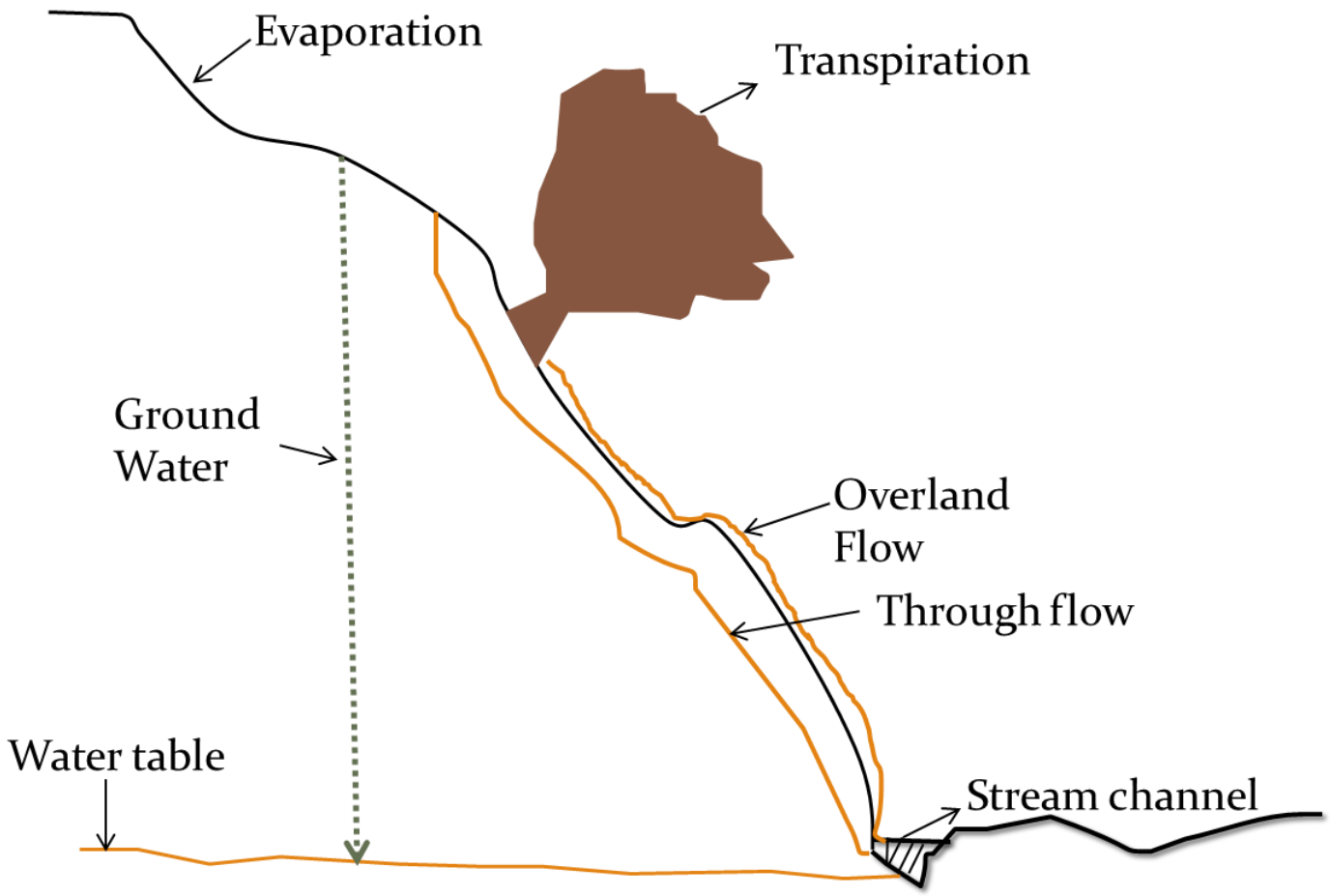
What Happens to Precipitation?

3. **Overland flow**: could run downhill and end up in the stream channel after running over the land surface
4. **Infiltration**: Find its way downhill and into the stream channel by
   - Through Flow
   - Ground Water

   Infiltrating water is stored temporarily in a region called the *soil-water belt* where it is available to plants
   - **Percolation** *is the process by which water gets into the soil-water belt*
   - *Percolating water fully saturates the pore spaces of bedrock, regolith, or soil, at which point it is called* **groundwater.**

   The water table is the upper limit of the saturated zone

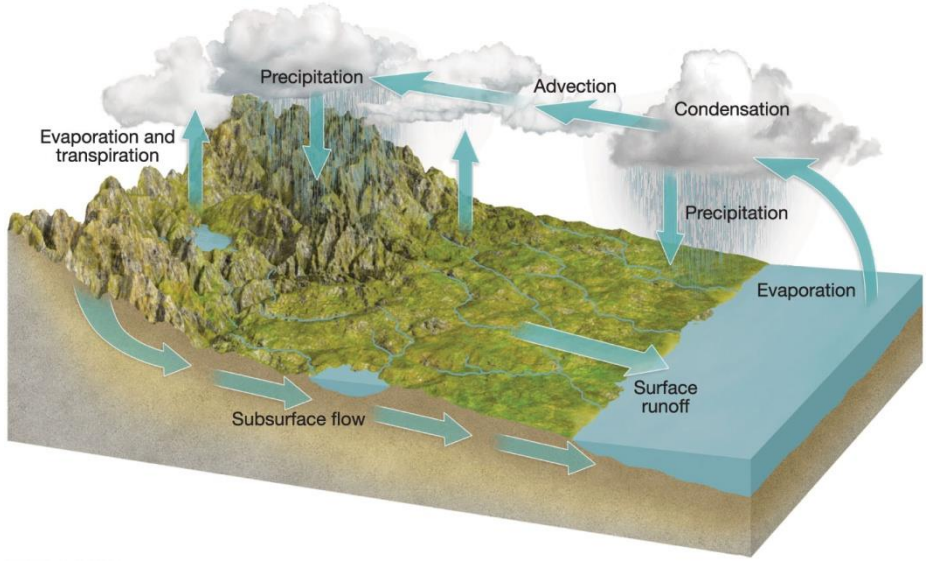
What Happens to Precipitation?



The Hydrologic Cycle

Three primary movement types

1. Surface to air
   - Ocean evaporation
   - Vapor remains in air for a short time
2. Air to surface
   - Precipitation – 78% falls on oceans and 22% on land



The Hydrologic Cycle

Three primary movement types (cont.)

3. Movement beneath the surface – runoff
   - Water collects in lakes and rivers and either penetrates the ground or runs off if sloped
   - Becomes a part of underground water supply
   - Reemerges as springs or becomes part of rivers and streams

Water table – marks the top of the saturated zone of groundwater.

- Paths of groundwater flow – long time for water to flow along the deeper paths, but flow near the surface is faster
- Most rapid flow is close to the stream, where the arrows converge

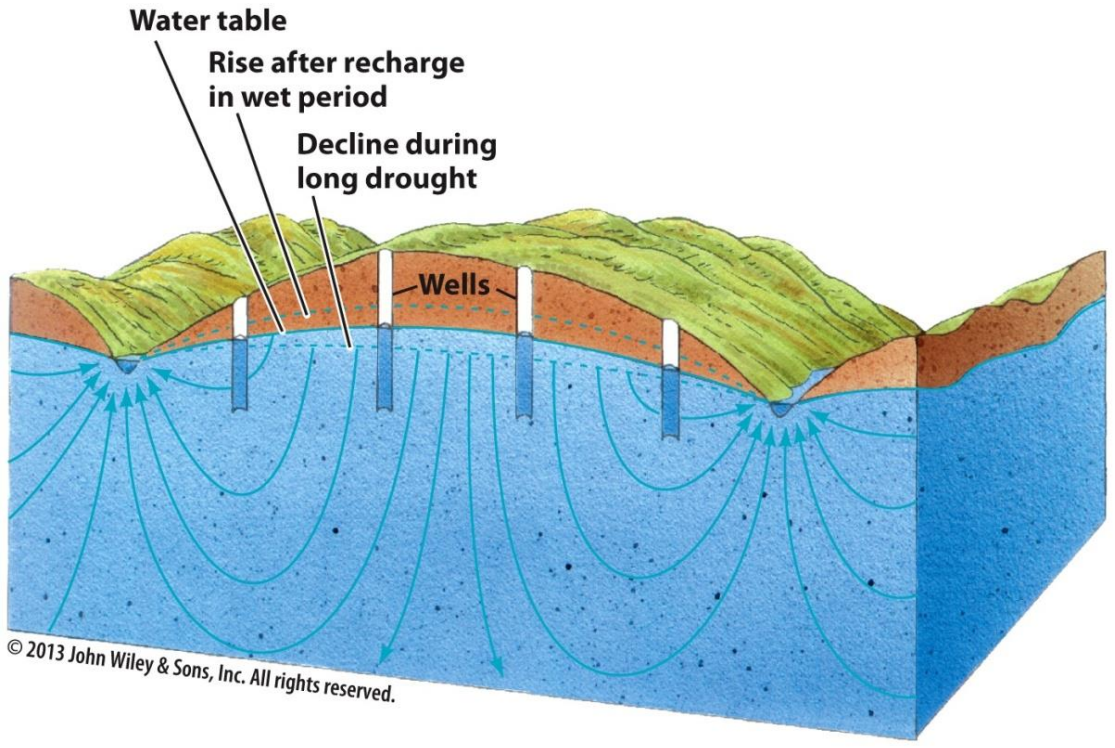


Figure 14.8

Groundwater Withdrawal

Old-fashioned dug well supplies water for household needs in Uttar Pradesh, India

- Well is lined with bricks, and groundwater seeps in to fill the well

George F. Mobley/NG Image Collection

Figure 14.14 part 1

Groundwater Withdrawal

- **<u>Wells draw down the water table at a point, creating a cone of depression</u>**
- As water is drawn, the water table is depressed in a cone shape centered on the well.
- This *cone of depression* may extend out as far as 15 km (9.3 mi) or more from a well where heavy pumping is continued.

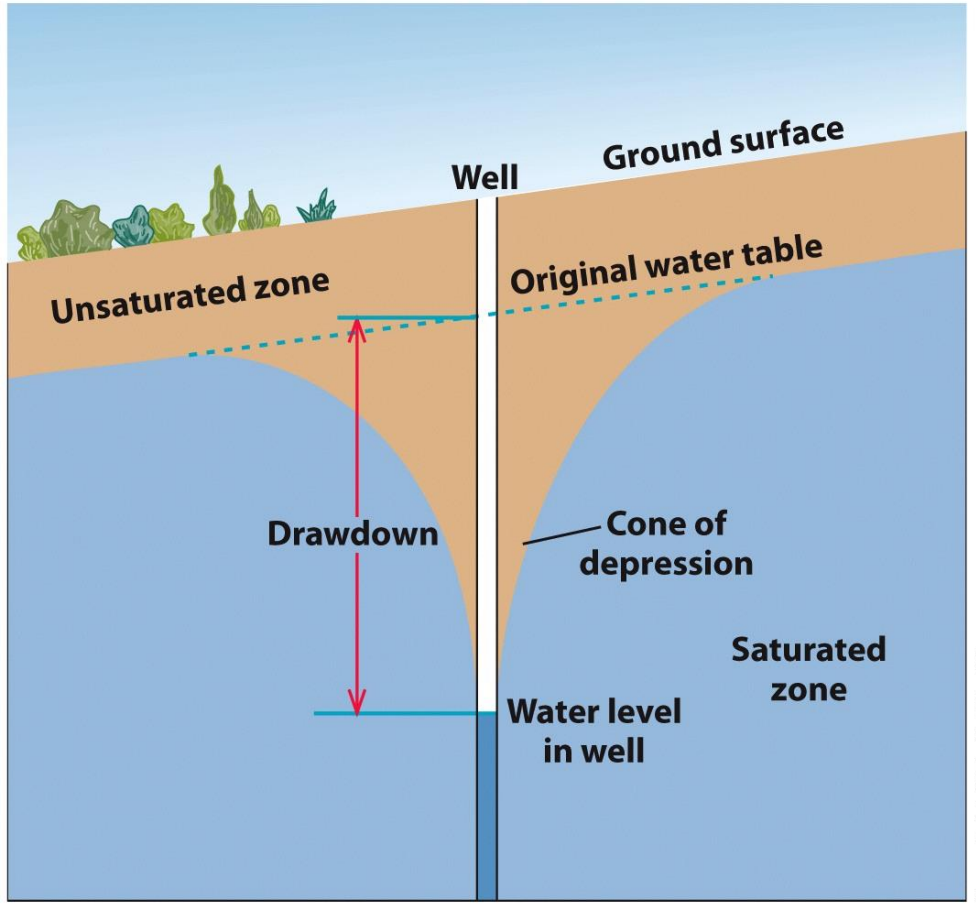


Figure 14.15

Subsidence

- ***Subsidence***: the sinking of the ground surface due to excessive groundwater withdrawal
- Land subsidence has subjected Venice to episodes of flooding by the Adriatic Sea. Here, high water has swamped the Piazza San Marco and an outdoor café.

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Figure 14.16 part 1

Overland Flow


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Figure 14.18

Runoff (excess water when soils are saturated or rain falls too quickly) flowing down the land slopes in sheets is called ***overland flow***

Several forms:

- Smooth soil or rock surface: flow as a continuous thin film, called *sheet flow.*
- Rough or pitted ground:
  overland flow in a series of
  tiny rivulets
- Grass-covered slope: overland
  flow is divided into **countless**
  tiny threads of water, passing
  around the stems

On a heavily forested slope, overland flow may be concealed under decaying litter

Drainage System

A drainage basin, or watershed, consists of a branched network of stream channels and adjacent slopes that feed the channels

Stream order
Smallest tributaries are first-order, two first-order joint to give a second order, and so forth

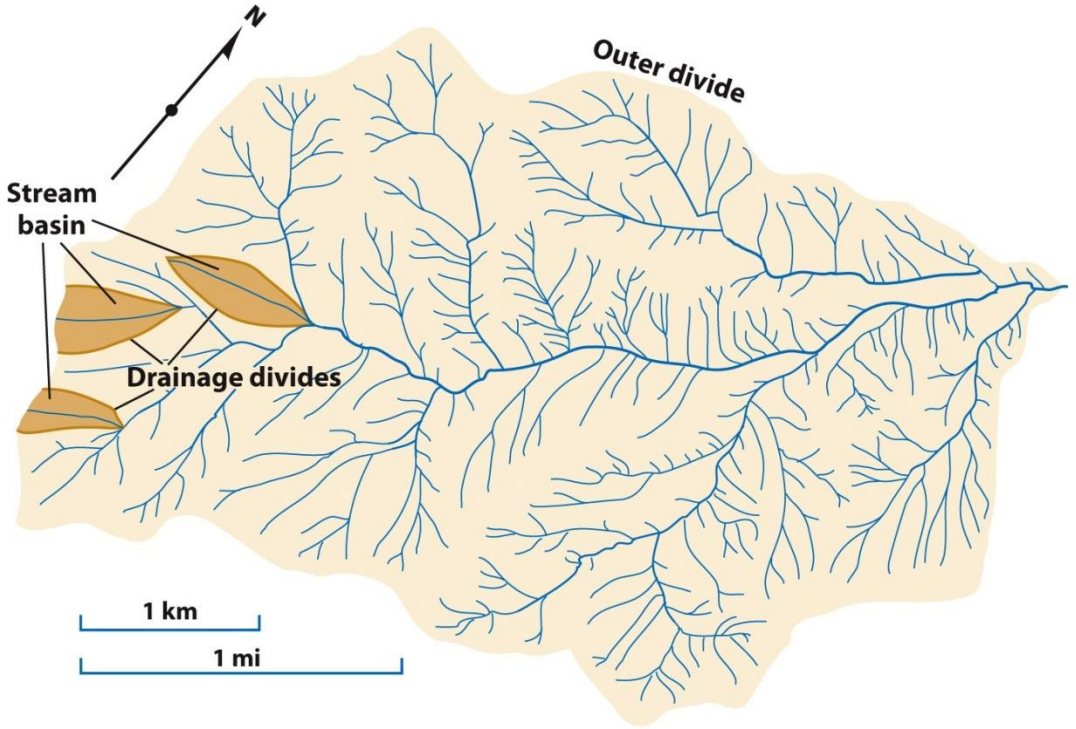


Figure 14.19

Infiltration or Overland Flow?

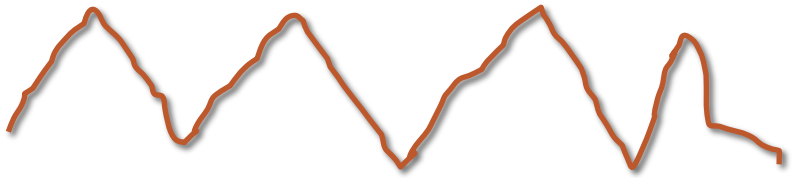
Environmental Factors Influencing Infiltration Versus Overland Flow

1. **Soil**:
    1. **Texture of soil** is MOST critical. Coarse texture soil – large particles
        - There are larger spaces in sandy soils compared to clay soils. Water infiltrates faster in a sandy soil than a clay soil
        - Coarse texture = Infiltration
        - Fine texture = overland flow

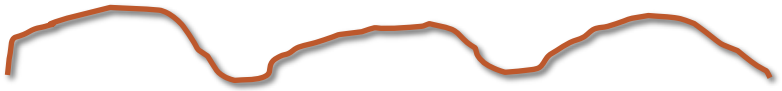
2. **Soil depth**: deep soil favours infiltration, shallow soils favors overland flow

Environmental Factors Influencing Infiltration Versus Overland Flow

3. Topography



Steep favors overland flow



Gentle favors infiltration

Environmental Factors Influencing Infiltration Versus Overland Flow

4. Vegetation

Obstruct overland flow – if there are a lot of stems on the surface these would create some resistance to water movement

Protects from raindrop splash –

- raindrops come down at fast rates which could send particles flying into the air. These particles tend to fall into the lowest parts of the soil where the "clog" pores for infiltration.
- Vegetation protects the soils from raindrop splash
- Denser vegetation favor infiltration; sparse vegetation favors overland flow.

Environmental Factors Influencing Infiltration Versus Overland Flow

5. Climate

- **affects vegetation**
- **Frozen ground** – water cannot infiltrate. Snow on surface can prevent infiltration
- **Characteristics of precipitation:** intensity. If it's coming down so fast that infiltration cannot keep up with the rate at which the water reaches land.
- High intensity = overland flow
- Low intensity = infiltration

Environmental Factors Influencing Infiltration Versus Overland Flow

6. Land Use

- **Logging**: removing vegetation cover would tend to favor overland flow
- **Livestock**: the movement of cattle over the soil results in compaction, pushing particles closer together, creating less room for water to go through, thus favoring overland flow.
- **Urbanization:** the growth of cities and sub-urbs can affect stream patterns
  - **Built up areas and buildings says NO infiltration, favoring (dramatically) overland flow**

Stream Discharge: Stream Q

Volume of water reaching a stream is difficult to track

Wider rivers can accommodate more water than narrow streams

But we can measure how much water is passing through/leaving a stream

Discharge = volume/time

Measured in terms of cubic feet/second (cfs) or cubic meter/second

Discharge is referred to as **Q**