Bell Ringer

1. What is the difference between a rock that is permeable and a rock that is impermeable?

2. What is the recharge zone?

3. Name two things that affect the depth of the water table.

Finish Groundwater pollution lab

Water Resource Problems

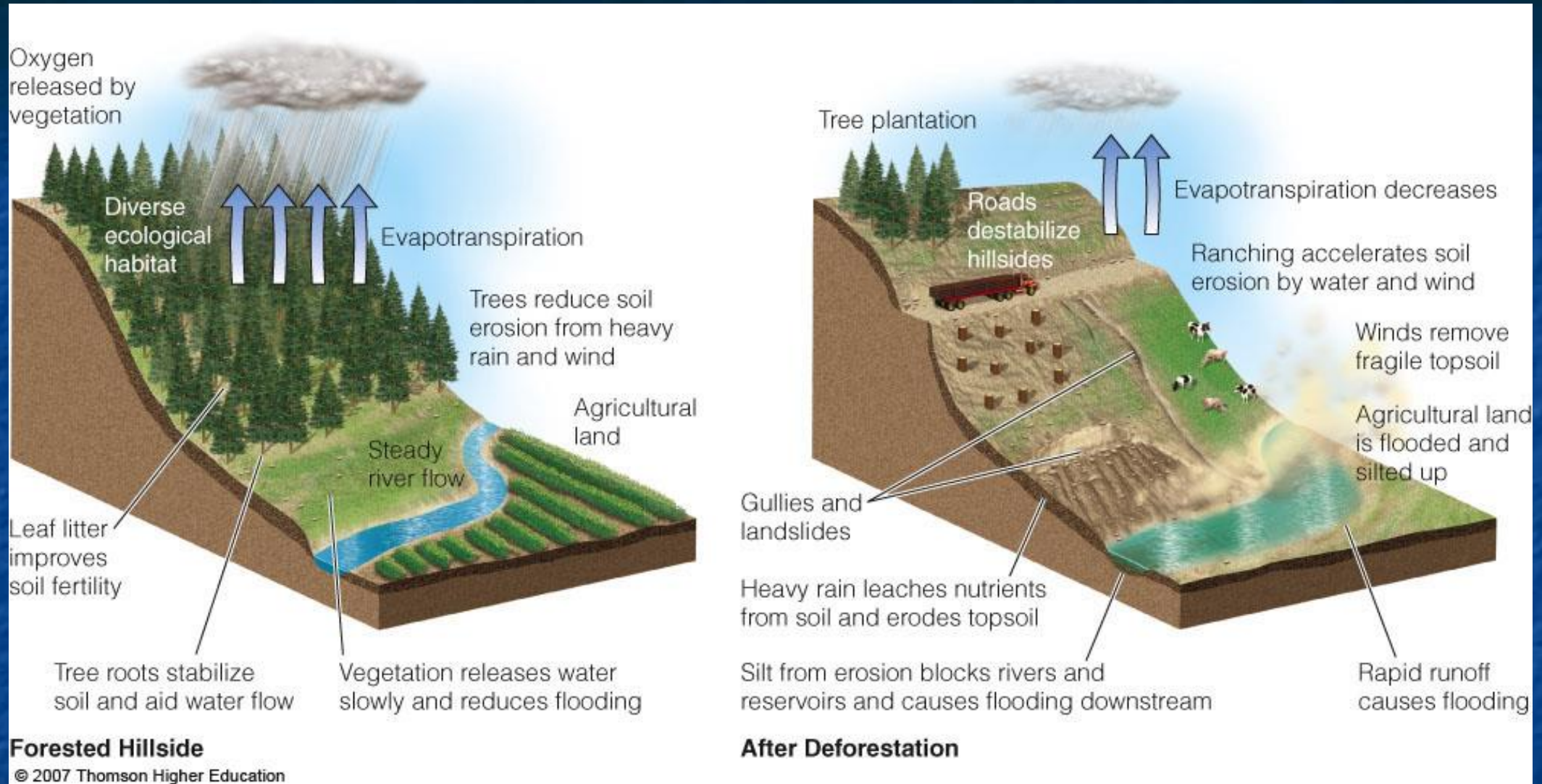- Too much water
- Too little water
- Poor-quality water

Too Much Water

- Heavy rainfall, rapid snowmelt, removal of vegetation, and destruction of wetlands cause flooding.

- Floodplains, which usually include highly productive wetlands, help provide natural flood and erosion control, maintain high water quality, and recharge groundwater.

- To minimize floods, rivers have been narrowed with levees and walls, and dammed to store water.

Changes in Surface Runoff

- Prior to 1970 about 10% of stormwater became runoff
- Now 55% of stormwater is transported as runoff as development exceeds 75% of the permeable soil area
- https://www.youtube.com/watch?v=fUOtHkBU1Jc
- https://www.youtube.com/watch?v=g1tdnAcjHhU

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Forested Hillside

- Oxygen released by vegetation
- Diverse ecological habitat
- Evapotranspiration
- Trees reduce soil erosion from heavy rain and wind
- Agricultural land
- Steady river flow
- Leaf litter improves soil fertility
- Tree roots stabilize soil and aid water flow
- Vegetation releases water slowly and reduces flooding

After Deforestation

- Tree plantation
- Evapotranspiration decreases
- Roads destabilize hillsides
- Ranching accelerates soil erosion by water and wind
- Winds remove fragile topsoil
- Agricultural land is flooded and silted up
- Gullies and landslides
- Heavy rain leaches nutrients from soil and erodes topsoil
- Silt from erosion blocks rivers and reservoirs and causes flooding downstream
- Rapid runoff causes flooding

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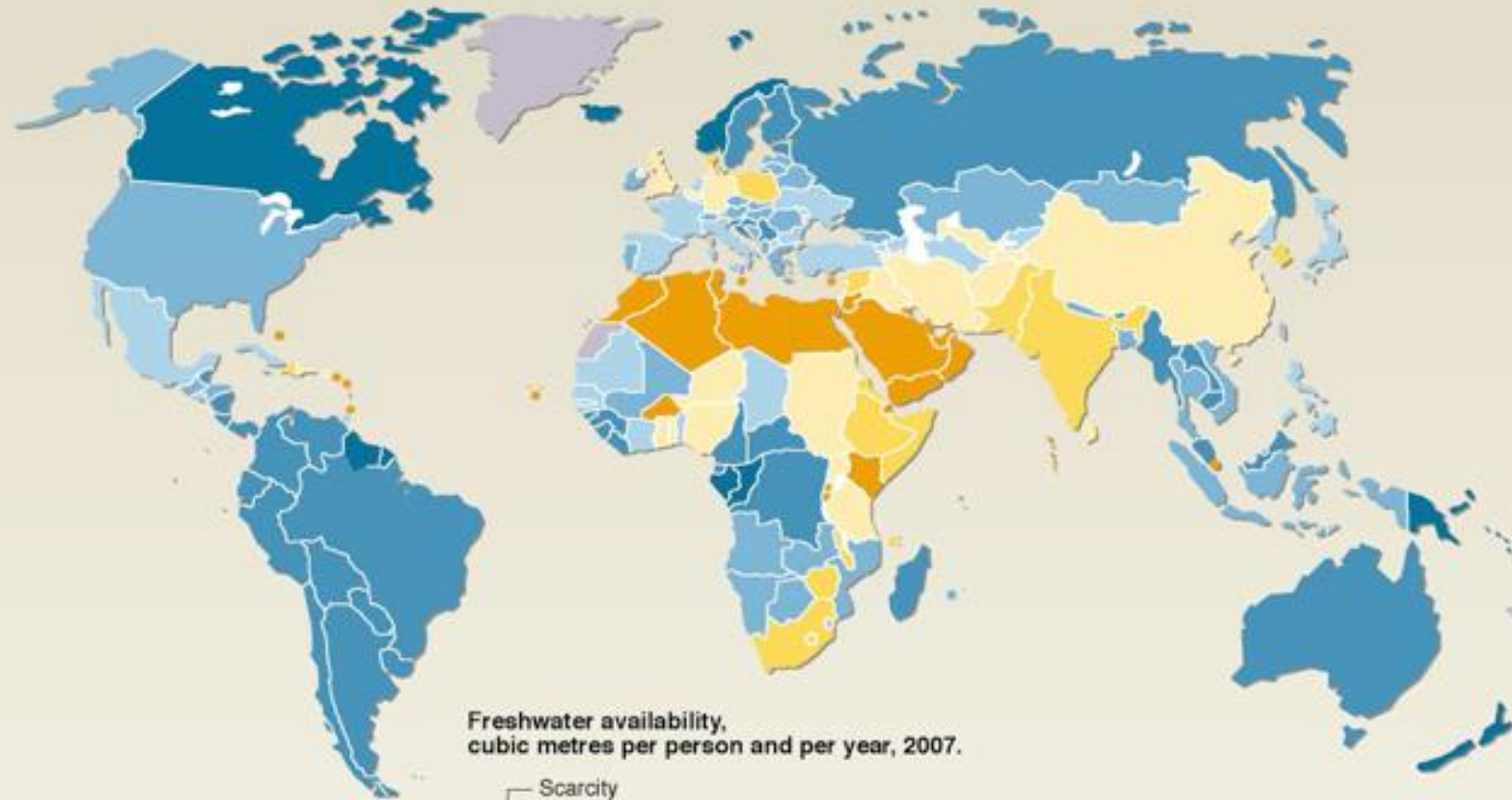Human activities have contributed to flood deaths and damages

Too Little Water

- Arid & semiarid lands (growing in extent -- desertification)
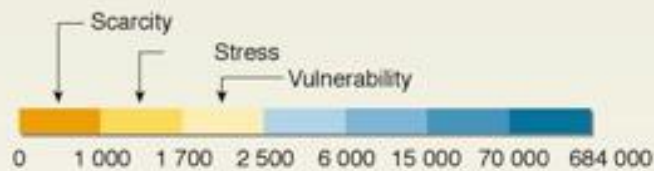- Irrigation required to produce food
  - Greatest use of water (71%)

Figure 10-7 Visualizing Environmental Science, 1/e

Global Freshwater Availability Per Capita in 2007

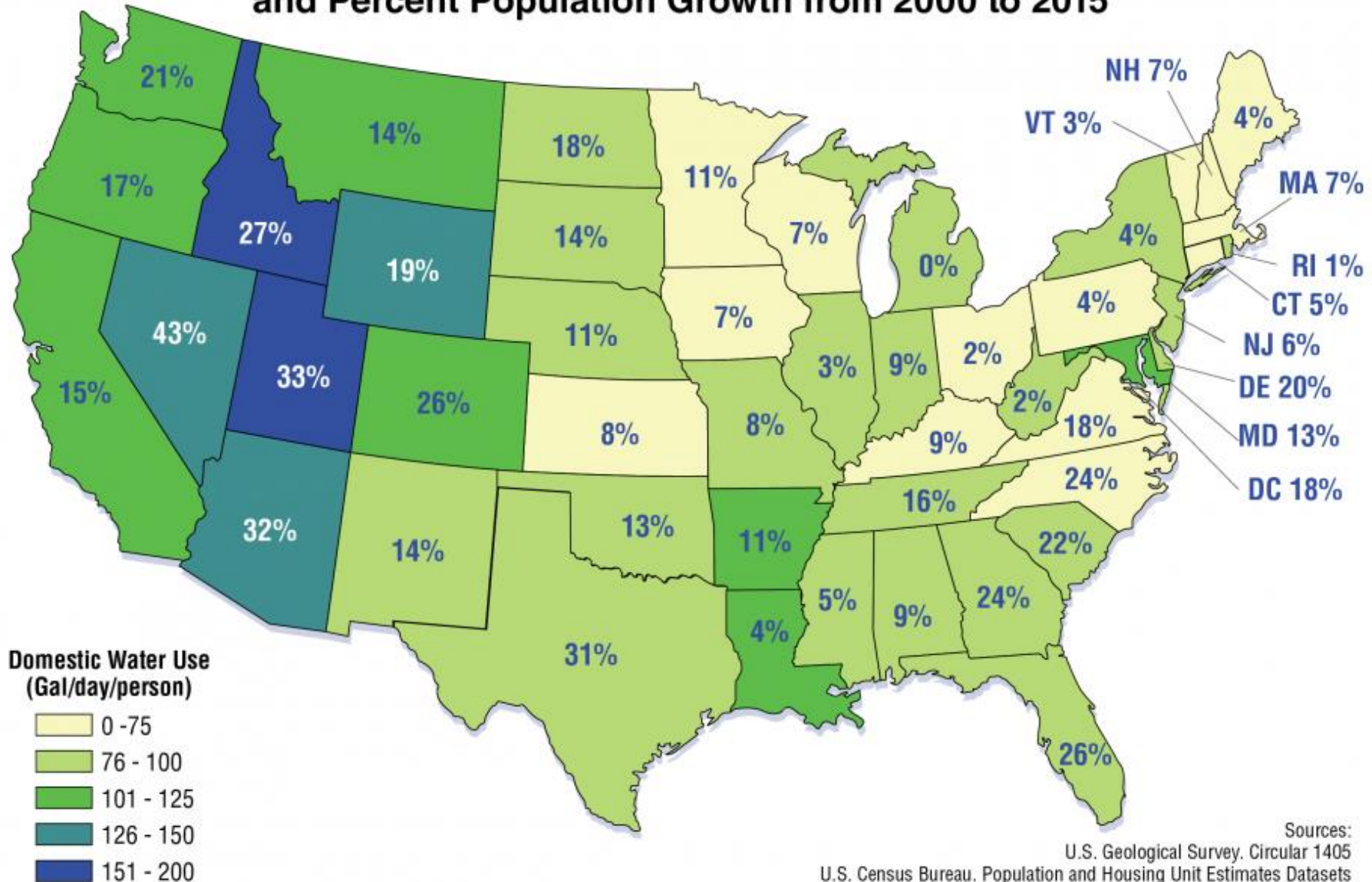Freshwater availability, cubic metres per person and per year, 2007.

Scarcity
Stress
Vulnerability

0   1 000   1 700   2 500   6 000   15 000   70 000   684 000

Data non available

Source: FAO, Nations unies, World Resources Institute (WRI).

PHILIPPE REKACEWICZ
FEBRUARY 2008

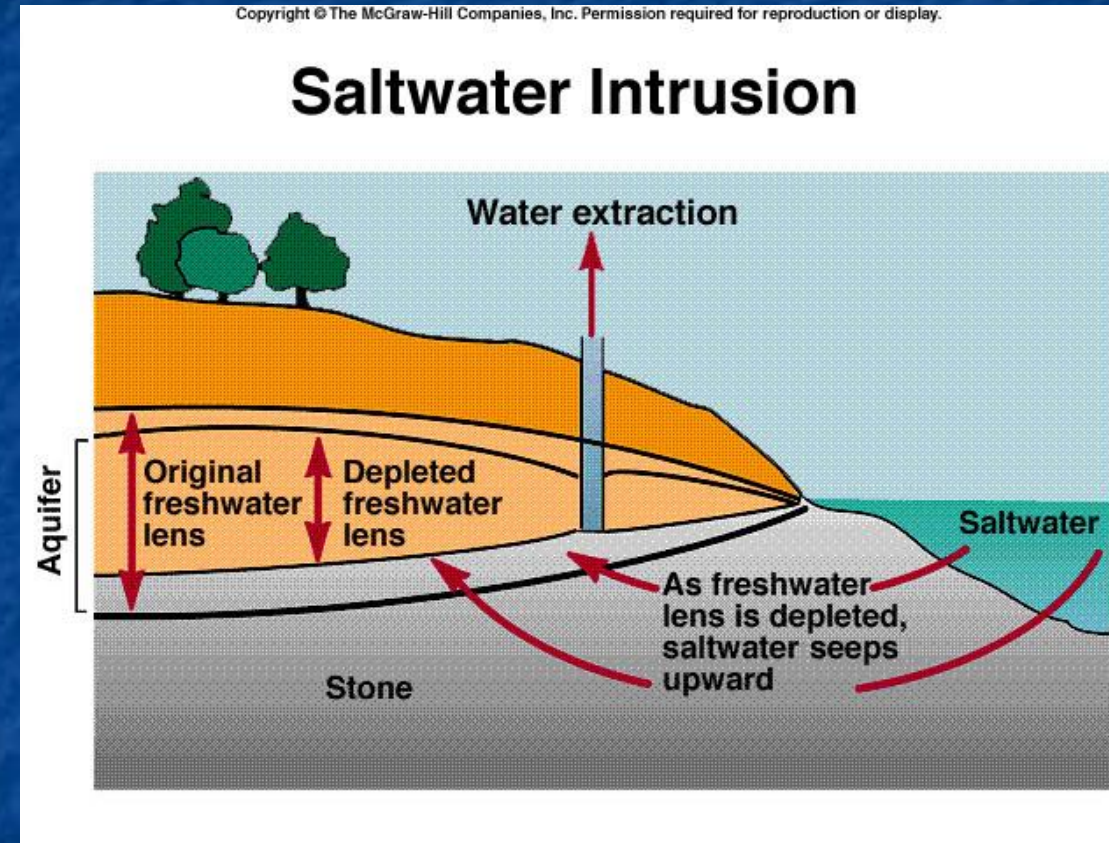Domestic Water Use in Gallons per Day per Person and Percent Population Growth from 2000 to 2015

Aquifer Depletion

- Removing groundwater faster than it is replenished
- Lowers water table
- Land subsidence
- Saltwater intrusion
  - Salt water seeps into fresh water
  - Occurring in South Florida

https://www.youtube.com/watch?v=8zxZUSVjg10

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Saltwater Intrusion

Water extraction

Aquifer

Original freshwater lens

Depleted freshwater lens

Saltwater

As freshwater lens is depleted, saltwater seeps upward

Stone

DECLINING GROUNDWATER LEVELS ACROSS THE U.S.

Groundwater levels have fallen in many areas of the United States during the past 20 years. The biggest declines have occurred in the West, in areas such as the farmlands that rely on the Ogallala Aquifer. But pockets of depletion have appeared in counties across the nation, and in wetter regions as well as dry regions.

Average countywide changes in groundwater levels:
- ● More than 15 feet
- ● 5 to 15 feet
- ● Less than 5 feet
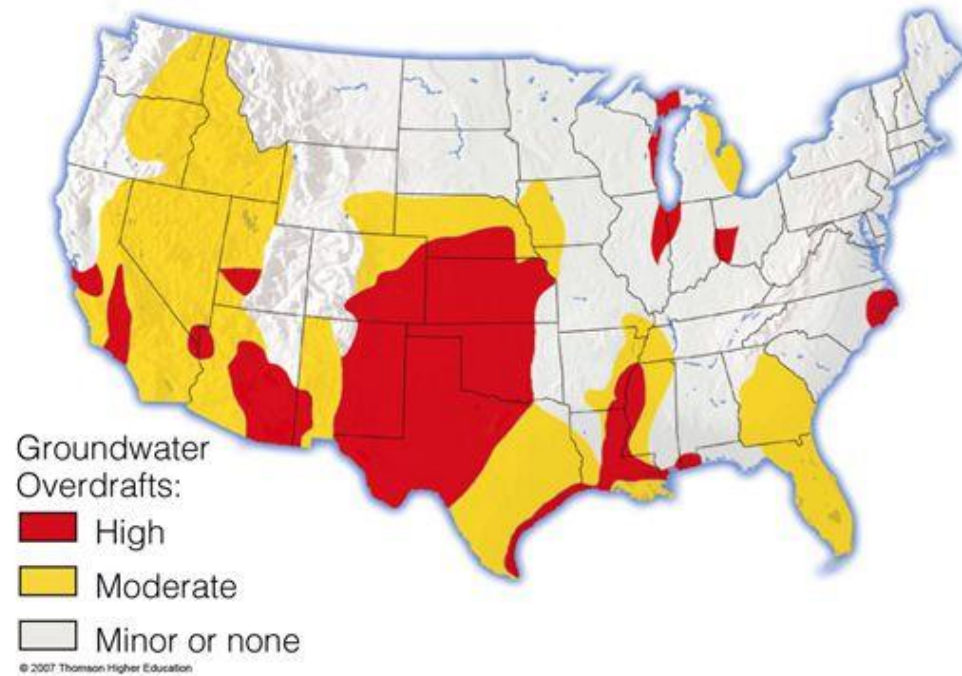- ● No decrease

Ogallala Aquifer
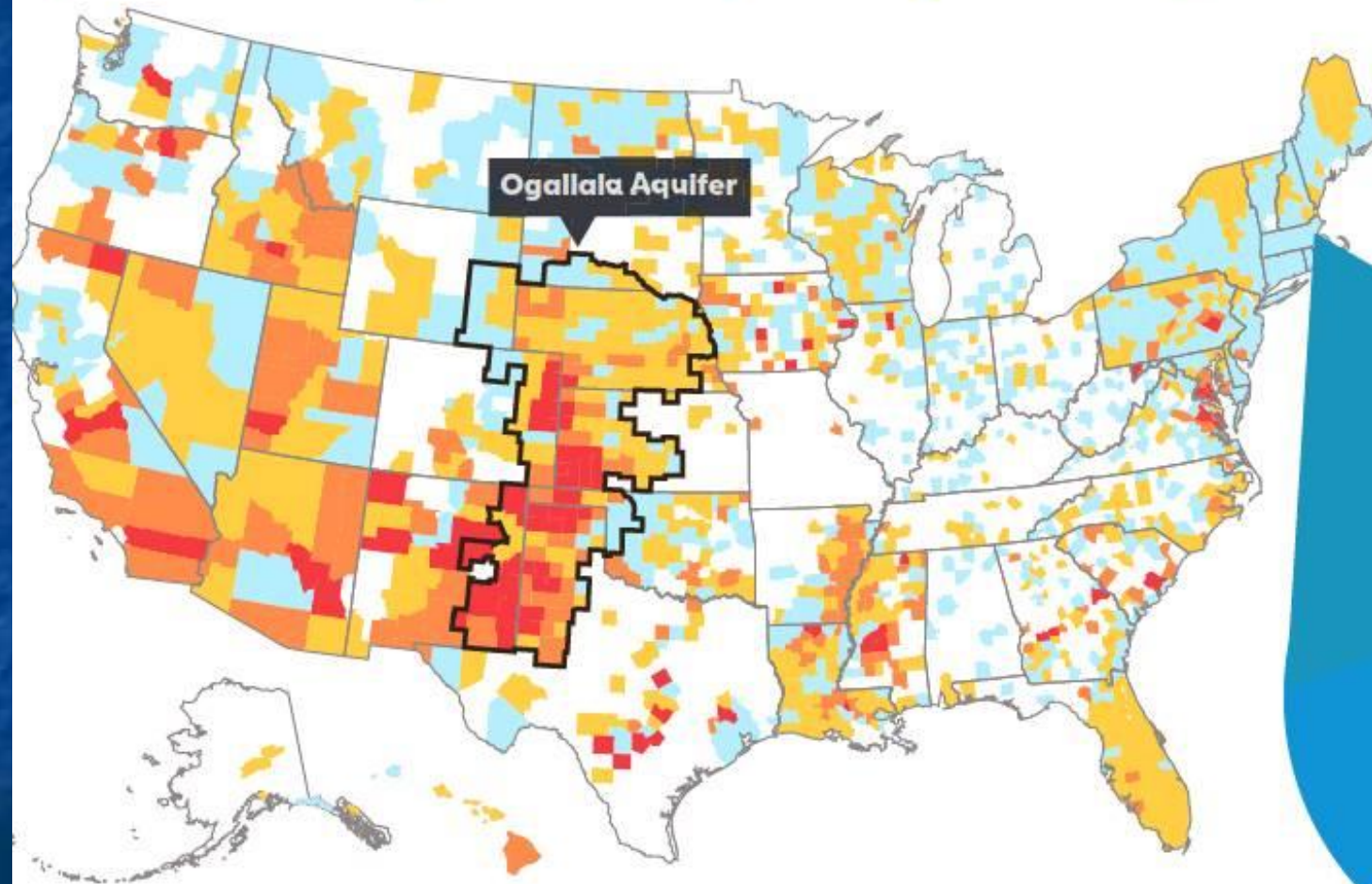
Note Groundwater data were insufficient for analysis in white areas.

Source USA TODAY NETWORK analysis of U.S. Geological Survey data

MITCHELL THORSON, JIM SERGENT AND FRANK POMPA, USA TODAY

Groundwater Depletion: A Growing Problem

Areas of greatest aquifer depletion from groundwater overdraft in the continental U.S.

Groundwater Overdrafts:
- High
- Moderate
- Minor or none

© 2007 Thomson Higher Education

The Ogallala, the world's largest aquifer, is most of the red area in the center (Midwest).

Figure 14-8

Overdrawing Surface Waters

- <u>Damaging to ecosystems</u>
- Wetlands dry up (Everglades)
- Estuaries become too salty (FL Bay)
- <u>Worldwide, the demand for water is growing as the human population and individual consumption continue to grow exponentially</u>
- <u>Water wars</u>

Arial Sea

Figure 10-10 Visualizing Environmental Science, 1/e
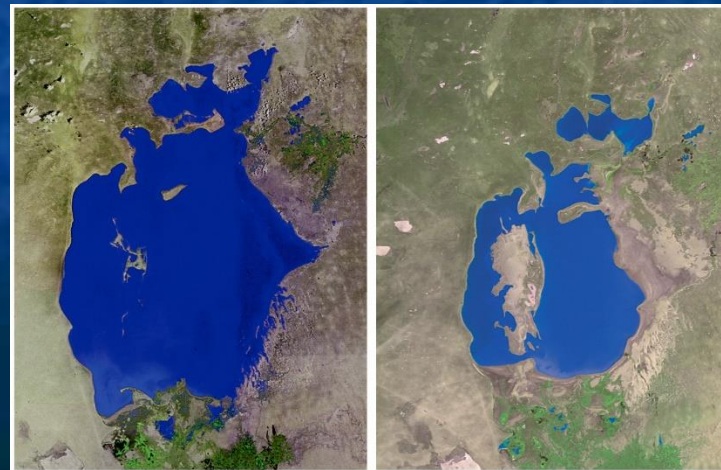
What can we do?

- California
  - Paper plates at restaurants
  - Rationing
  - Regulations – lawns only on certain days.
  - Incentives

Water Management

- Goal: sustainable supply of high quality water
- How do we supply water?
  - Building dams (ex: Columbia River)
  - Diversion (ex: Colorado River)
  - Desalination (ex: FL Keys) - very expensive to build & operate plants

Water Conservation: Agriculture

- Single largest user of water worldwide

- Much lost to evaporation or seepage

- Solution: drip irrigation

  - Perforated pipes distribute water

  - Goes straight to plants

  - Reduces water use 40-60%

- Shark Tank: https://www.youtube.com/watch?v=IK9Xuqky9zE

Figure 10-14 Visualizing Environmental Science, 1/e

Water Conservation: Municipal

- Solutions:
  - Use gray water (relatively clean waste water from baths / sinks)
    - Use for flushing / irrigation / etc.
  - Education: modify habits
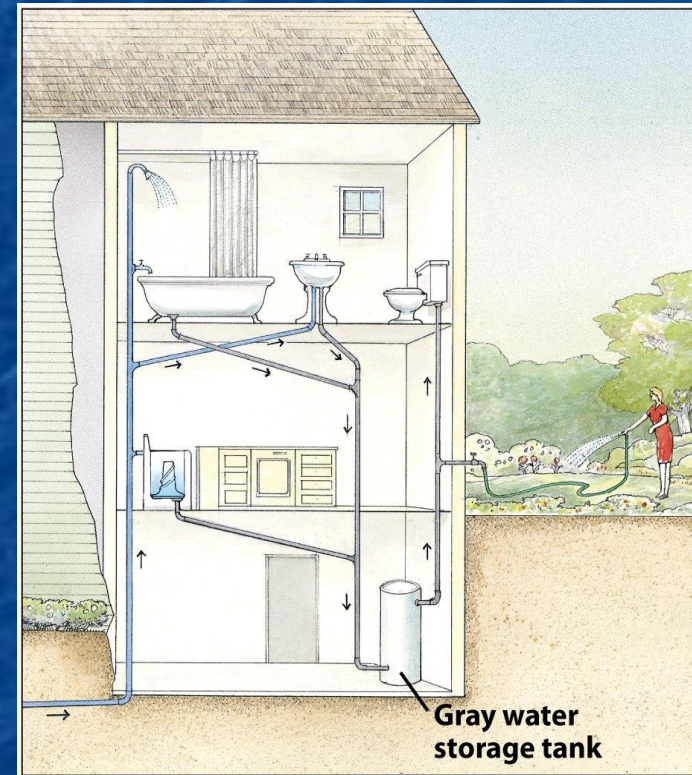 - Water-saving fixtures & Appliances
  - Repair leaks

Gray water storage tank

Figure 10-15 Visualizing Environmental Science, 1/e
© 2007 John Wiley & Sons

Water Pollution Lab

Bell Ringer

Finish pollution lab

Water Pollution

- Physical or chemical change in water that adversely affects the health of humans or other organisms
- Global problem

Figure 10-17 Visualizing Environmental Science, 1/e

Sources of Water Pollution

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Point source: specific spot

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Nonpoint source
- Enters over a large area
- Runoff (agriculture or, urban lawns) or atmospheric deposition

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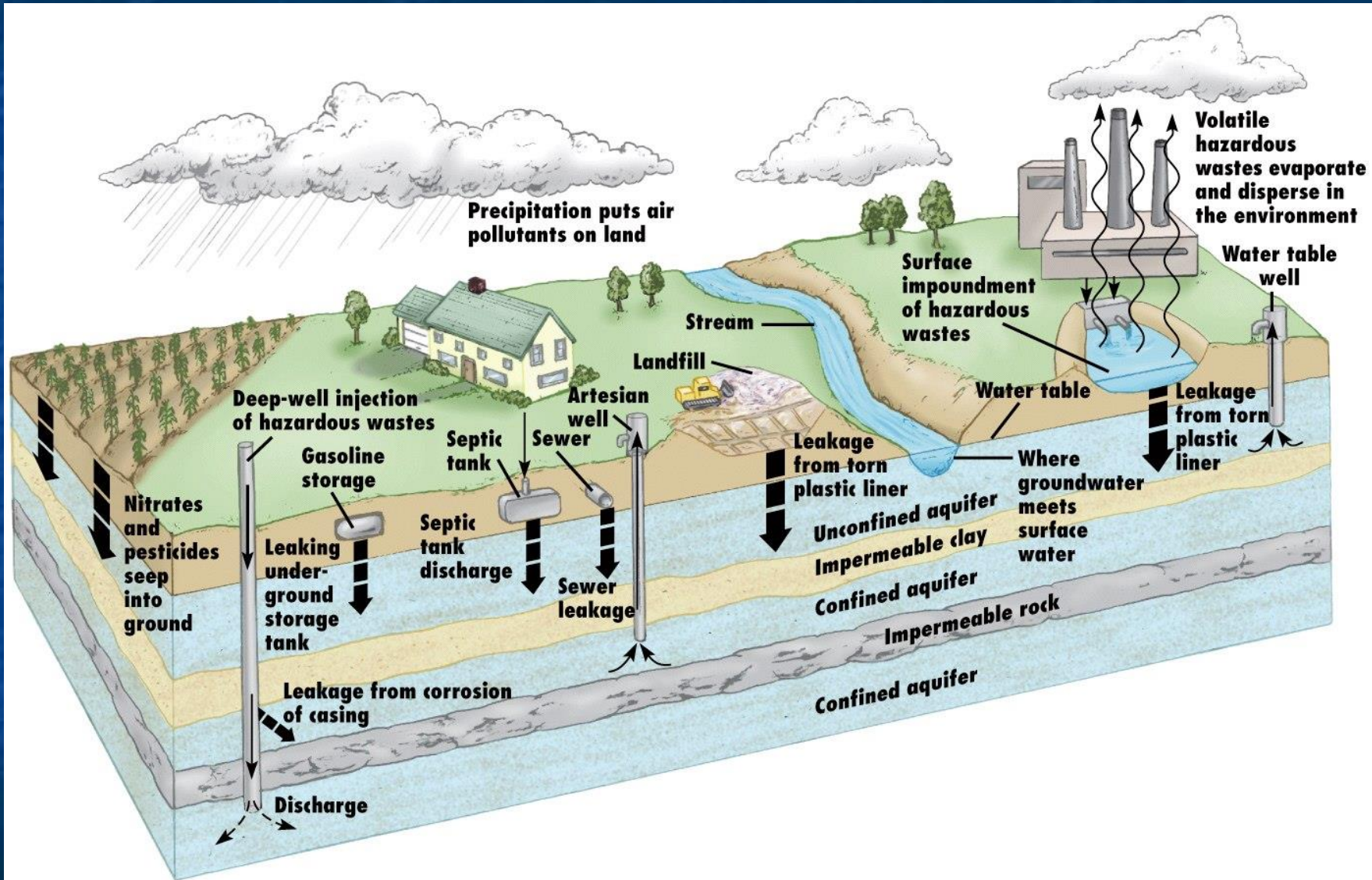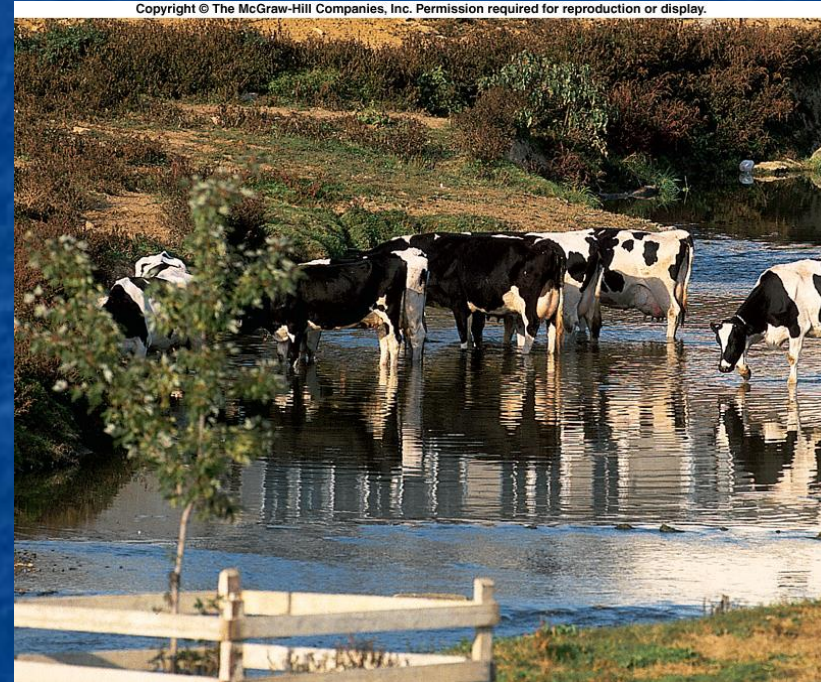
Groundwater Pollution Sources

Figure 10-19 Visualizing Environmental Science, 1/e
© 2007 John Wiley & Sons

Stormwater Runoff
(greatest contributor to nonpoint source pollution) contains:

- Nutrients*
- Metals*
- Suspended solids*
- Pesticides
- Oil / Gasoline
- Microorganisms
- Toxic waste

*Present in nearly 100% of stormwater samples

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Agriculture

- Poorly managed grazing and/or a concentration of animals near streams can cause a loss of riparian vegetation (vegetation near streams) and an increase in erosion.

- When fertilizers and pesticides are applied in large quantities they can enter the groundwater or get washed away into nearby water bodies.

Construction

- **Sediment runoff:** Dirt and soil from construction sites is easily washed into storm drains during rain storms.
- Oil and gas from machinery often spills and gets washed into storm drains.

Deforestation

- Removing trees and other vegetation causes an increase in erosion. More sediment is washed into streams and rivers.

- Similar to problems concerning construction.

Landfills

- Chemicals and other substances can sometimes leak into groundwater, contaminating it and making it unsafe to drink and use for other purposes.

Surface Mining

- Surface mining releases lots of sediment and metals into the air and into the ground water as they're dug up. Machinery also causes lots of oil and gas to spill as well.

Eutrophication

- <u>Build up of nutrients in a body of water</u>
- <u>Naturally occurs slowly</u>
- Humans cause imbalances by creating pulses of nutrients due to over-fertilizing crops & lawns and raising animals in confined areas

Unnumbered figure pg 250a Visualizing Environmental Science, 1/e

Unnumbered figure pg 250b Visualizing Environmental Science, 1/e

Nutrients include nitrogen and phosphorus-containing compounds that are essential to life in small quantities but harmful in excess.

Controlling Water Pollution

1. Source Reduction (Pollution Prevention)

- Cheapest and most effective way to reduce pollution is to <u>avoid producing it or releasing it into the environment</u>.
  - <u>Design products that do not pollute</u>
  - Soil Conservation

2. Ban release of pollutants - EPA

3. Reward purchasing environmentally preferable products (e.g. rebates)

- https://www.youtube.com/watch?v=cV_Vr_xgrn0
- https://www.youtube.com/watch?v=ECamImhCNuY
- https://www.youtube.com/watch?v=VaRdUHrUnBs