# Groundwater: Wisconsin's Buried Treasure



Center for Watershed Science and Education
College of Natural Resources
University of Wisconsin-Stevens Point

Wisconsin Geological and Natural History Survey
DIVISION OF EXTENSION
UNIVERSITY OF WISCONSIN–MADISON

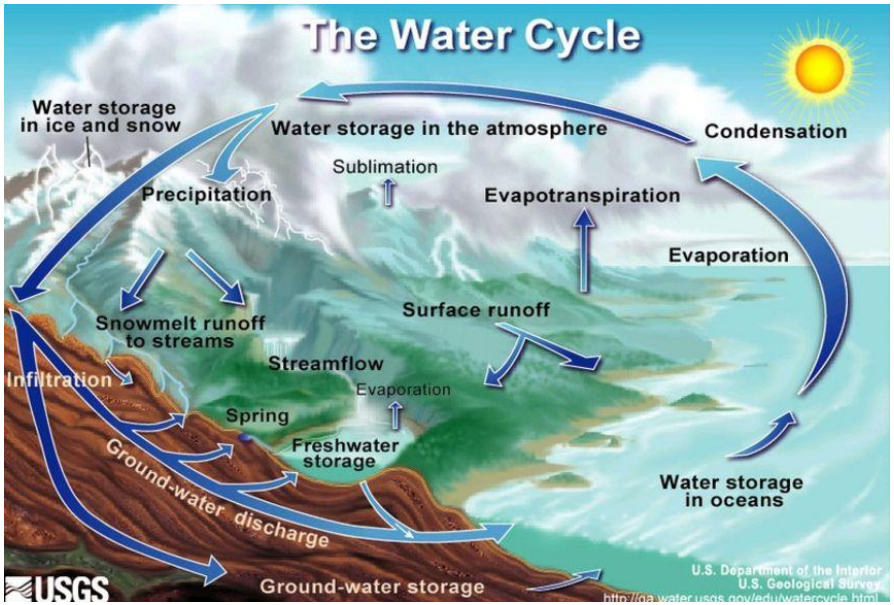
**What's one question that you have about groundwater which you would like answered at the workshop?**

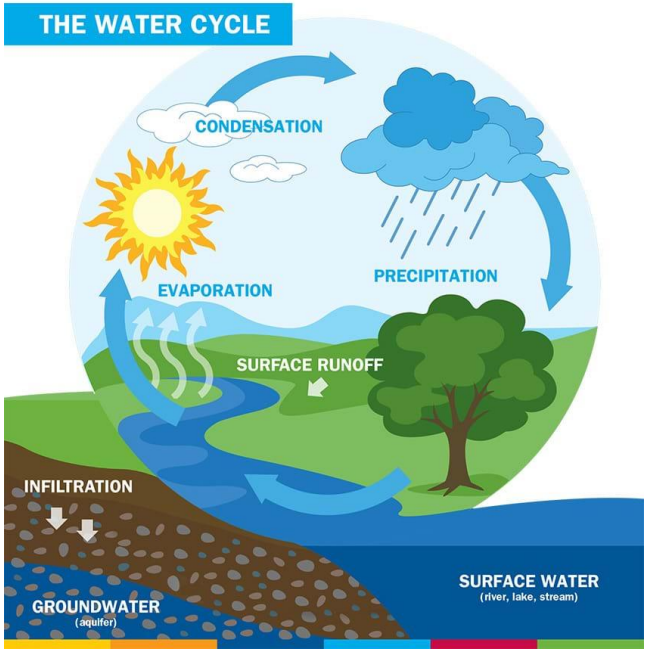
- Besides disuse of pollutants, it's there anything prior could do to help restore groundwater purity?
- How the ground purifies water, and how to test well water.
- Timeline of land use impact on groundwater, if I have a well that is 10mg/l nitrate measured today how old is that water? Is that due to agriculture happening now, or was it from 10 years ago and is the current water that hasn't made it down to the aquifer worse?
- Is there a data collection point where nitrate levels in groundwater are stored or can be added to that is available for the public to view?
- Do contaminants in ground water get filtered out before entering a river or tributary?
- How have Wisconsin's changing laws and policies re: high-capacity wells over the past few decades affected water quality and quantity across regions of our state and is there a recharge-rate map that provides insight into Wisconsin's groundwater resources?
- PFAS have been in the news recently, I don't know alot about them or how they can impact groundwater. I'd like to know more.
- What impacts do geology have on the quality and quantity of groundwater? Can we track and possibly predict changes over time?
- How to relay groundwater info to the public in laymans terms
- How much groundwater do we have available vs unavailable to us
- What can the everyday person do to keep the community groundwater clean and safe?
- This is my first year in the position. I am coming to soak up all the information I can.
- How do I talk about groundwater to students without it going over their head?
- The groundwater related impact of improperly regulated landfills on them.
- How does ground water quality impact wildlife?

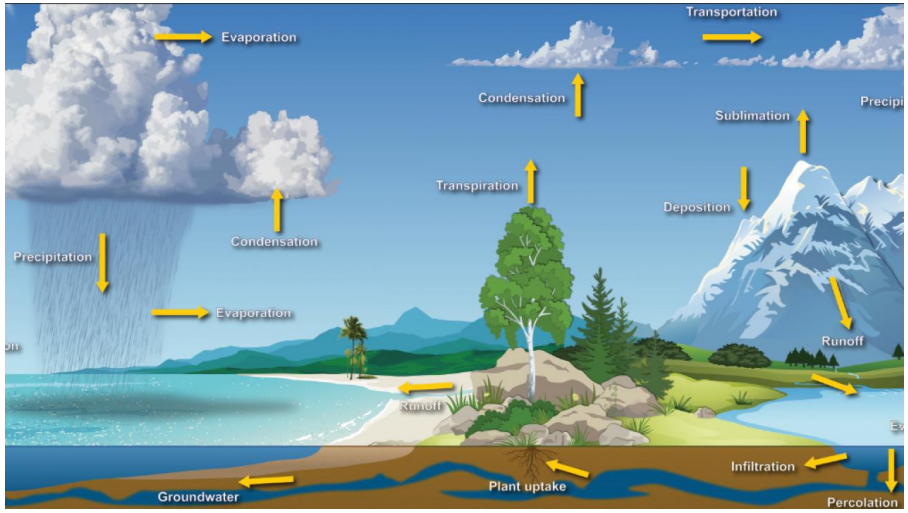
# If you currently teach about groundwater, what is the most common concept that students get wrong or struggle to understand?

- **What an aquifer is**
- Where our drinking water comes from and how it is filtered/treated for consumption.
- How water deep in the earth isn't replenished as fast as well can draw it out. How the soil filters water to be clean drinking water. How water so deep can become contaminated.
- Vocabulary, different types of aquifers, how to clean wells or aquifers.
- Students often believe they get their water supply from area lakes and streams.
- It's not an underground lake. Groundwater flows. Conflating "water table" with "aquifer"
- Folks love waterfalls but there's little connection drawn between river health and surrounding watershed/aquifer health.
- They have no idea about how using gravel and "dirt" can actually clean our water!
- How to determine the source of nitrates: septic, fertilizers (agriculture vs domestic), manure... how can you manage different sources?
- That the waste water of municipalities and industry becomes clean enough to drink.
- It is difficult for many students to believe there is water beneath our feet, even flowing water in some cases.
- When I studied groundwater at a very basic level as a student, the challenge was grasping terms like head and visualizing the quantity of water moving through an aquifer vs. water freely flowing in a surface body.
- Sometimes its a bit abstract to the students. We need more visuals aside from the model.
- Students struggled with tracing pollutants back to their source.
- **That all water is connected.**
- **Their water sources are right under their feet (a relatively small area), the water does not free flow from faraway places underground.**

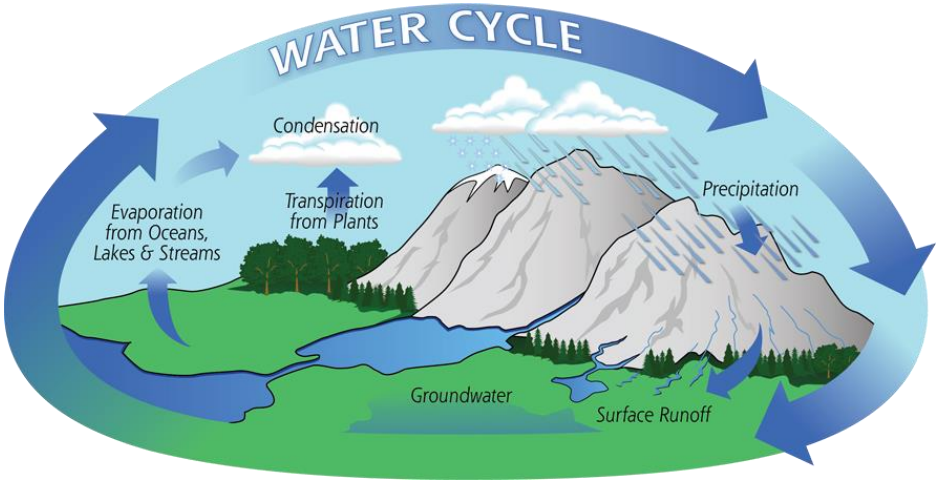
# Water Cycle Examples



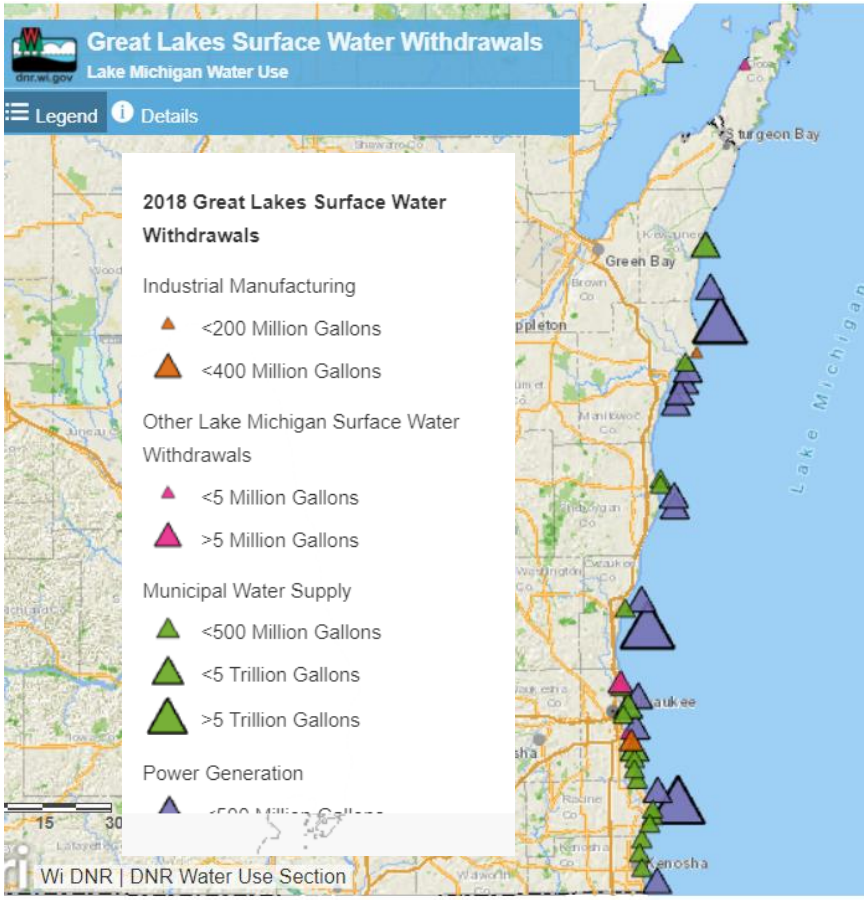

NOAA




NASA

# Sources of Wisconsin's Water

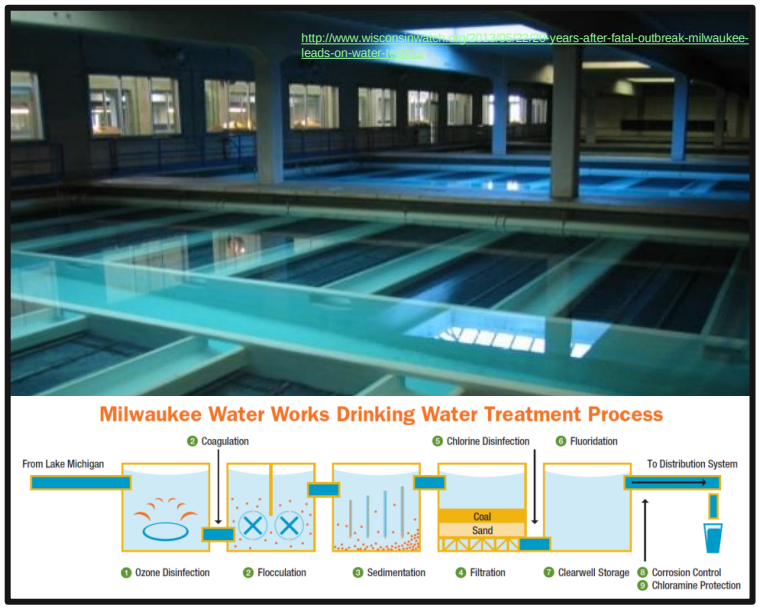
- **Surface Water (25% of population)**
  - Municipalities along the Great Lakes
  - A few communities along Lake Winnebago
- **Groundwater (75% of population)**
  - 95% of Wisconsin communites
  - All rural landowners
  - Almost all water for agricultural operations
  - 1/3 of industrial water use
  - ½ of commercial water use



# Public water supplies versus private wells

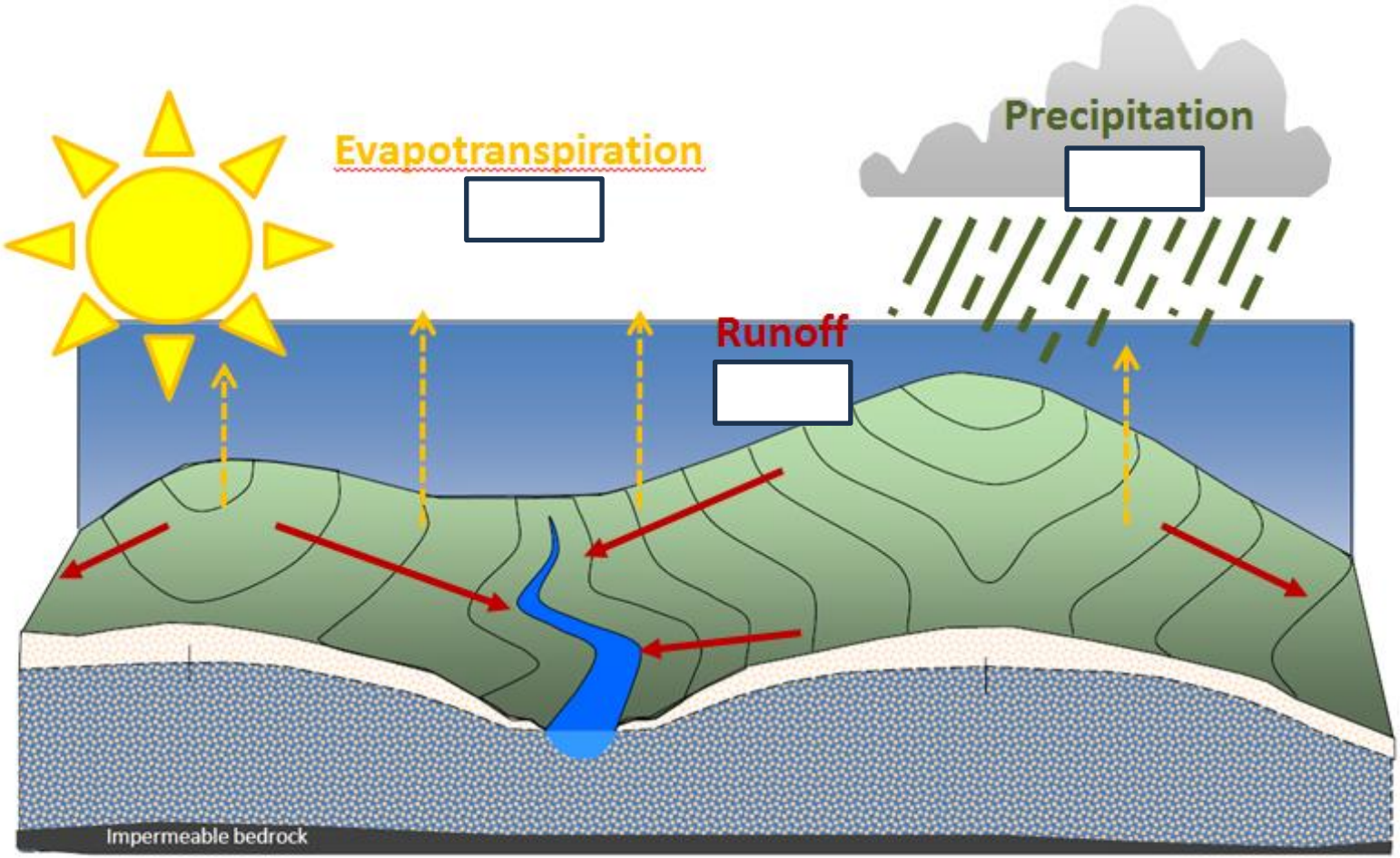
## Public Water Supplies (4.1 million people)

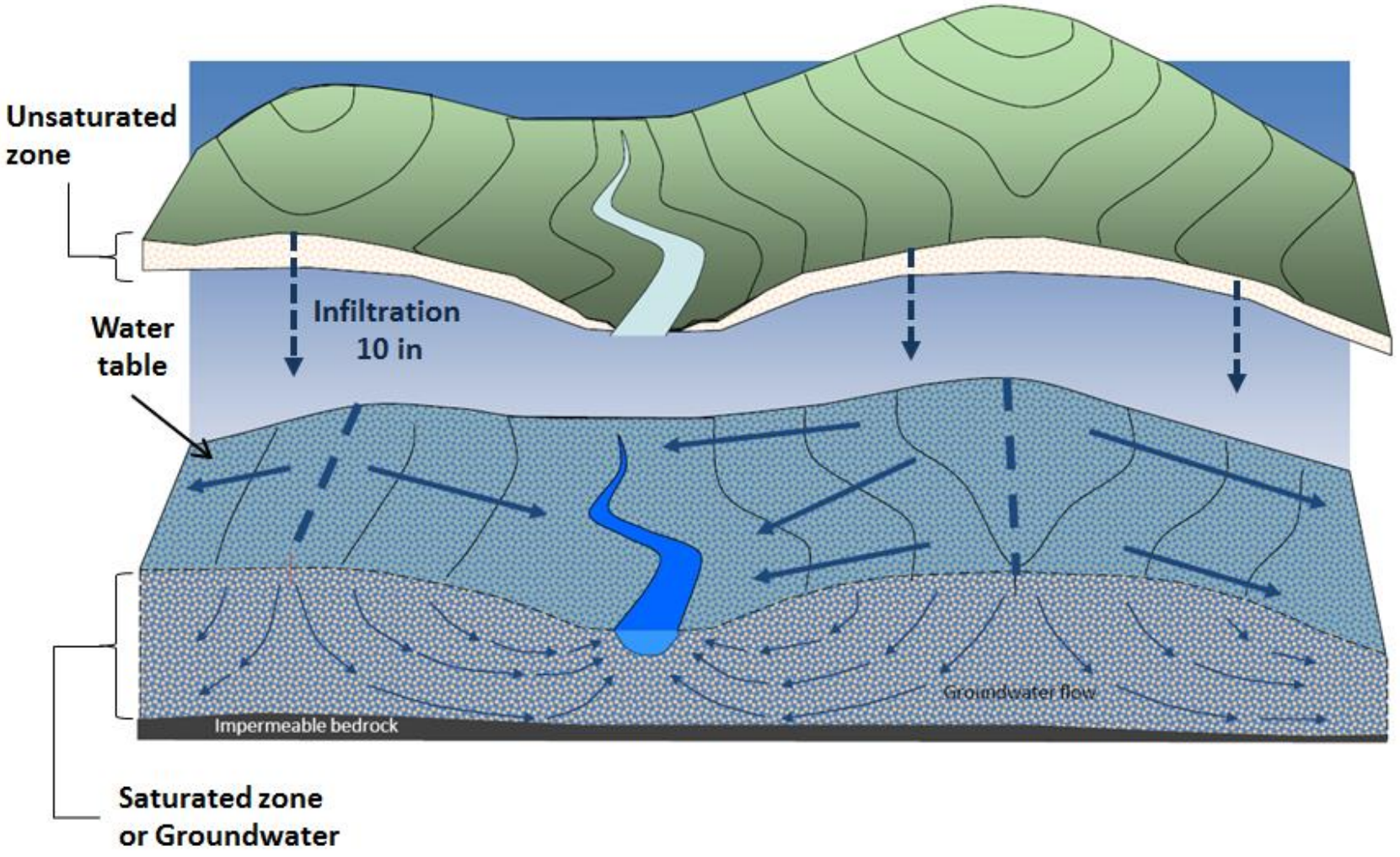
- Regularly tested and regulated by drinking water standards
- Annual Consumer Confidence Report (CCR) summarizes water quality



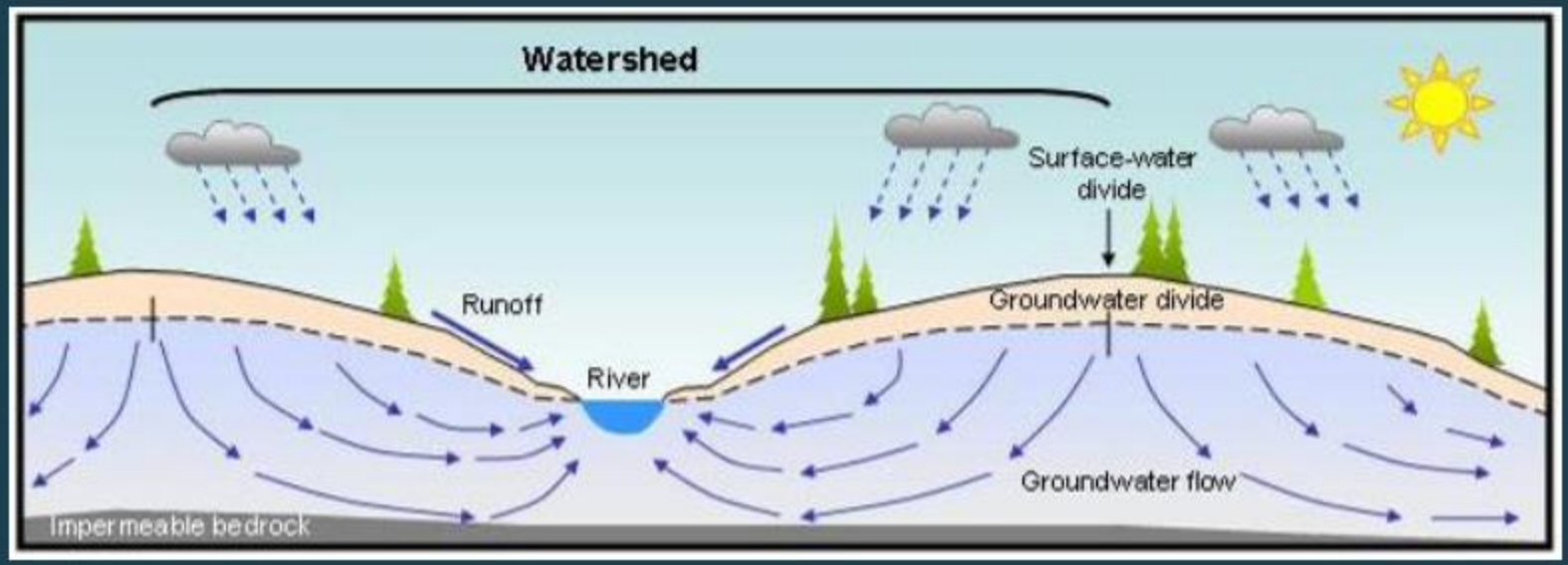

## Private Wells (1.7 million people/800,000 wells)

- Not required to be *regularly* tested
  - Well construction – Bacteria & Nitrate (since 2014)
  - Well/pump work or well inspection – Bacteria, nitrate (2014) and arsenic (2014)
- Not required to take corrective action
- Owners must take special precautions to ensure safe drinking water


Evapotranspiration
Precipitation
Runoff
Impermeable bedrock


Unsaturated zone
Infiltration 10 in
Water table
Groundwater flow
Impermeable bedrock
Saturated zone or Groundwater

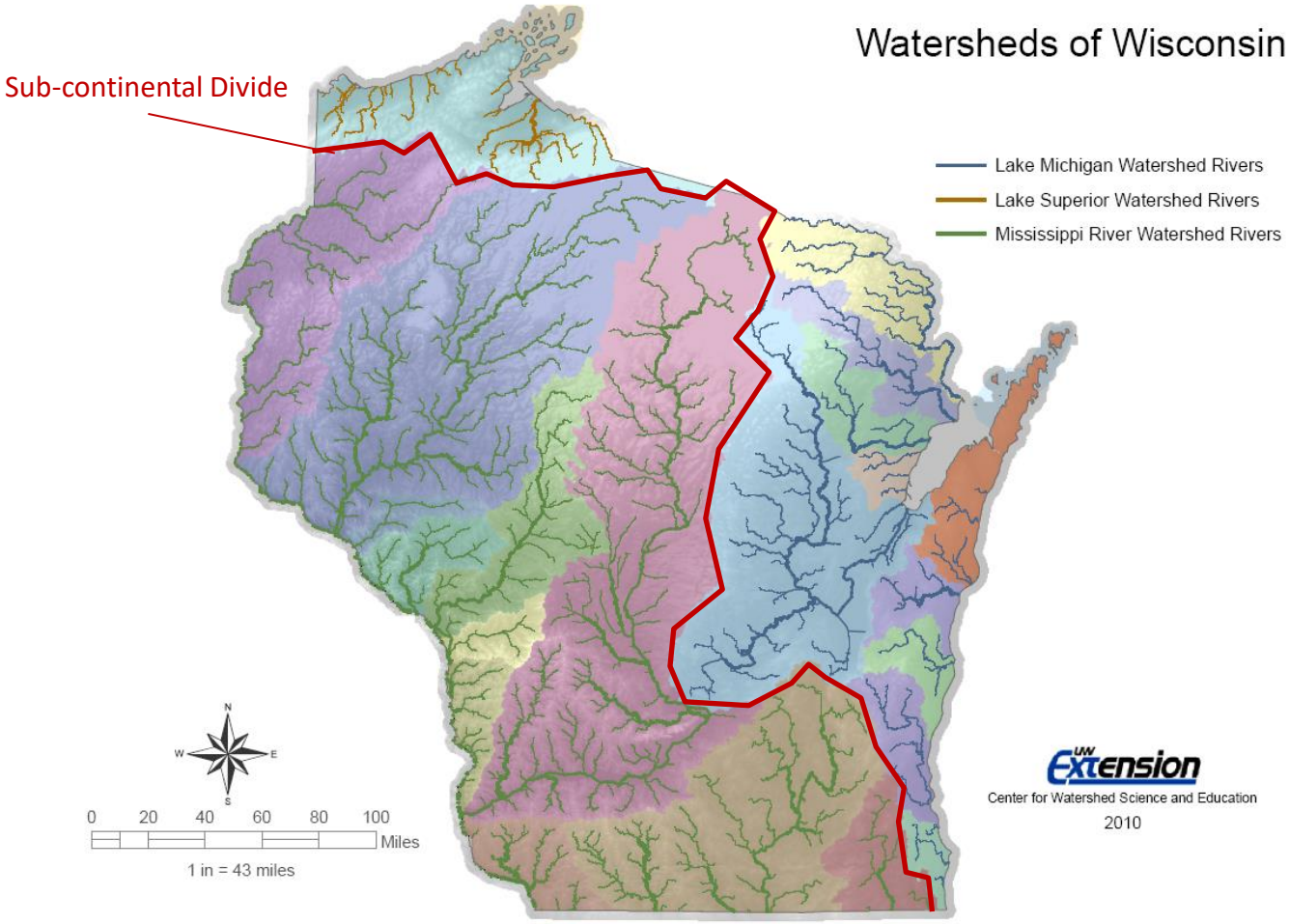
**Watershed** – the land area where water originates for lakes, rivers or streams. Water flows from high energy to low energy.



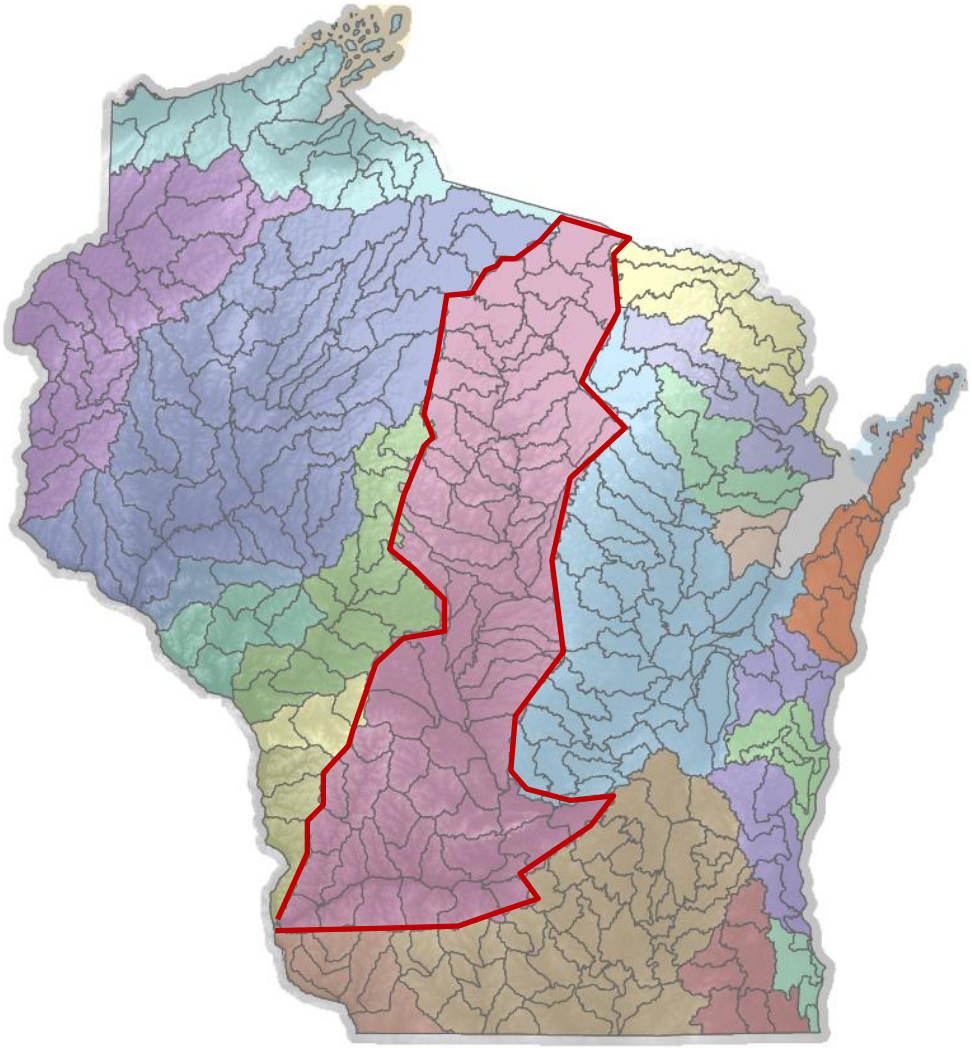
# Wisconsin's Watersheds

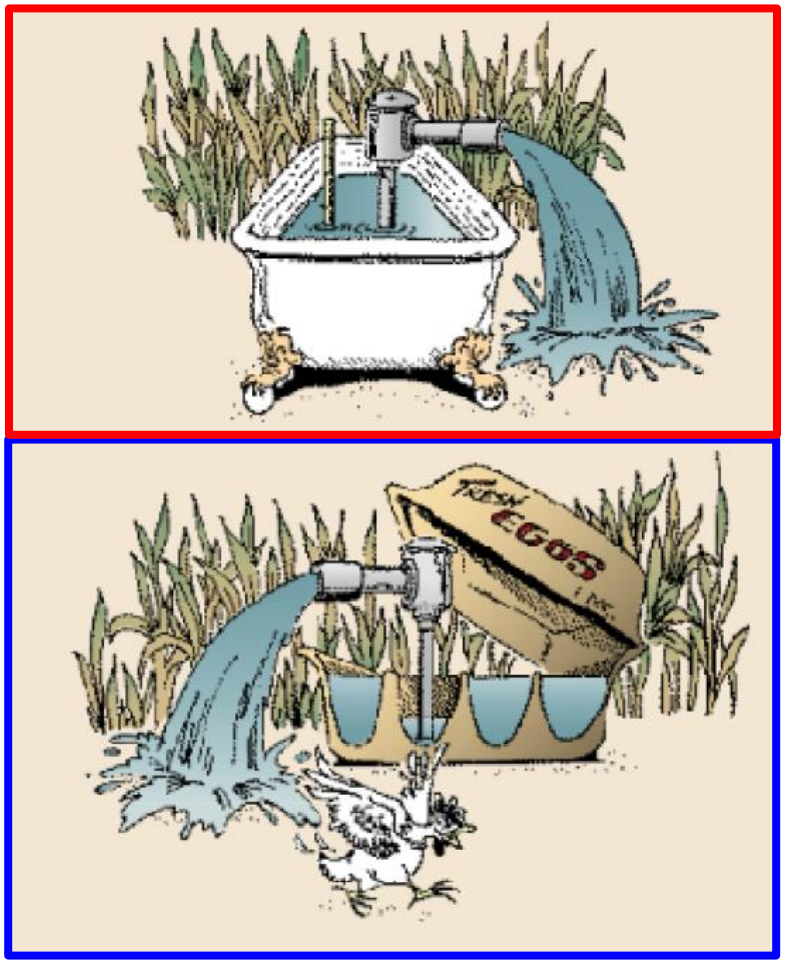
Wisconsin has three major watersheds or drainage basins. Rivers in the Lake Michigan Watershed are indicated by blue lines, rivers in the Lake Superior Watershed are indicated by orange lines, and rivers in the Mississippi River Watershed are indicated by green lines.

These three watersheds are further subdivided into the watersheds that you see below, represented by the different colors.

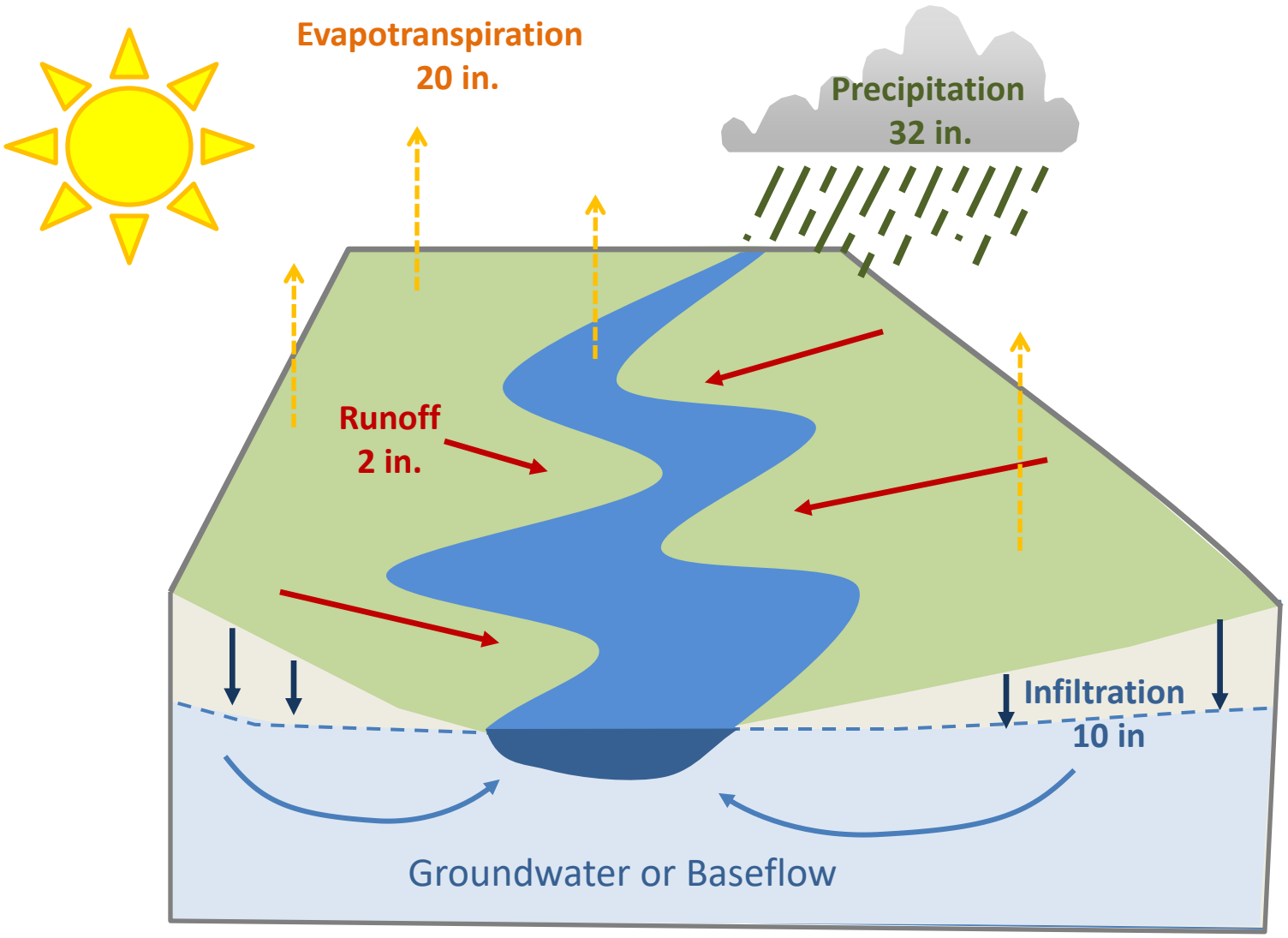


# Groundwater Issues in Wisconsin





http://pubs.usgs.gov/circ/circ1186/pdf/circ1186.pdf

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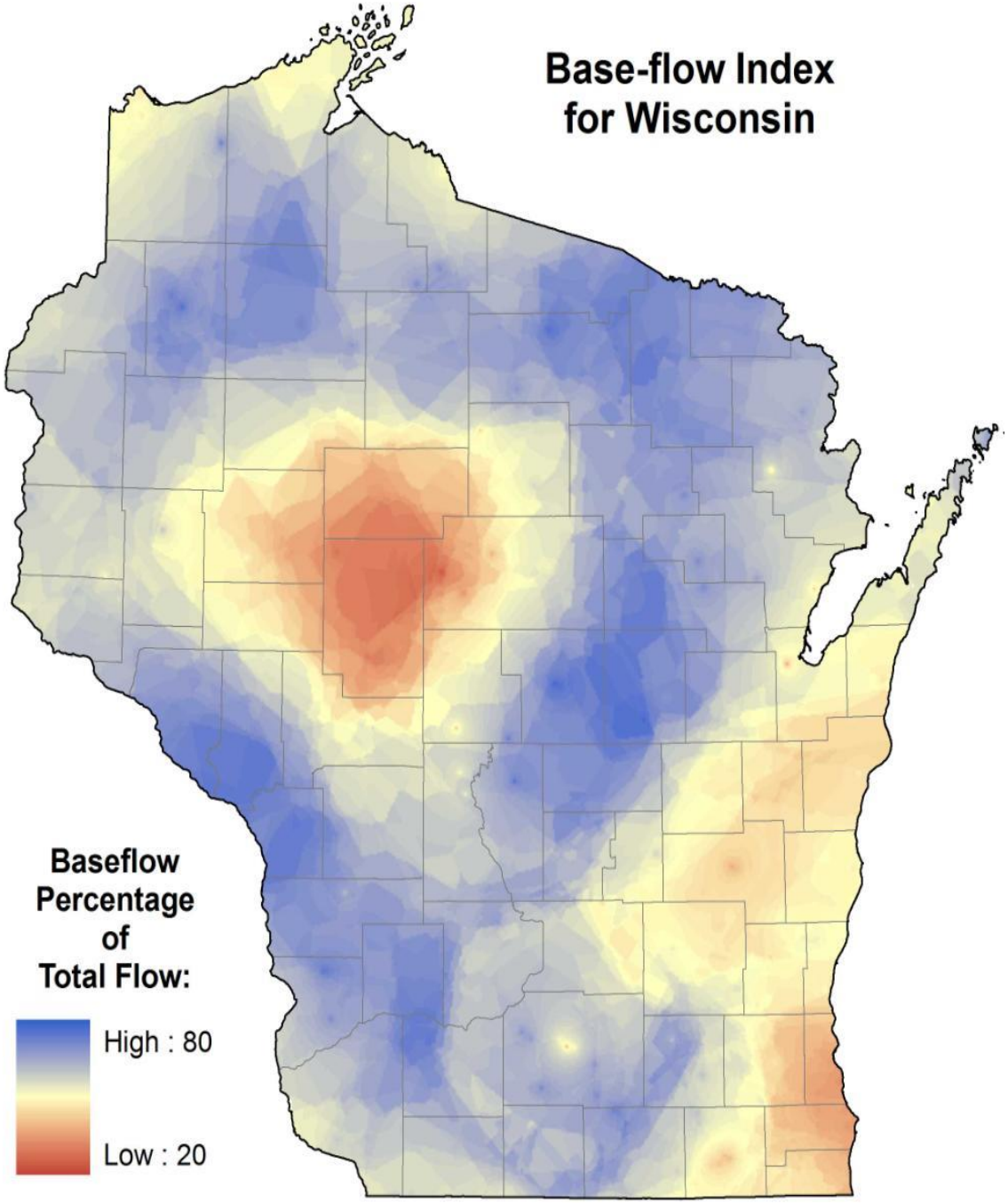
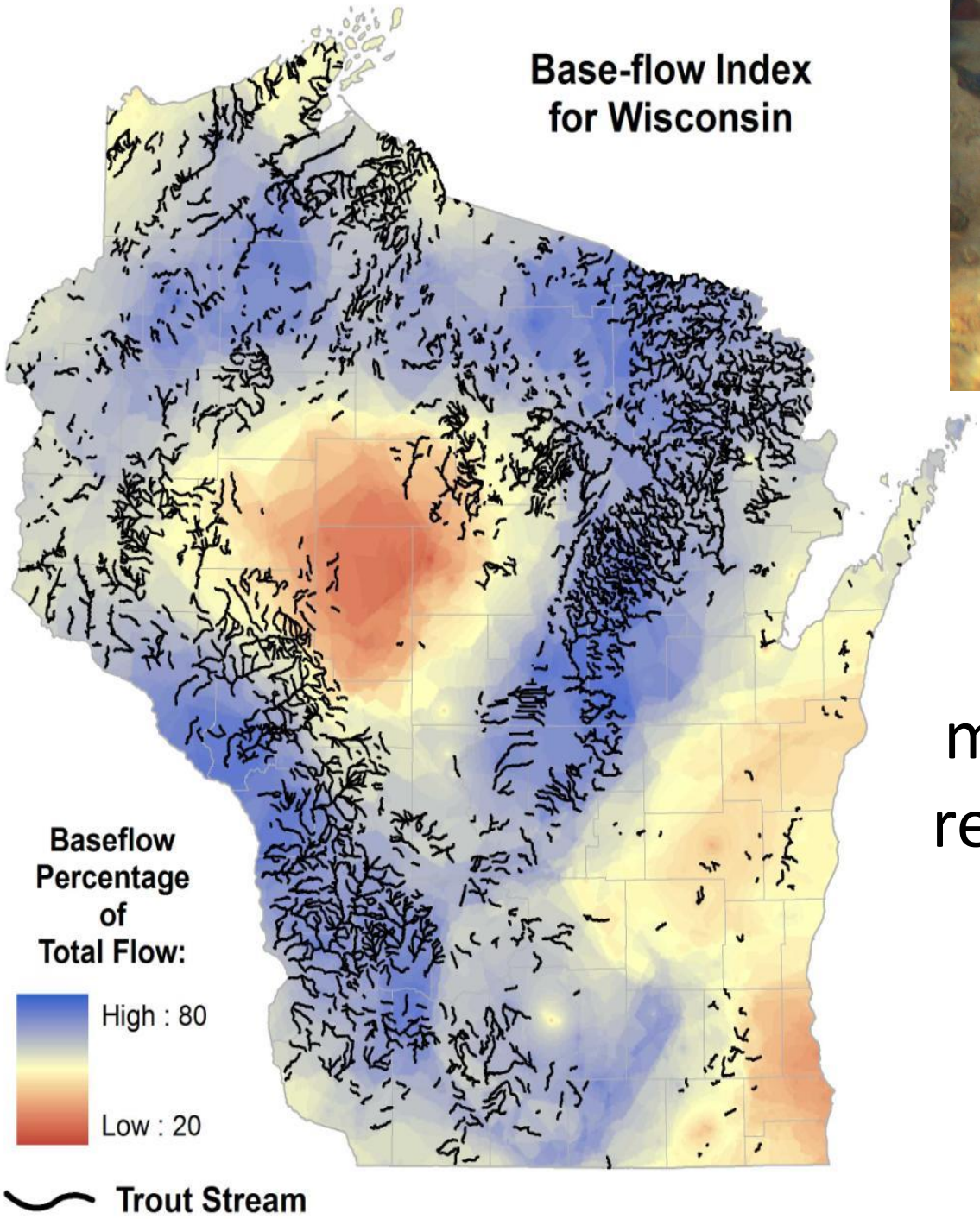
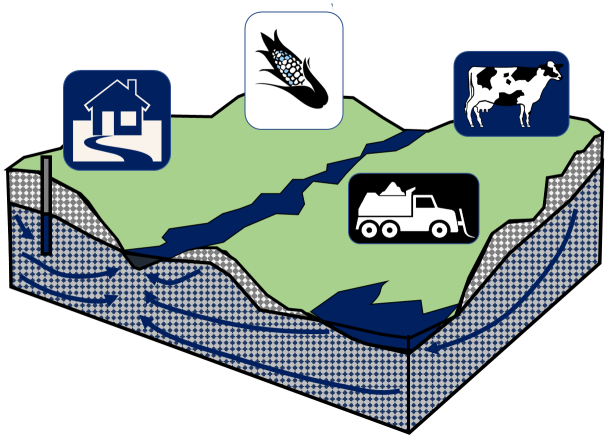

Base-flow Index
for Wisconsin
Baseflow
Percentage
of
Total Flow:
High : 80
Low : 20

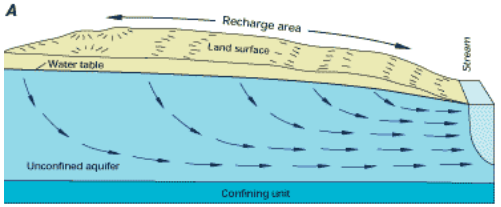


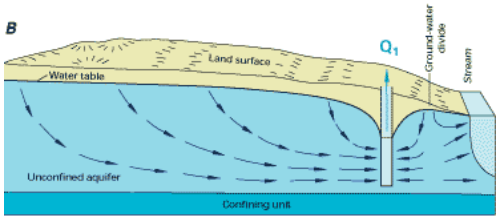

In addition to humans, fish and macroinvertebrates rely on groundwater too!

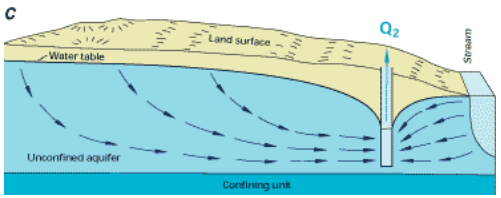
# Wisconsin Groundwater Concerns

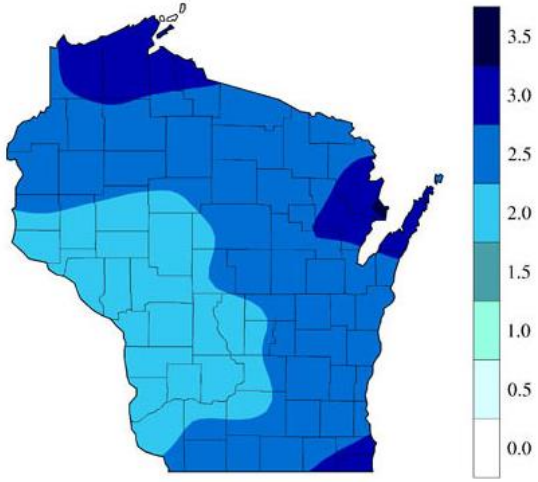
- Groundwater Quality
- Groundwater Quantity
- Climate Change??





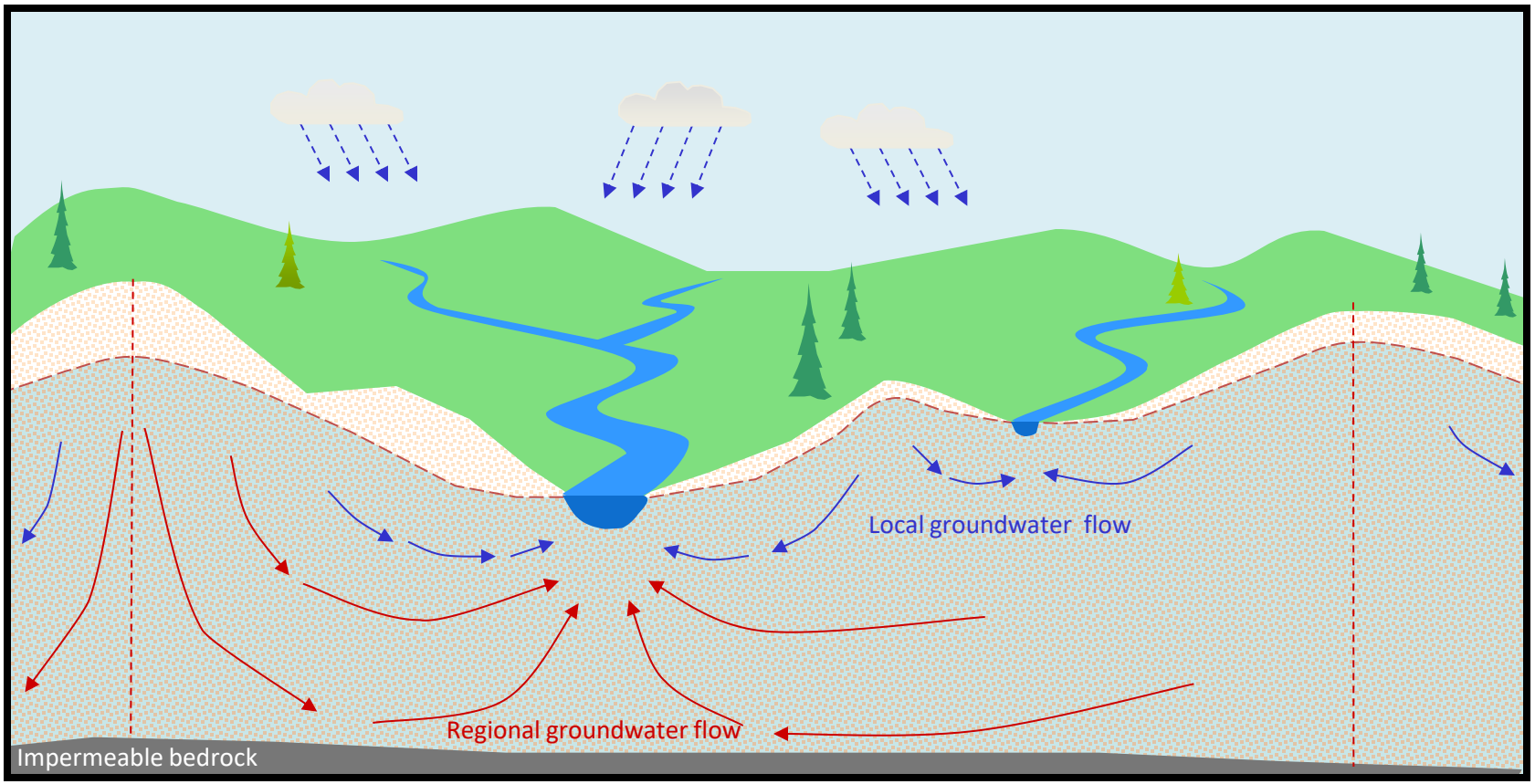




Projected Change in the Frequency of 2" Precipitation Events (days/decade) from 1980 to 2055

# What happens when we have more rain?

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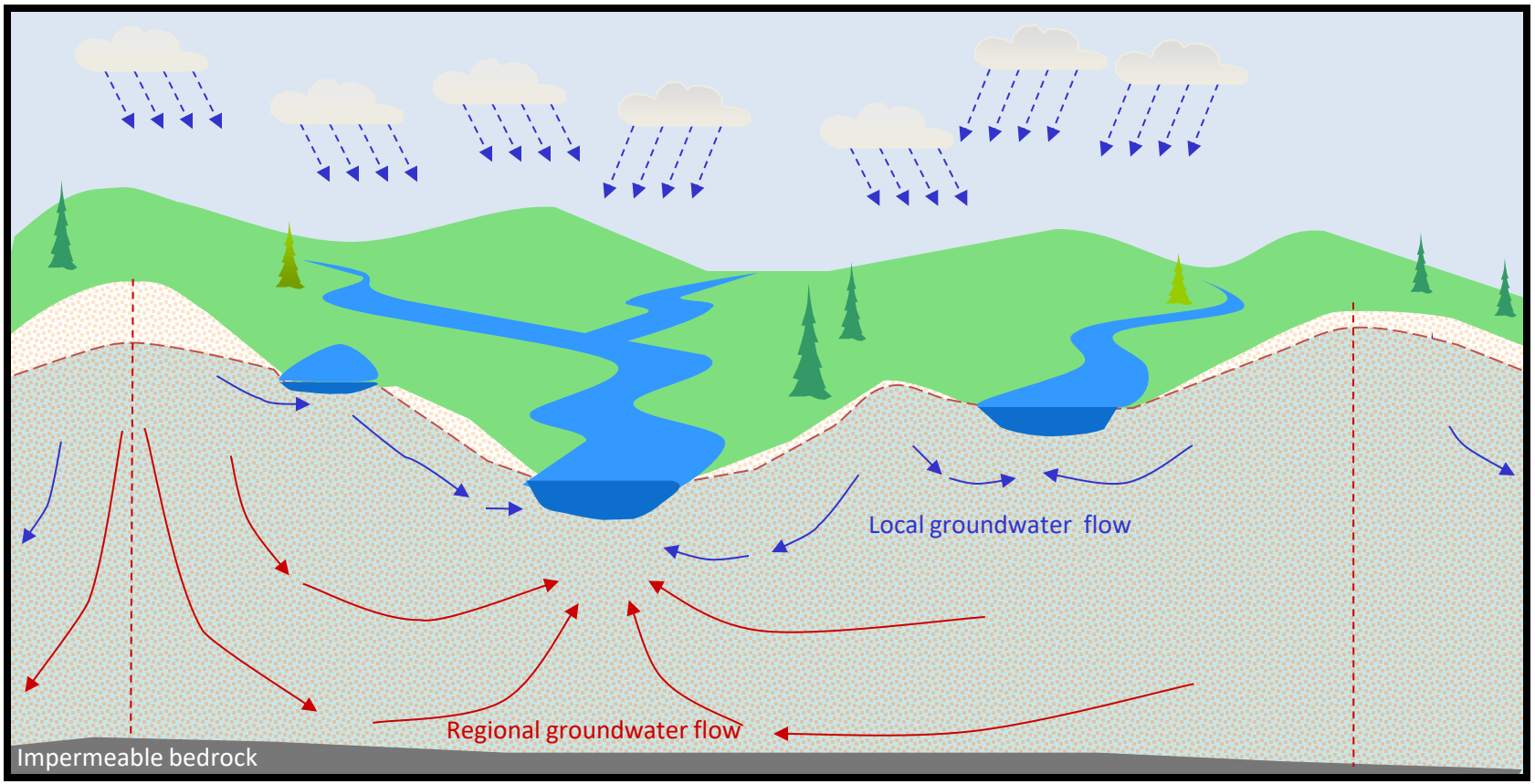


- More infiltration
- Groundwater levels rise
- More water in rivers, lakes and streams
- *Seasonal and climatic implications*

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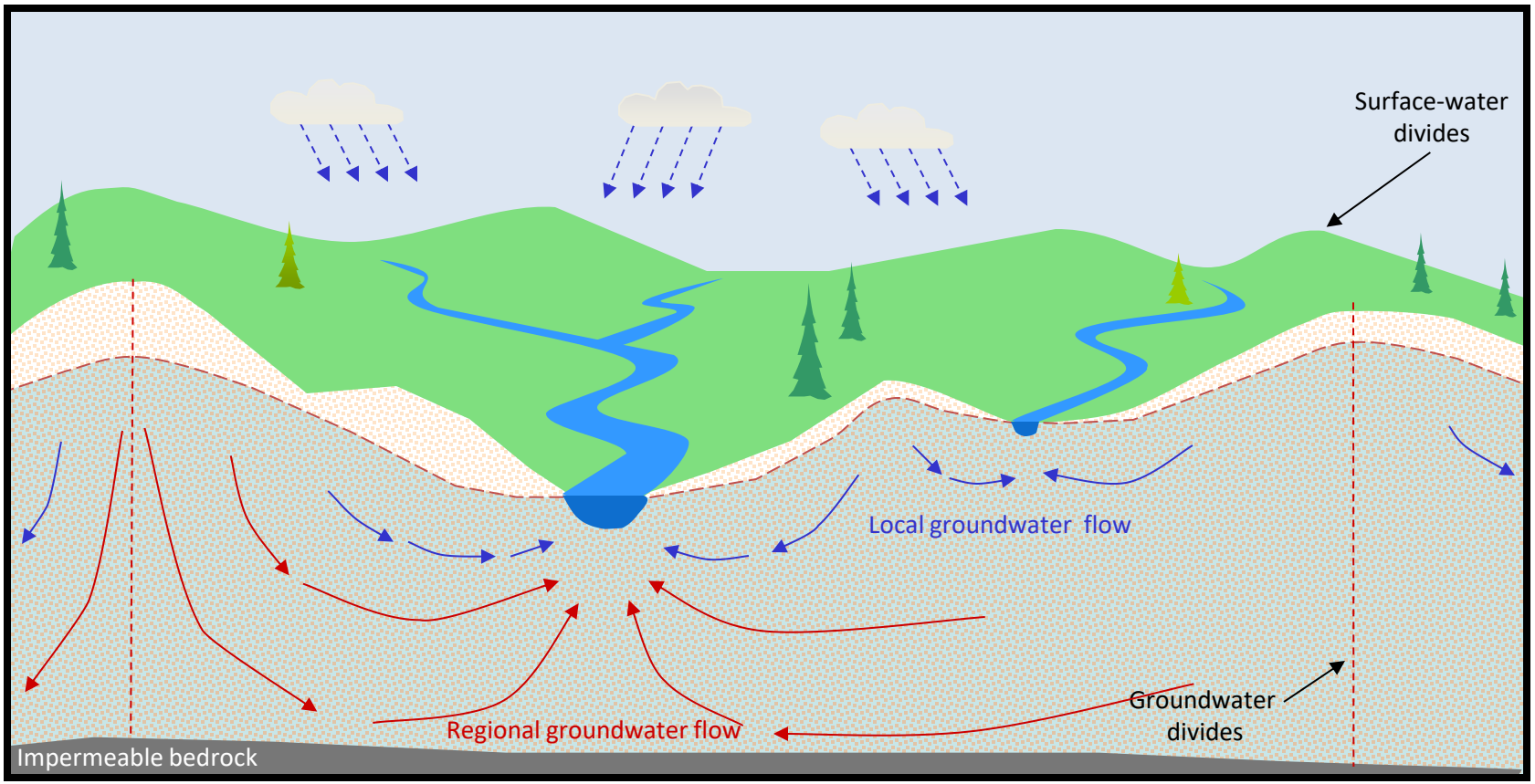
# What happens when we have less rain?

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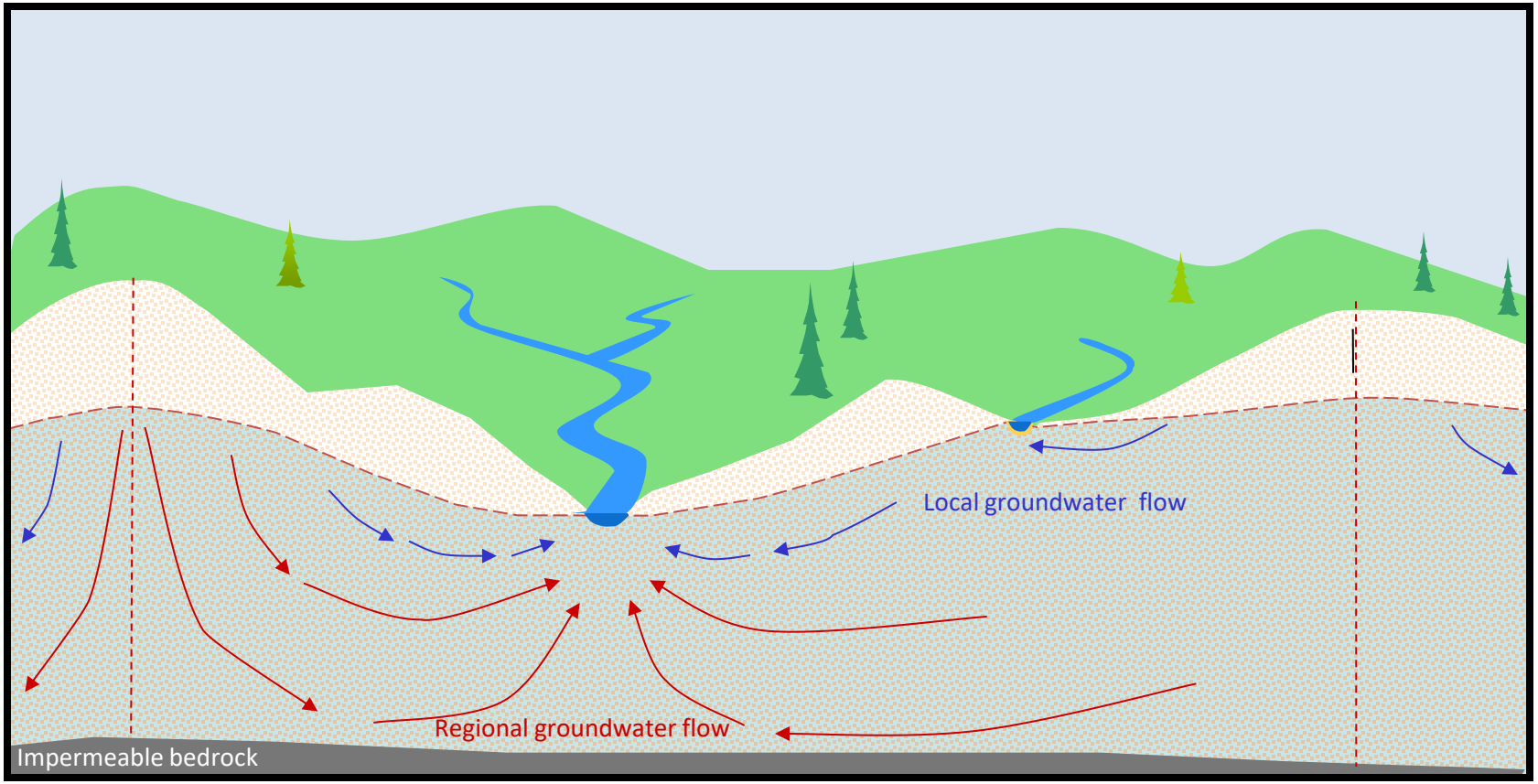
# What happens when we have less rain?




- Less infiltration
- Groundwater levels start to go down
- Less water in rivers, lakes and streams
  - *Seasonal and climatic implications*

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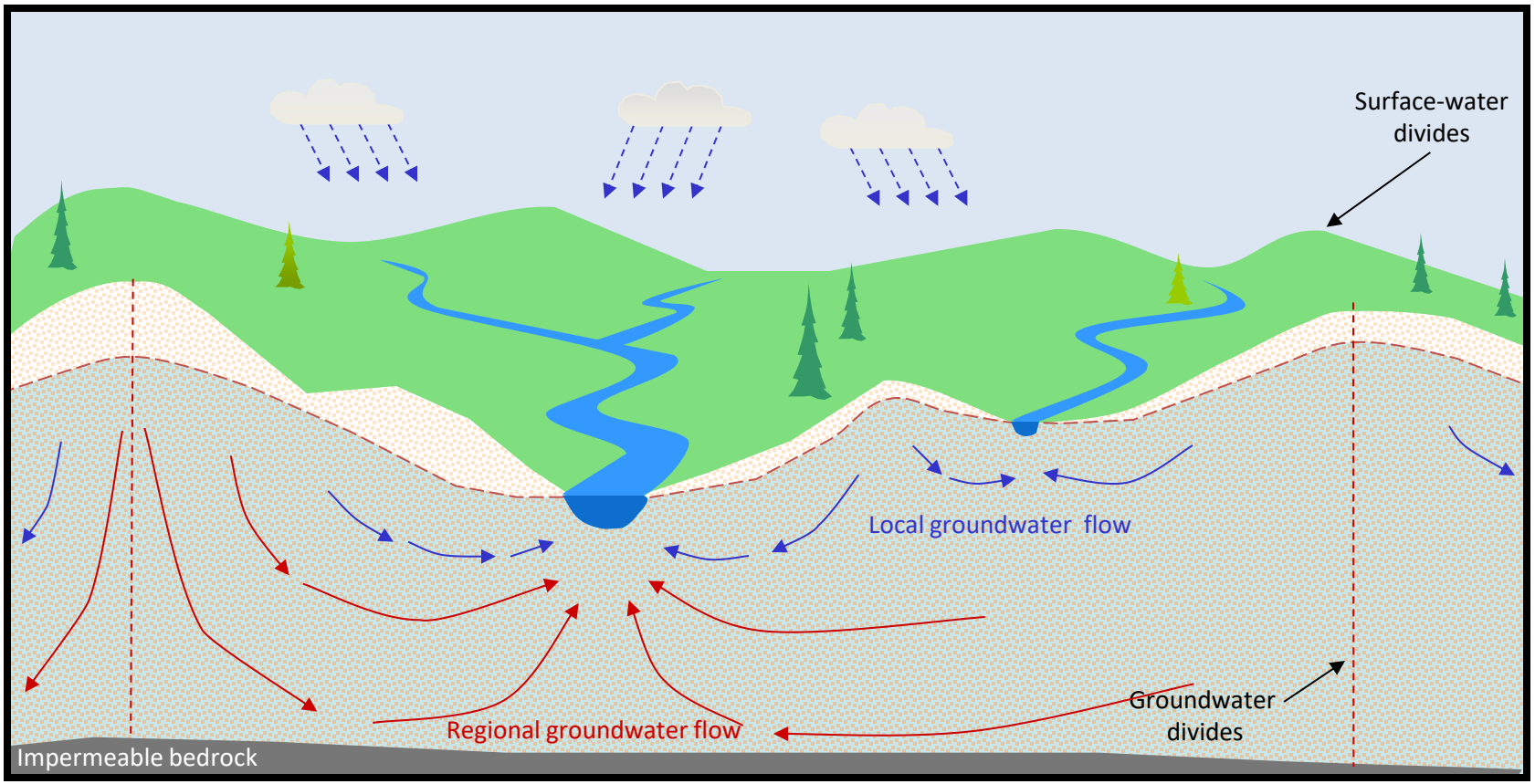
# What happens when we decrease infiltration?

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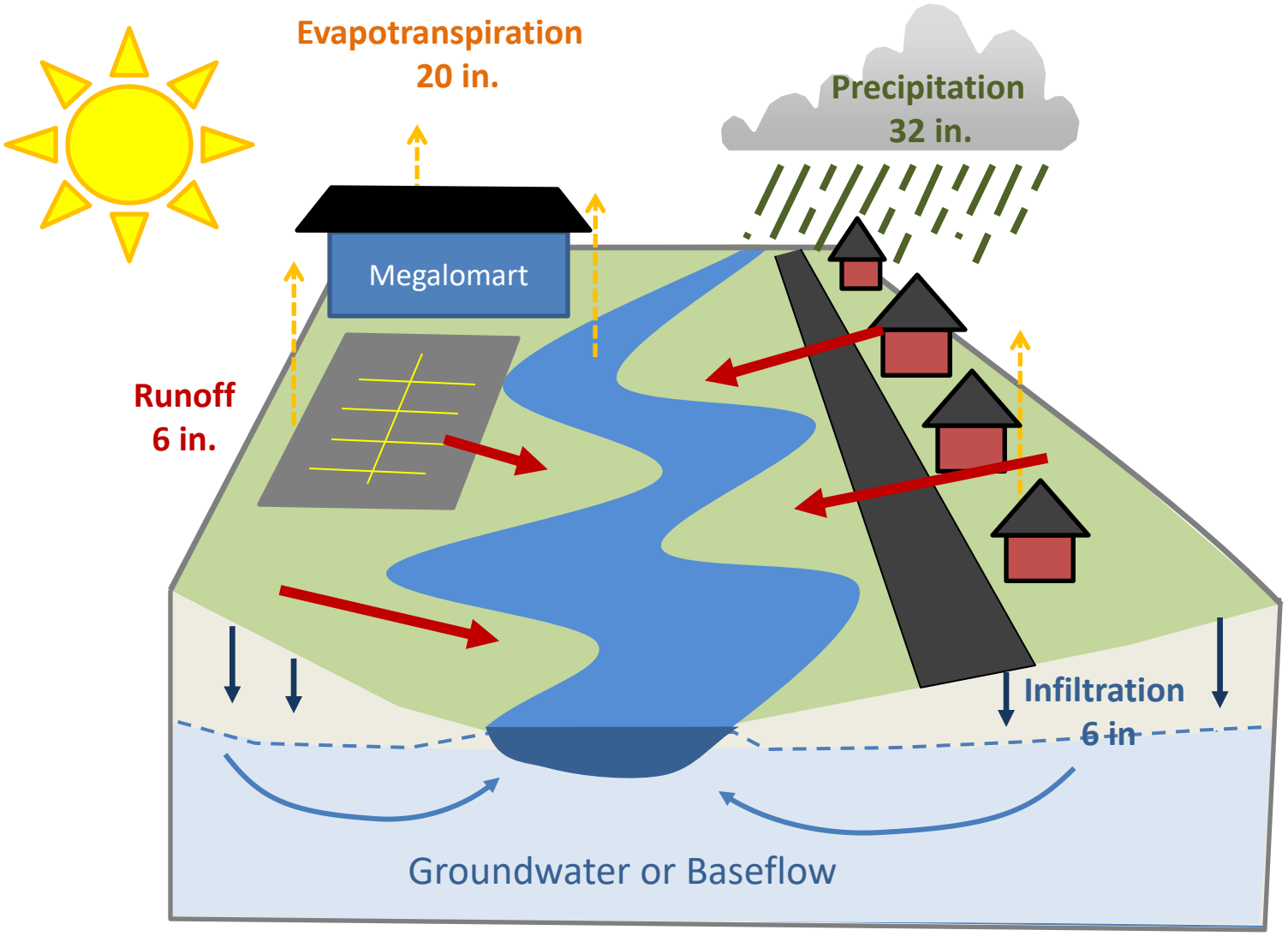


Increase in impervious surfaces means more flooding and more transport of pollutants, sediment *and heat*.

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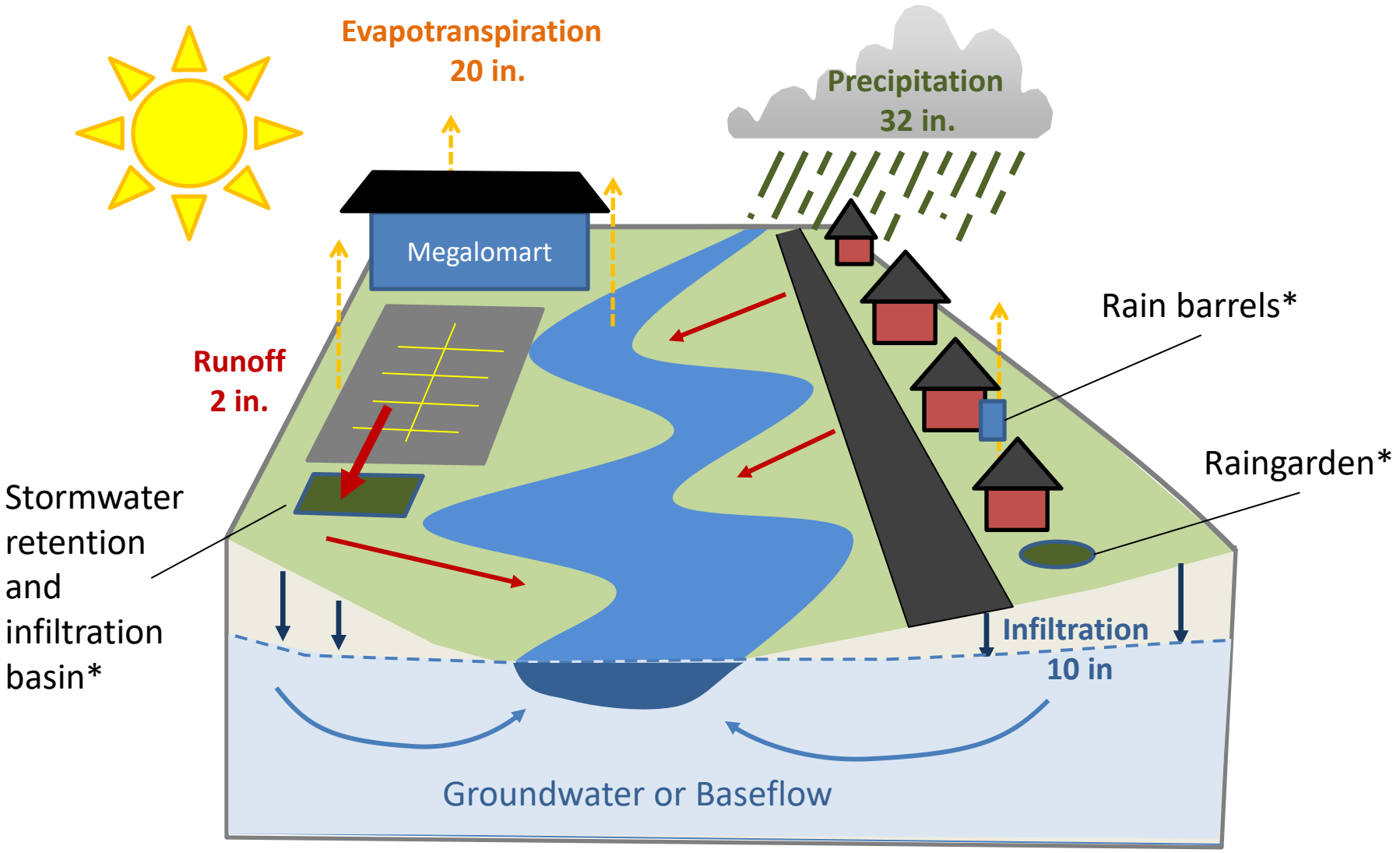


*All aimed at capturing storm water and releasing back into the environment slowly.

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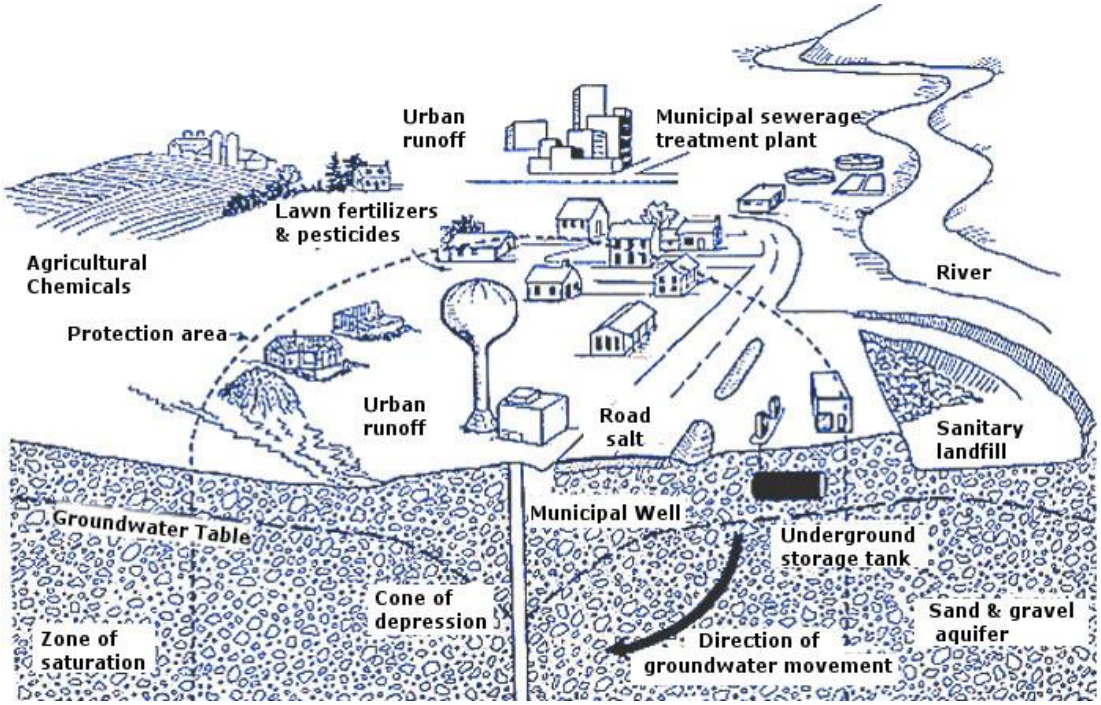
# So, what is this groundwater?


https://youtu.be/hkZK58FqmoM?si=5uJy-SjFZgYI7qLy&t=217

# Source water protection

- Municipal water systems have wellhead protection plans that limit what activities can be located within the 5,10, and 20 year capture zones of the well

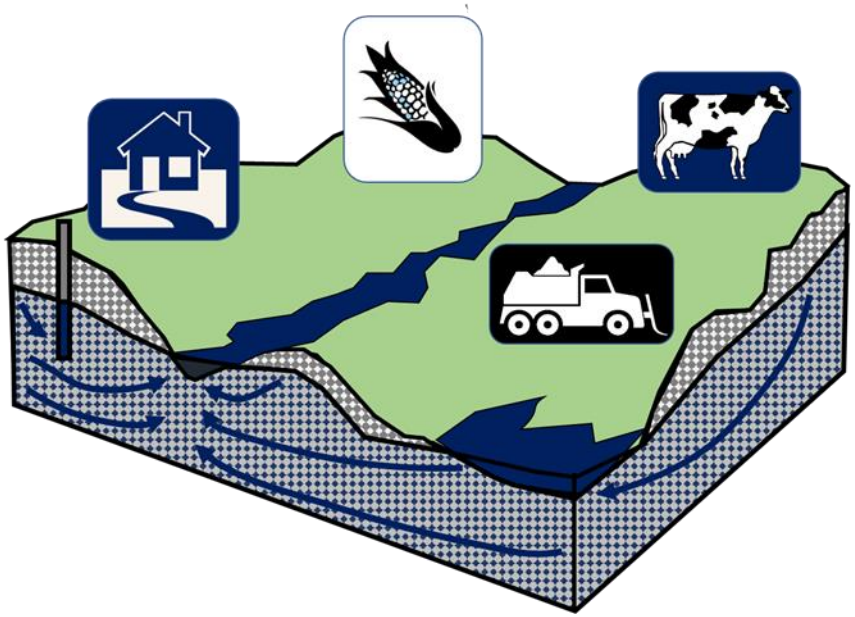


# An Ounce of Prevention

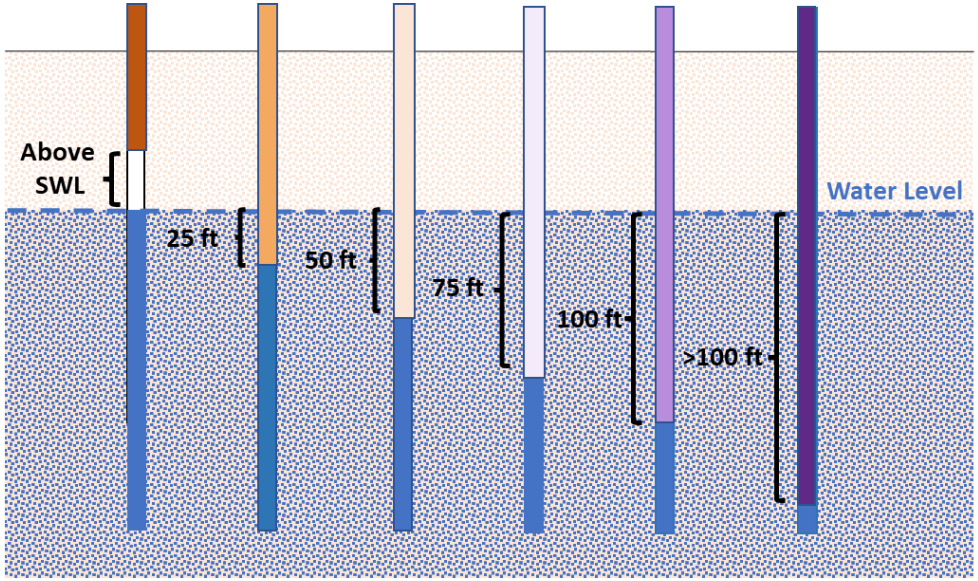

https://www.youtube.com/watch?v=x08ISXHBKo0

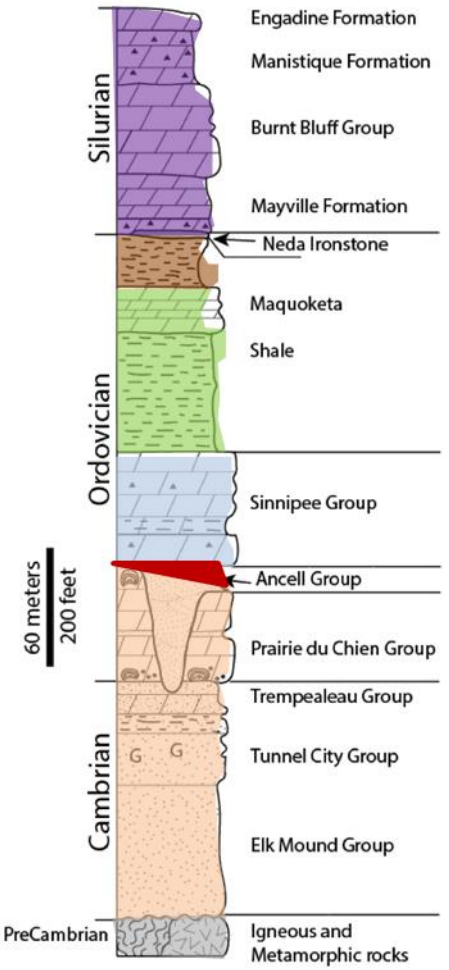
# Accessing local resources

- Well construction reports
- Accessing well data
  - DNR GRN
  - WI Well Water Viewer
- Additional geology & groundwater resources



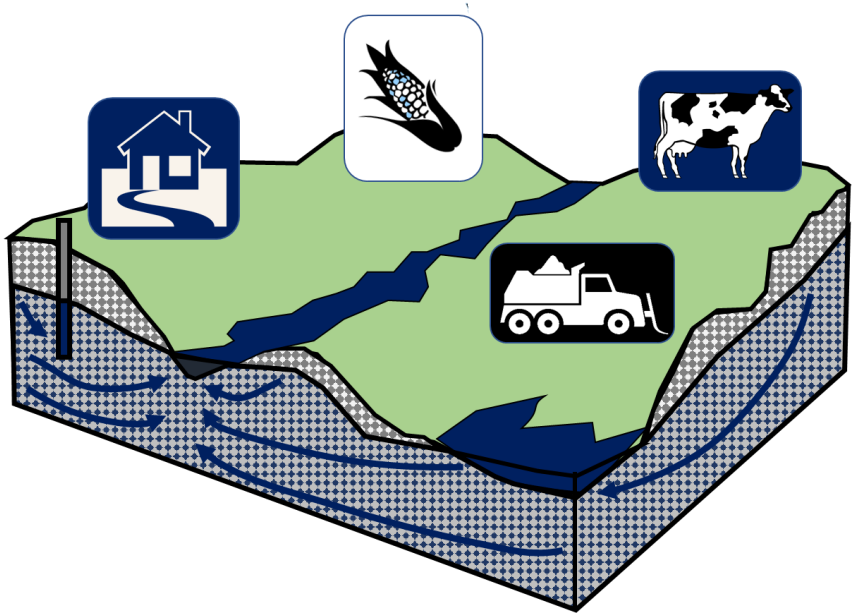
# Well Construction Reports

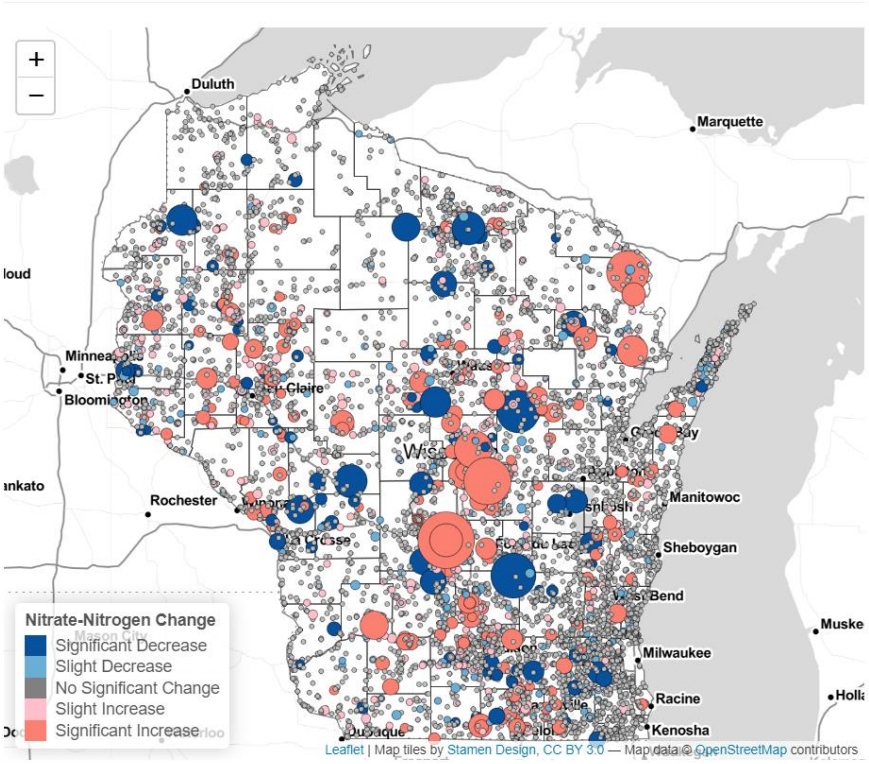



https://dnr.wi.gov/WellConstructionSearch/#!/PublicSearch/Index

# WQ Data for Public Water Systems

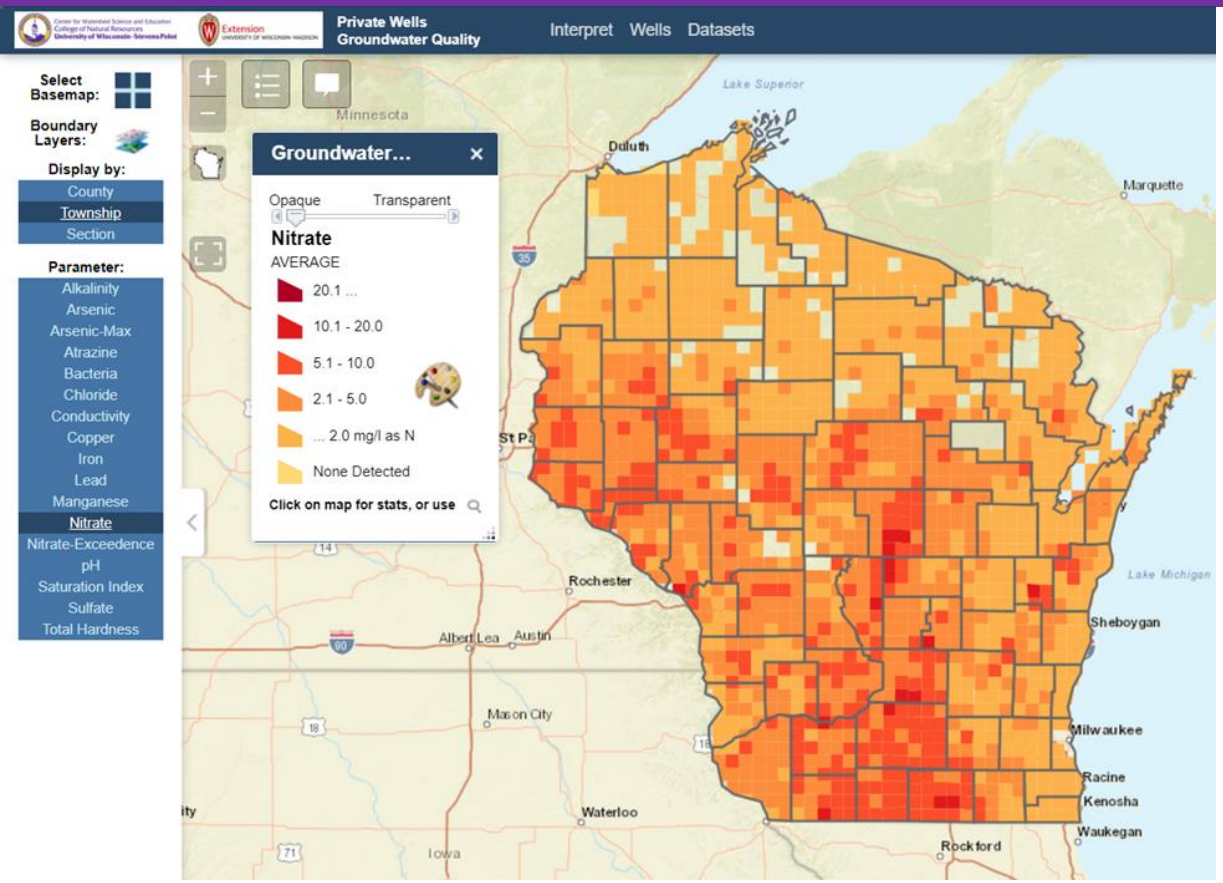





https://dnr.wisconsin.gov/topic/Groundwater/Data.html

https://shiny.theopenwaterlog.com/nitrate_trends/

# UWSP WI Well Water Viewer

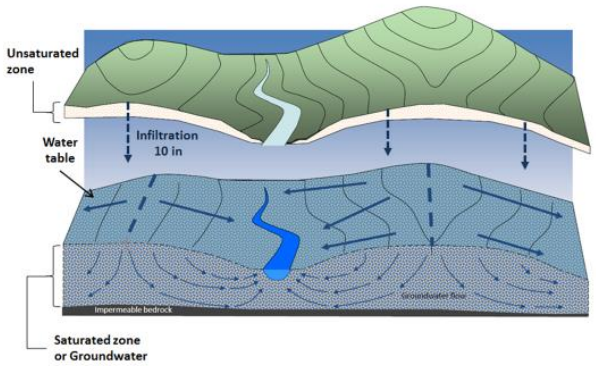


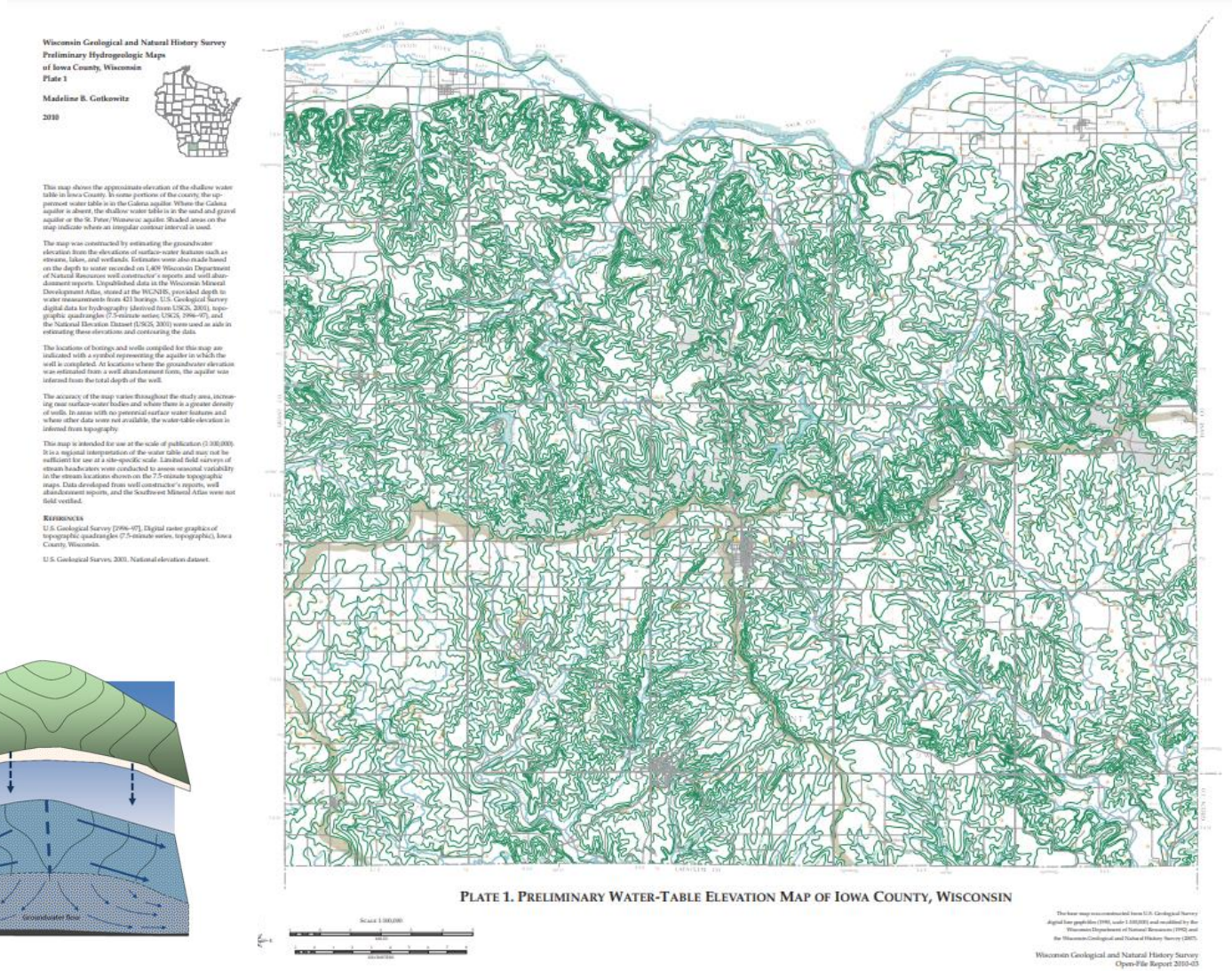

***Online interactive data visualization tool***

- Paints the picture of well water quality in Wisconsin
  - Nitrate, Arsenic, Alkalinity, Atrazine, Hardness, Chloride, Bacteria, Conductivity, pH, Iron, Lead, Manganese, Sulfate, Copper
- The well water viewer includes over 218,279 individual well samples from 1987 to the present
- Includes ***nitrate*** data from multiple sources:
  - UWSP/WEAL - 105,381
  - DNR GRN – 44,985
  - DNR NR 812 Required Testing - 59,677
  - DATCP – 8,236
  - La Crosse Health Dept – 5,381
  - Eau Claire Health Dept – 2,189

https://www.uwsp.edu/cnr-ap/watershed/Pages/WellWaterViewer.aspx

# Local Geology and Groundwater Resources



Wisconsin Geological and Natural History Survey
Preliminary Hydrogeologic Maps
of Iowa County, Wisconsin
Plate 1

Madeline B. Gotkowitz

2010

PLATE 1. PRELIMINARY WATER-TABLE ELEVATION MAP OF IOWA COUNTY, WISCONSIN

Wisconsin Geological and Natural History Survey
Open-File Report 2010-03

https://wgnhs.wisc.edu/