

ASSESSING THE QUALITY OF THE NATION'S GROUNDWATER: WHAT IS IT TODAY AND WHAT MIGHT IT BE IN THE FUTURE?

May 8, 2015

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NAWQA – THREE “SIMPLE QUESTIONS”

- **What is the quality of the Nation’s groundwater?**
- **Is it getting better or worse?**
- **How might groundwater quality change in response to changing conditions [land use, water use, climate ...]?**

WHAT IS OUR CURRENT FOCUS (2013-2022)?

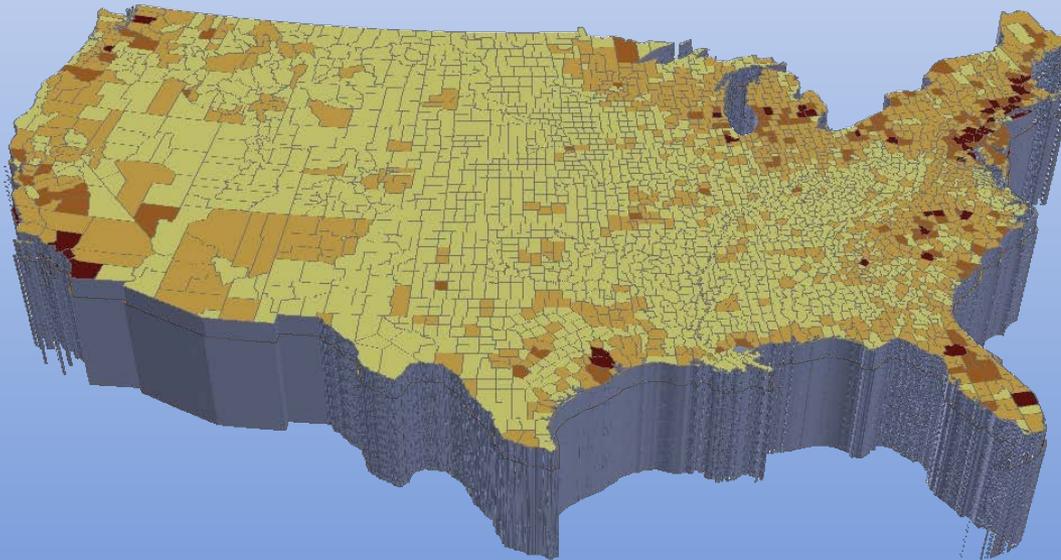
- **Assess water quality at the depth zones used for public supply and domestic supply**
- **Evaluate loading of contaminants by groundwater to streams**
- **Assess and forecast changes in groundwater quality**

NEW COMPONENT

ASSESS GROUNDWATER USED FOR DRINKING SUPPLY

- **Background – why?**
- **Approach – what have we done, where are we headed?**
- **Expectations – what will we accomplish?**

WHY IS GROUNDWATER IMPORTANT?



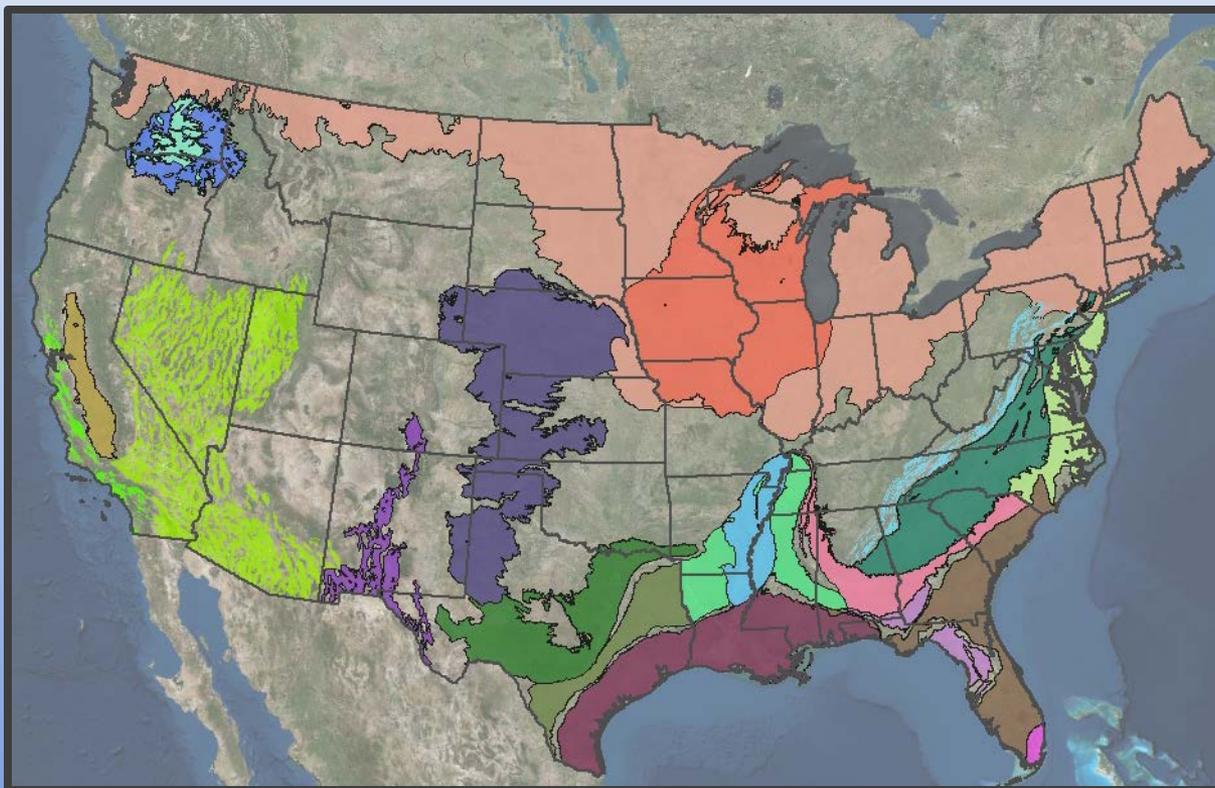
Domestic Supply
~ 44 million people
~ 50 to 150 feet deep

Public Supply
~ 98 million people
~ 150 to 750 feet deep

County population relying
on groundwater, thousands

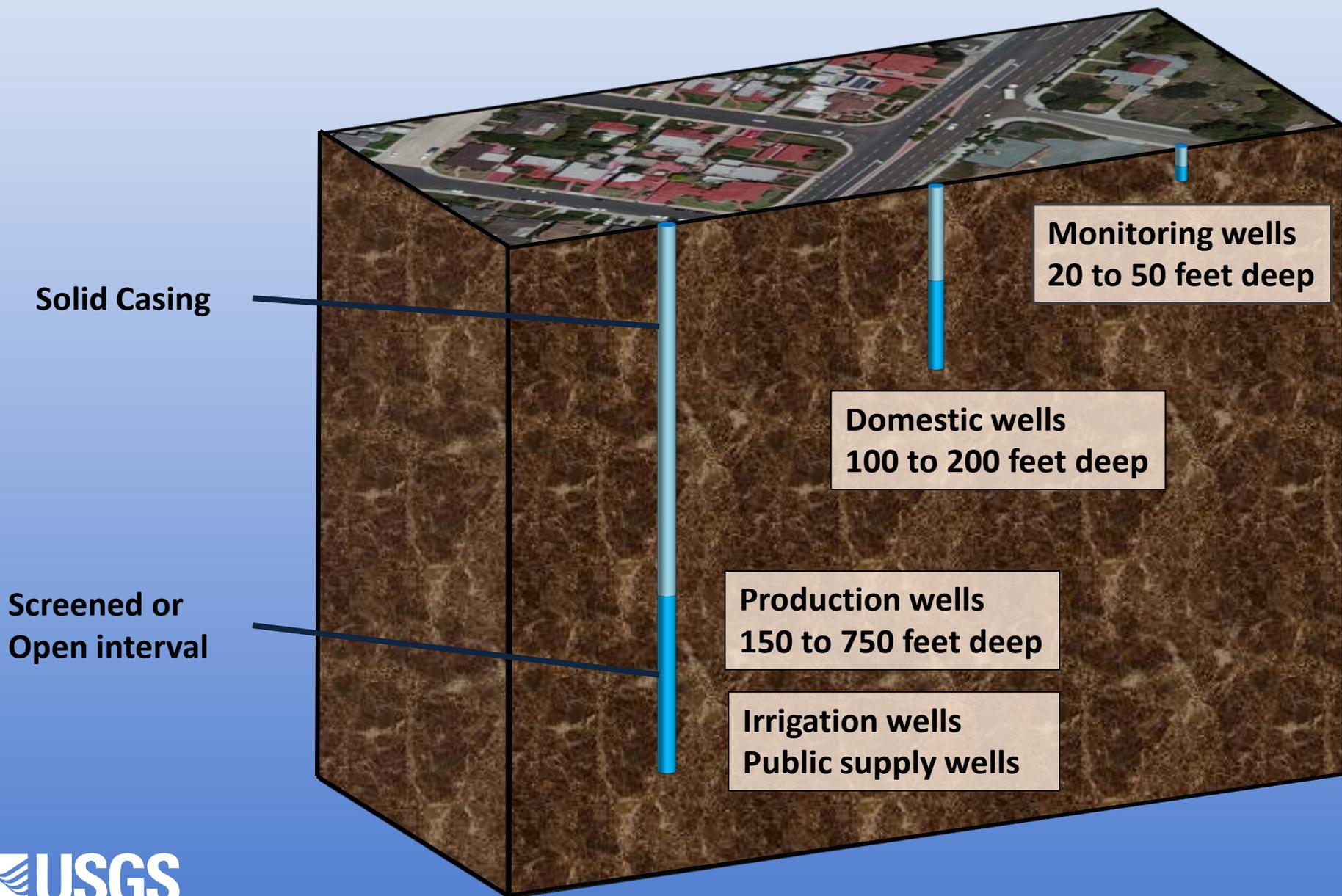


PRINCIPAL AQUIFERS PROVIDE A FRAMEWORK FOR ASSESSMENT



- 20 PRINCIPAL AQUIFERS WILL BE ASSESSED
- 90% of pumping for public supply
- 85% of pumping for domestic supply

GROUNDWATER: A THREE DIMENSIONAL RESOURCE



WHICH CONSTITUENTS DOES NAWQA ANALYZE FOR?

- **Water quality constituents, regulated and unregulated**
 - **Geologic sources: trace elements, radionuclides**
 - **Human sources: nutrients, organic compounds, microbiological indicators**
 - **Nuisance constituents: iron, manganese, dissolved solids, hardness, ...**
- **New analytes (“emerging” concern)**
 - *Pharmaceuticals, Hormones, Polonium, Enterococci ...*

WHICH CONSTITUENTS DOES NAWQA ANALYZE FOR?

- **Geochemical indicators**
 - Major ions, redox, pH, DO, T
- **Tracers of groundwater age**
 - Tritium, SF₆, CFCs, carbon-14, noble gases
- **Low-level detection methods**
 - < parts per billion (PPB) VOCs and pesticides
 - Tracers of human “fingerprint”

**COMPREHENSIVE & CONSISTENT
MONITORING AT A NATIONAL SCALE**

WHAT IS THE QUALITY OF THE USED RESOURCE? (1991-2012)



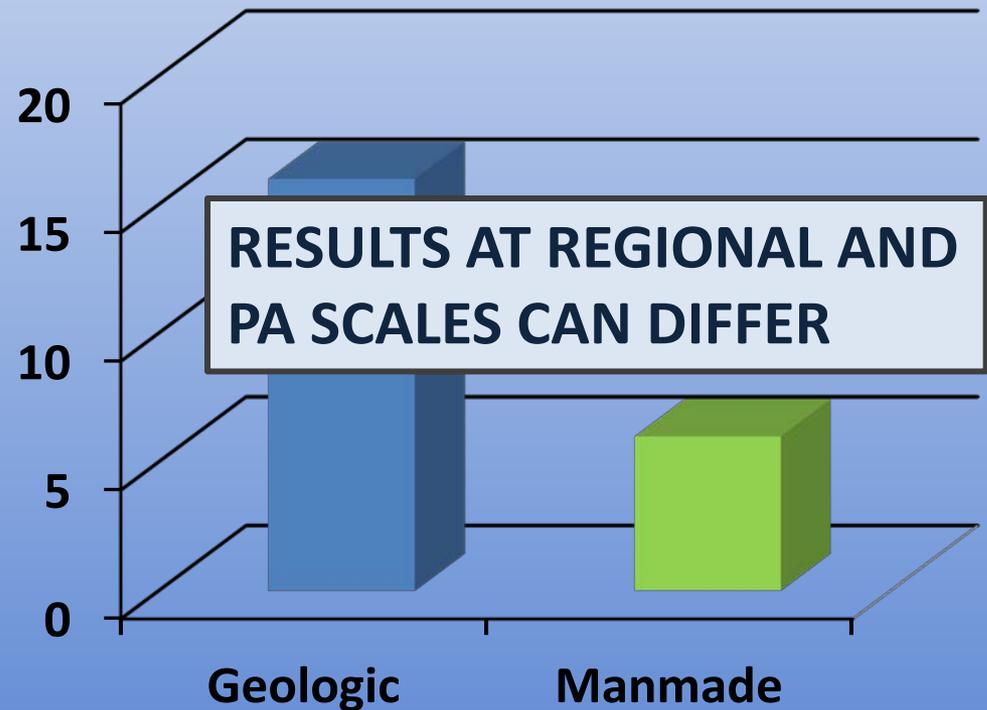
MAJOR AQUIFER NETWORKS

- regional aquifers used for drinking supply
- primarily domestic wells, 20 – 30 wells per network
- Intermediate depth groundwater
- ~ 50 to 150 feet deep

NATIONAL RESULTS FROM MAJOR AQUIFER STUDIES

- **Geologic source**
 - Manganese (7%)
 - Arsenic (7%)
 - Radon (4%)
- **Manmade source**
 - Nitrate (4%)
 - Pesticides (<1%)
 - Solvents (<1%)

Percentage of samples with concentrations above a human health benchmark



WHAT HAVE WE LEARNED ABOUT THE FACTORS AFFECTING GROUNDWATER QUALITY? (1991-2012)

LAND USE NETWORKS

- Shallow groundwater
- 20- 30 wells per network
- primarily monitoring wells
- ~ 20 to 50 feet deep



Well in an urban area



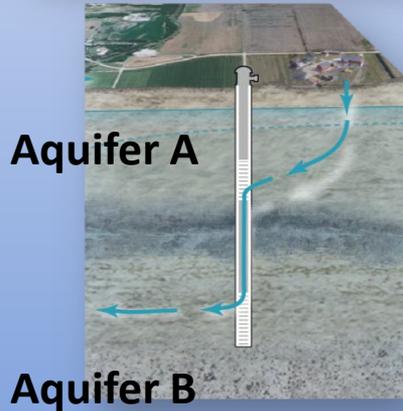
Well in an agricultural area



EXAMPLE: HUMAN FACTORS CAN AFFECT GROUNDWATER QUALITY



Irrigation in the western US has mobilized uranium in some aquifers



Wells screened across aquifers have also mobilized uranium in the High Plains



In the east, nitrate fertilizer and lime has mobilized radium in quartz sand aquifers

HUMAN ACTIVITY CAN ELEVATE THE CONCENTRATIONS OF NATURALLY OCCURRING CONTAMINANTS

WHAT ASPECTS OF NAWQA HAVE CHANGED? INCREASED SPATIAL AND DEPTH COVERAGE



**Shallow & intermediate
depth groundwater**
~ 20 to 150 feet
~ 2500 wells nationwide
~ 250 wells per year

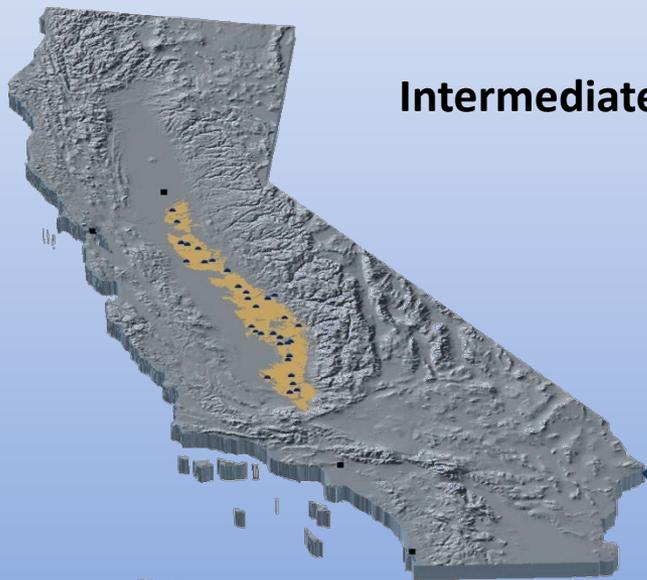


Deeper groundwater
~ 150 to 750 feet deep
~ 70% of drinking supply
~ 1500 wells nationwide
~ 1000 wells sampled to date

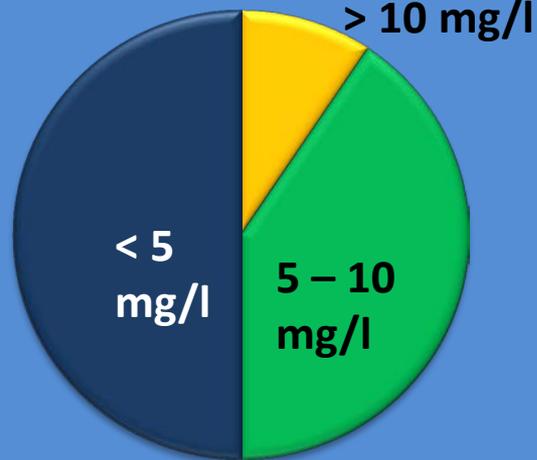
WHY CHARACTERIZE GROUNDWATER QUALITY IN THREE DIMENSIONS?

EXAMPLE: NITRATE IN THE SAN JOAQUIN VALLEY

Intermediate



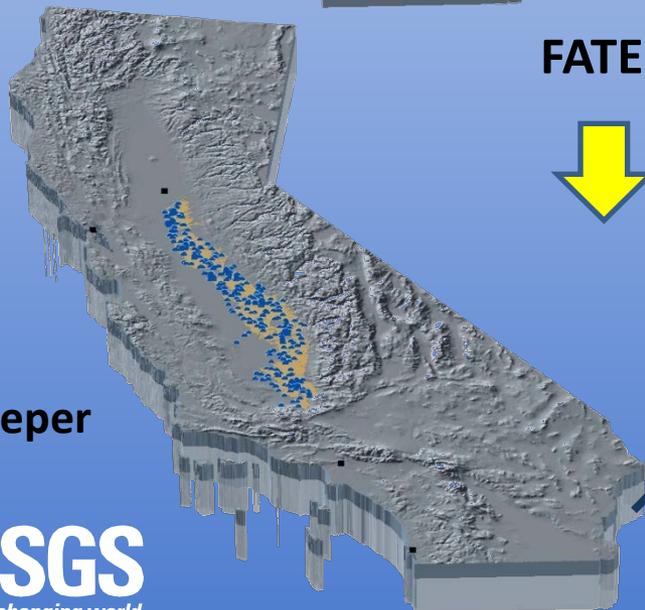
GROUNDWATER – DOMESTIC



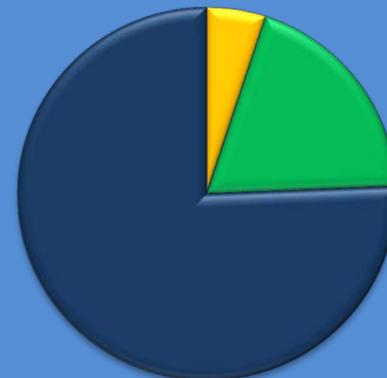
FATE?



Deeper



GROUNDWATER – PUBLIC SUPPLY



WHY DOES IT MATTER?



- **> 120,000 PUBLIC SUPPLY WELLS SERVING ~ 100 MILLION PEOPLE**
- **Most of these wells are regularly sampled for regulated constituents**
- **NAWQA samples for additional constituents that allow for understanding and forecasting**

HOW DOES GROUNDWATER QUALITY CHANGE WITH TIME?



**NAWQA NOW HAS >25 YEARS OF DATA AND IS POISED
TO EVALUATE THE DRIVERS AND PROCESSES**

DECADAL RESAMPLING TO ASSESS TRENDS

DISSOLVED SOLIDS



EXPLANATION

Change in dissolved solids concentration, median of changes in study network, in milligrams per liter

Increase Decrease

↑ ↓ < 10

↑↑ ↓↓ 10 to 50

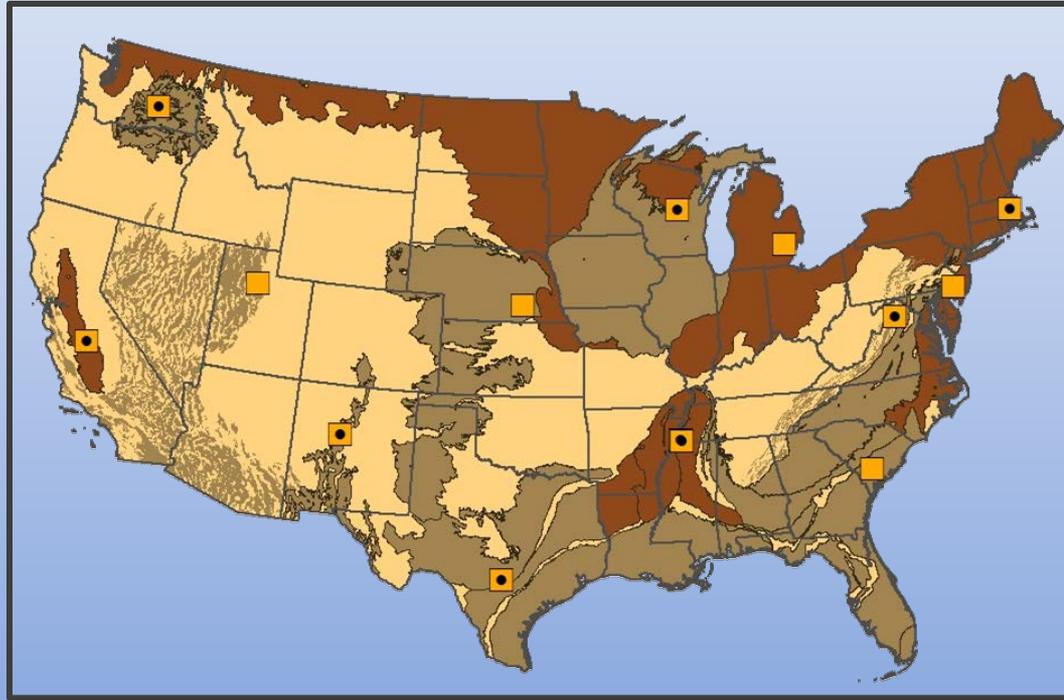
↑↑↑ ↓↓↓ > 50

• No significant change

○ ↑ Median concentration in second sampling event is greater than 500 milligrams per liter

BETA-TESTING OF WEB SITE
WE WOULD LIKE YOUR HELP

OVER WHAT TIME SCALES DOES GROUNDWATER QUALITY CHANGE?



EVALUATE LONG TERM FACTORS (> DECADES)



EVALUATE SHORT TERM AND LONG TERM FACTORS (SEASONAL AND YEARLY)



PRINCIPAL AQUIFER SURVEY



PRINCIPAL AQUIFER, MODELING

WHAT WILL WE ACCOMPLISH?

- **Assess water quality at the depth zones used for public supply and domestic supply**

MAPS AT REGIONAL AND NATIONAL SCALES

- **Evaluate loading of contaminants by groundwater to streams**

MODELS AND MAPS AT REGIONAL AND LOCAL SCALES

- **Assess and forecast changes in groundwater quality**

MAPS AND DECISION SUPPORT TOOLS

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MONITORING FOR ASSESSMENT & UNDERSTANDING

QUESTIONS?

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