



USGS Nebraska Water Science Center Activities

April 13, 2017

Robert B. Swanson

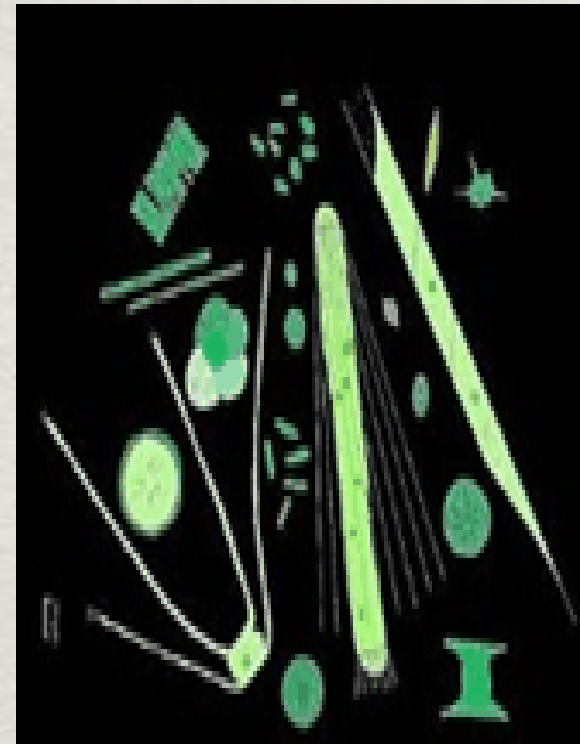
Director, USGS Nebraska Water Science Center



Harmful Algal Blooms

What are toxic algae?

- A type of cyanobacteria that produce toxins
 - They also produce a pigment called *phycocyanin*
- Toxic algae ~ Cyanobacteria ~ Blue-Green Algae
 - The *Microcystis* strain is most common in Willow Creek
 - When levels exceed 20 ppb, the lake gets put on alert



Relating Cyanobacteria to Potential Causes in Willow Creek Reservoir, Nebraska, 2012-14

NDEQ Update
February 22, 2016
Dave Rus and Brent Hall, USGS
Nebraska Water Science Center;
Steve Thomas, UNL

Why do they bloom?

- In general, nutrient enrichment (known as *eutrophication*) leads to algal blooms
- Cyanobacteria can outcompete other algae under certain conditions
 - Hot water
 - Murky water
 - Nitrogen-limited
- There's no smoking gun



National Water-quality Assessment

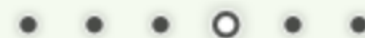
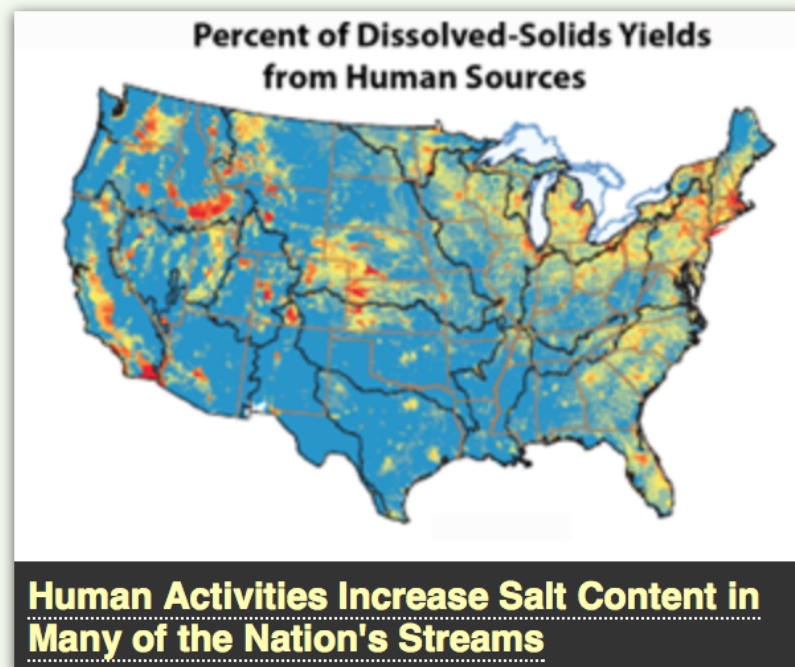


National Water-Quality Assessment (NAWQA) Program

[Home](#) [Headlines](#) [Featured Studies](#) [Liaison Committee](#) [Informing Decision Makers](#) [Data](#) [Modeling/Software](#) [Publications](#) [Maps](#)

National Maps

[view all maps](#)



Featured Studies

[view all studies](#)

- ▶ **National-Synthesis Assessments**
 - Pesticides
 - Volatile Organic Compounds (VOCs)

The [National Water-Quality Assessment Program \(NAWQA\)](#) provides an understanding of water-quality conditions; whether conditions are getting better or worse over time; and how natural features and human activities affect those conditions. Regional and national assessments are possible because of a consistent study design and uniform methods of data collection and analysis. Monitoring data are integrated with geographic information on hydrological characteristics, land use, and other landscape features in models to extend water-quality understanding to unmonitored areas. Local, State, Tribal, and national [stakeholders use NAWQA information](#) to design and implement strategies for managing, protecting, and monitoring water resources in many different hydrologic and land-use settings across the Nation.

Featured Headlines, Activities, and Publications

[view all headlines](#)

- ★ **Potential Corrosivity of Untreated Groundwater in the U.S.** (July 2016)
- ★ **Benefits of Ag Conservation in Upper Mississippi River Basin** (June 2016)
- ★ **Pharmaceuticals Commonly Detected in Small Southeastern Streams** (June 2016)
- ★ **Online Mapper Provides a Decadal Look at Groundwater Quality** (June 2016)
[Press Release](#) | [Online Mapper](#)
- ★ **Algal Toxins Detected in One-Third of Streams Assessed in Southeastern U.S.**
(March 2016)
- ★ **U.S. Rivers Show Few Signs of Improvement from Historic Nitrate Increases**
(October 2015)
[Press Release](#) | [Article](#)
- ★ **Predicting Pesticides in Streams and Rivers: Where is Water-Quality at Risk?**

Omaha Green Infrastructure

- MUNICIPALITIES NEED RESILIENT SOLUTIONS TO STORM RUNOFF
- GREEN INFRASTRUCTURE MITIGATES BOTH THE AMOUNT AND QUALITY OF RUNOFF



Monitoring the Missouri River for effects of the Combined Sewer Overflow System

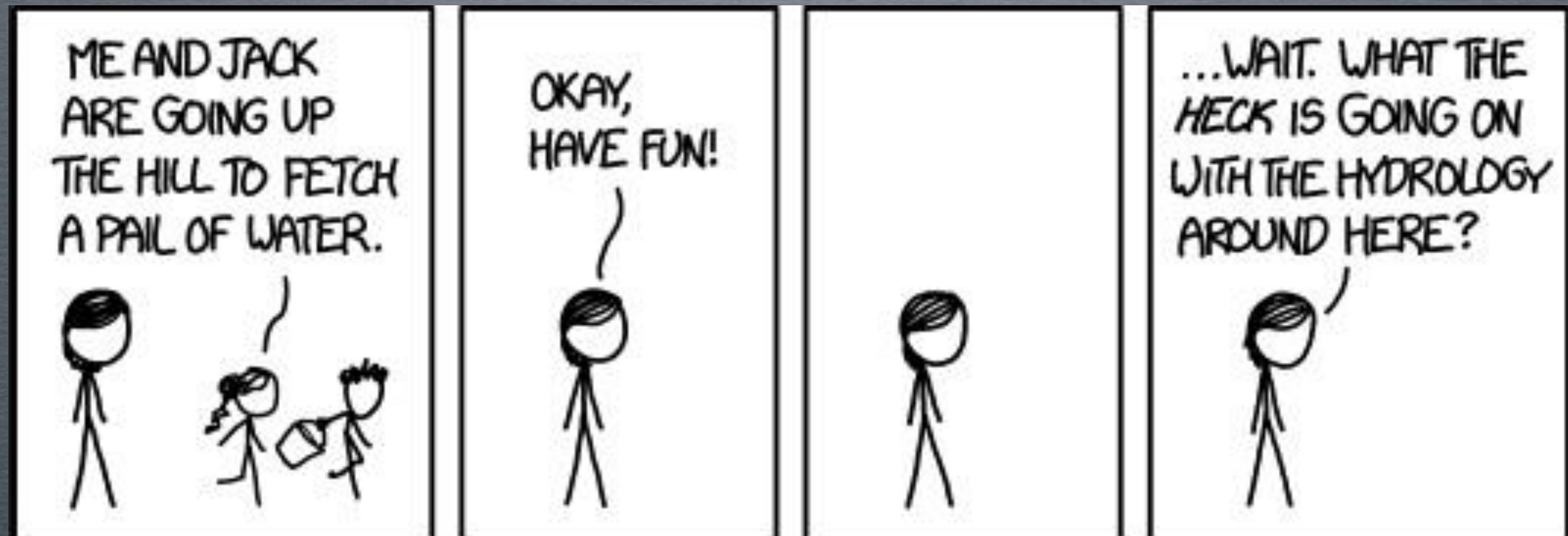
Sites



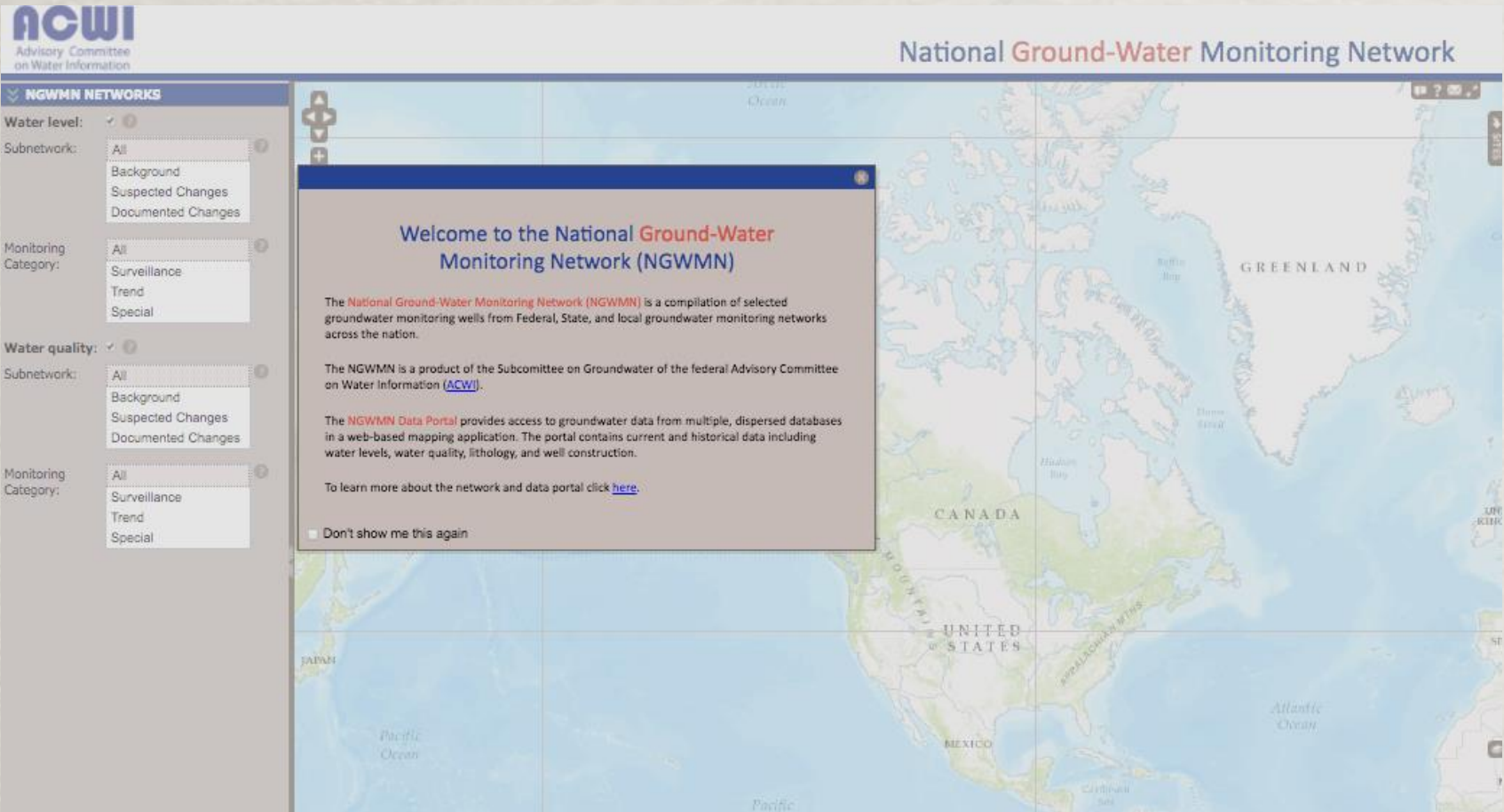
- HOW EFFECTIVE IS CSO/MISSOURI MIXING?
- MONITORING
 - CONTINUOUS REAL-TIME WATER QUALITY
 - REGULAR FIXED SAMPLES
 - STORM RUNOFF SAMPLES



The Groundwater State



National Ground-water Monitoring Network



[HTTP://CIDA.USGS.GOV/NGWMN/](http://cida.usgs.gov/ngwmn/)

Water-use Data and Research Program



Water-Use Data and Research Program

Water managers across the United States require more complete, timely, and accurate water-availability information to support policy and decision-making, specifically, data associated with water withdrawals and consumptive use. Recognizing the limitations of current water-use data, the SECURE Water Act authorized a program that supports activities related to data collection and methods research and development at the State level. The USGS Water-Use Data and Research program (WUDR) will provide financial assistance through cooperative agreements with State water resource agencies to improve the availability, quality, compatibility, and delivery of water-use data that is collected or estimated by States. The Act requires that these State water use and availability datasets be integrated with appropriate datasets that are developed and/or maintained by the USGS.

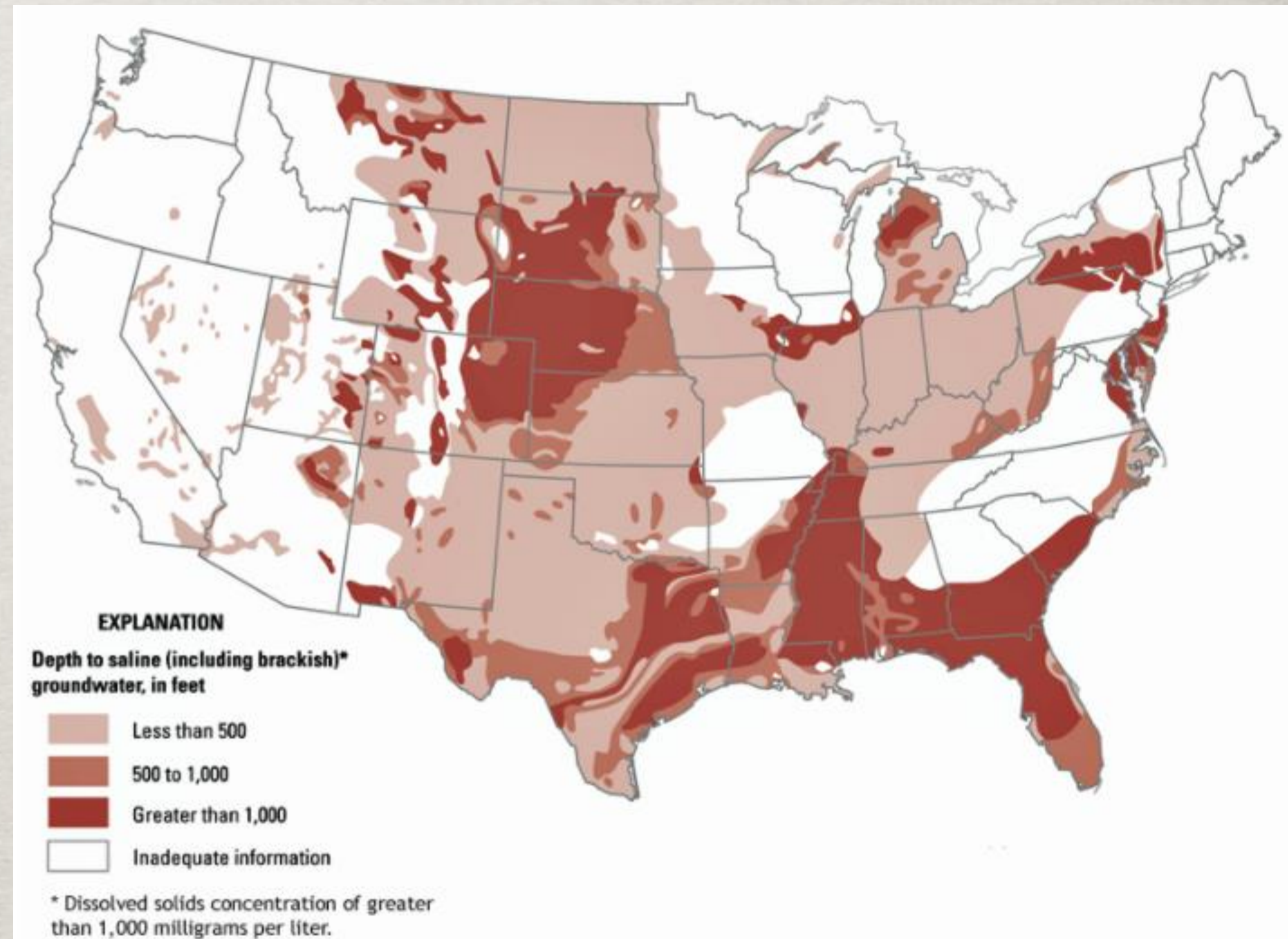
Federal fiscal year 2015 (FY2015), was the first year that funding was appropriated for this program. In FY15 funding was distributed to State Water-Resource Agencies non-competitively, in the amount of \$26,000 per state. The funding was provided to allow each State to evaluate their current water-use data in relation to USGS baseline standards for each category of water user and to develop a workplan to improve it. In FY2016 and subsequent years, funding will be distributed under a competitive proposal process.



[HTTPS://WATER.USGS.GOV/WAUSP/WUDR/](https://water.usgs.gov/wausp/wudr/)

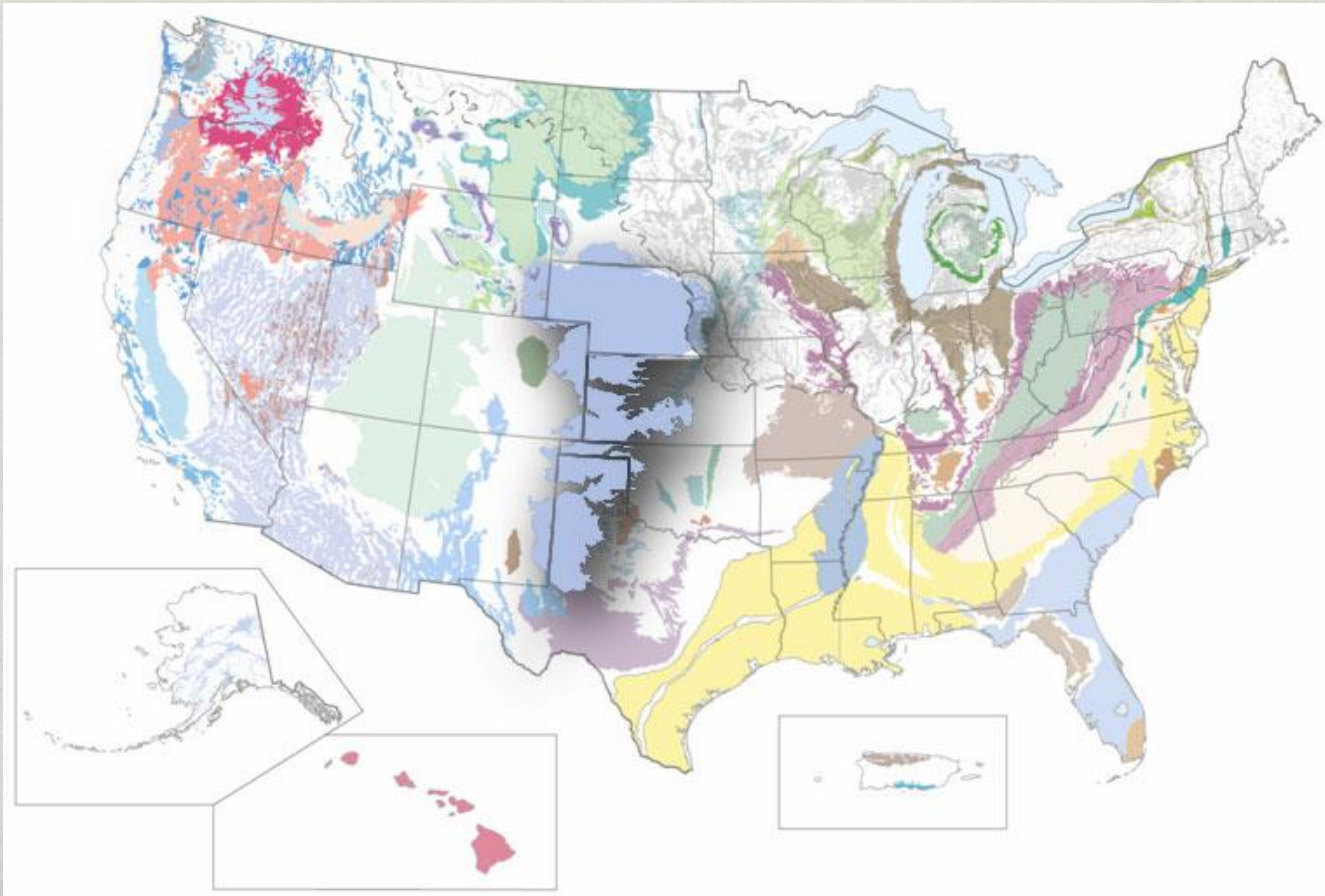
National Brackish Groundwater Assessment

- ✱ NEBRASKA LED
- ✱ POTABLE GW DECLINING IN THE US
- ✱ BRACKISH GW COULD SUPPLEMENT OR REPLACE FRESHWATER SOURCES

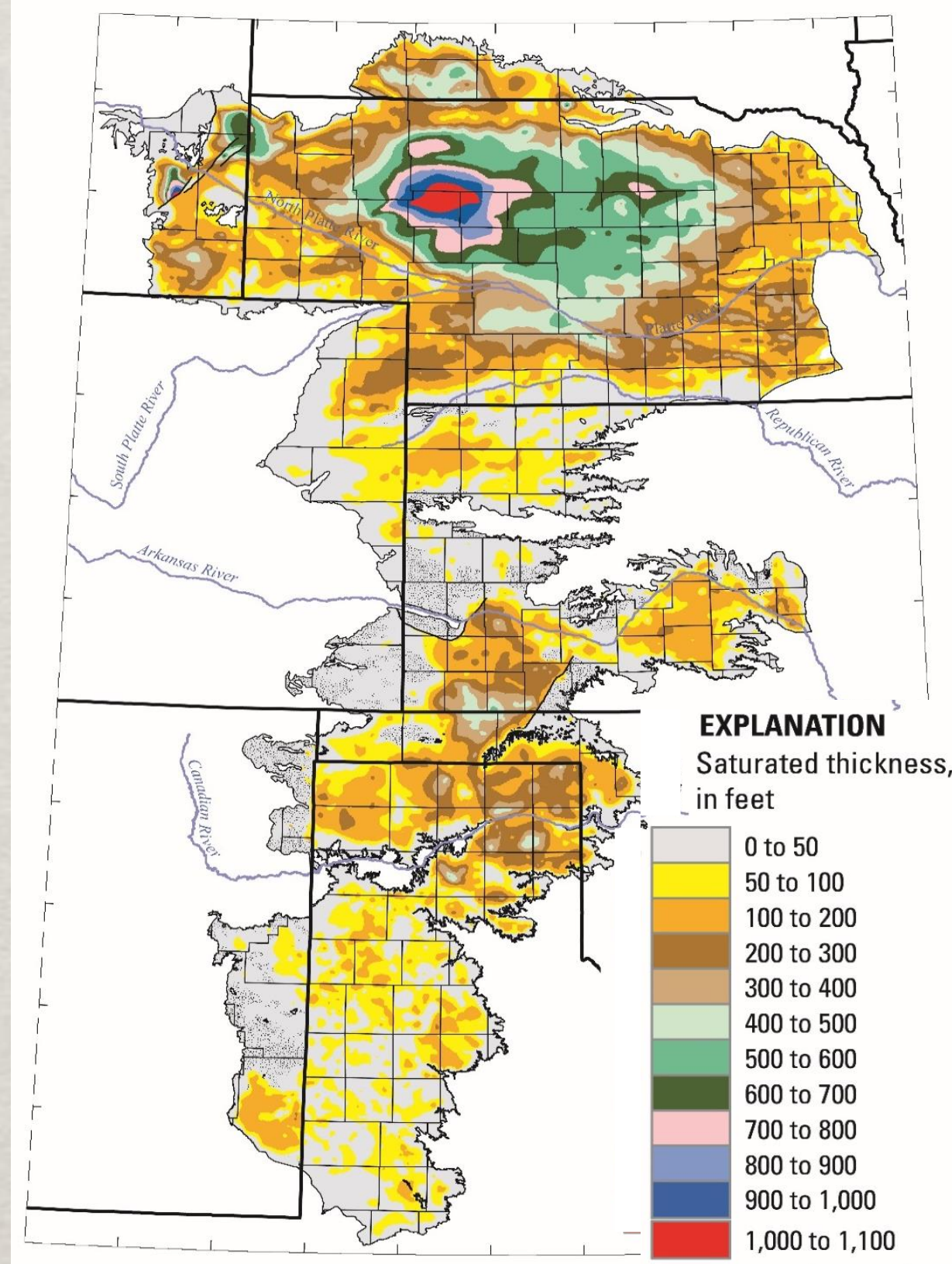


[HTTP://WATER.USGS.GOV/OGW/GWRP/BRACKISHGW/](http://water.usgs.gov/ogw/gwrp/brackishgw/)

High Plains Aquifer



High Plains Aquifer Water-level Change

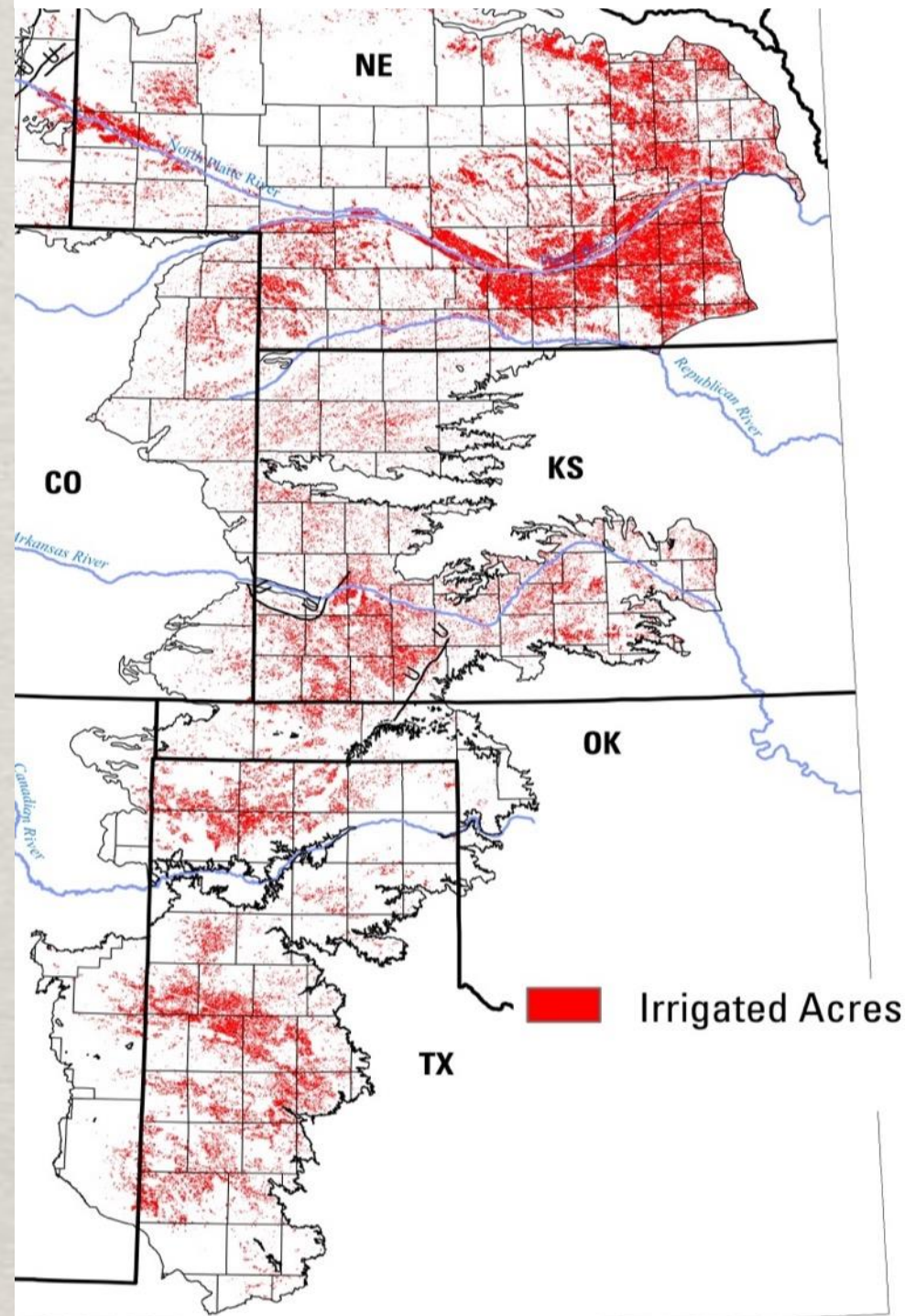


- THE HIGH PLAINS AQUIFER UNDERLIES 175,000 SQUARE MILES IN PARTS OF EIGHT STATES
- THE HIGH PLAINS AQUIFER IS ONE OF THE MOST INTENSELY USED AQUIFERS IN THE NATION
- 1986—CONGRESS DIRECTED USGS TO MONITOR LEVEL CHANGE

McGuire, Lund, and Densmore, 2012

High Plains Aquifer Water-level Change

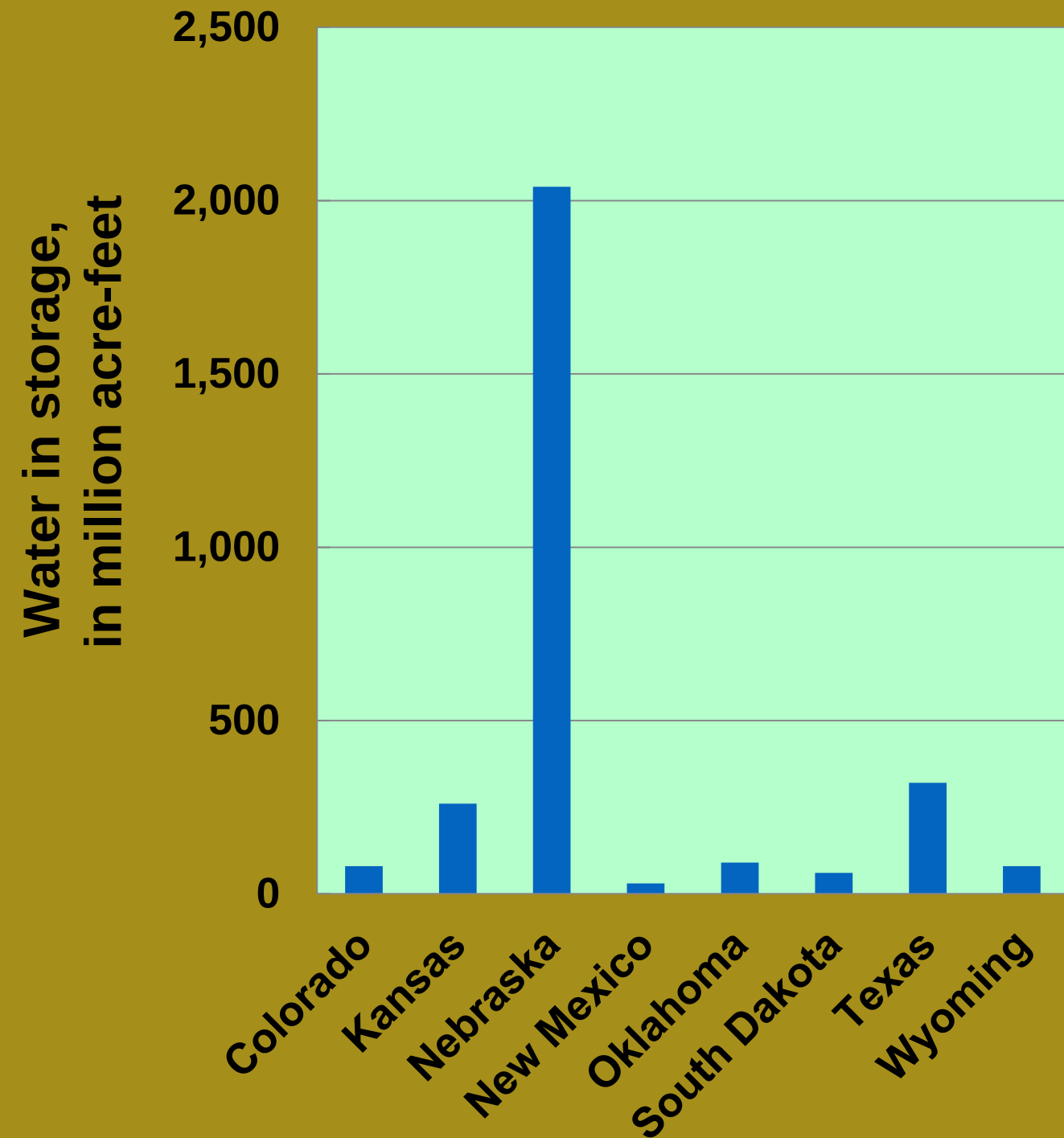
High Plains Aquifer: Irrigated Acres, 2012



USGS, 2015

- ABOUT 97 PERCENT OF WITHDRAWALS FROM THE HIGH PLAINS AQUIFER ARE FOR IRRIGATION.
- NEBRASKA, TEXAS, AND KANSAS USE ABOUT 88 PERCENT OF THE TOTAL WITHDRAWALS.

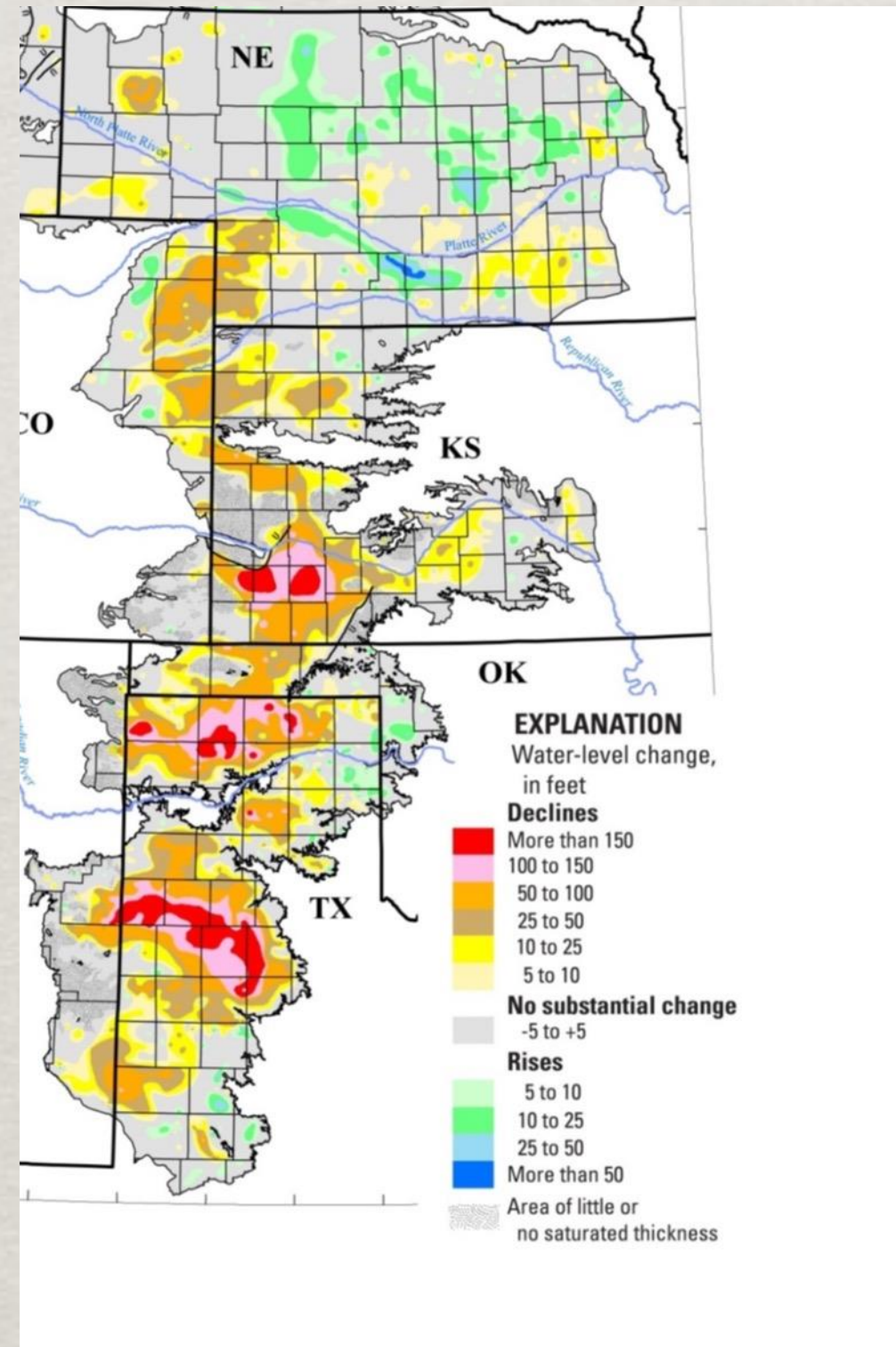
Water-in-storage, High Plains aquifer, 2009



Nebraska's water in storage
exceeds all the other states
combined

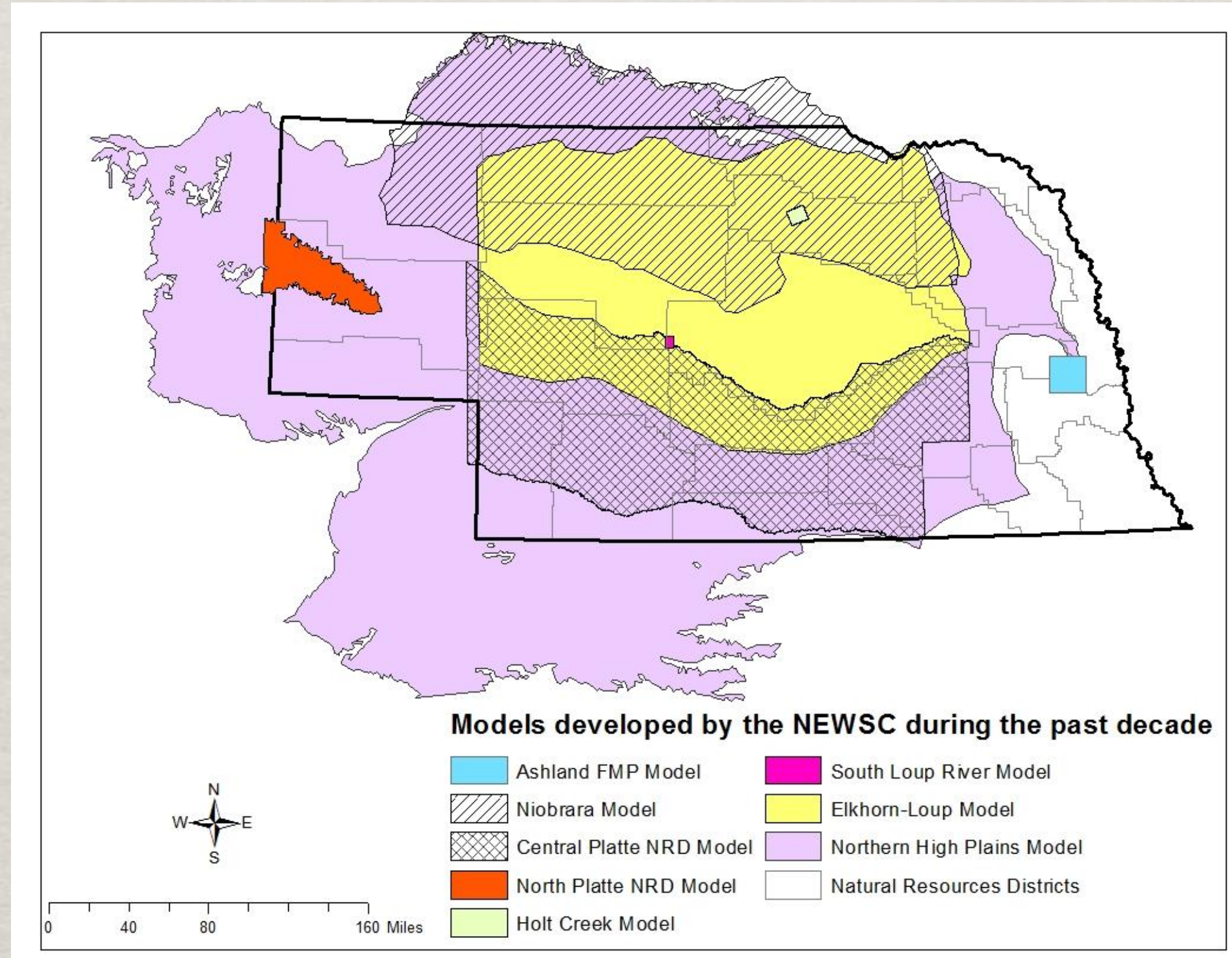
Long-term water-level changes

State	Change in water in storage, in million acre-feet
	Predevelopment to 2013
CO	-18.8
KS	-67.5
NE	-2.0
NM	-9.7
OK	-10.5
SD	0.4
TX	-158.2
WY	-0.4
HP Aquifer	-266.7

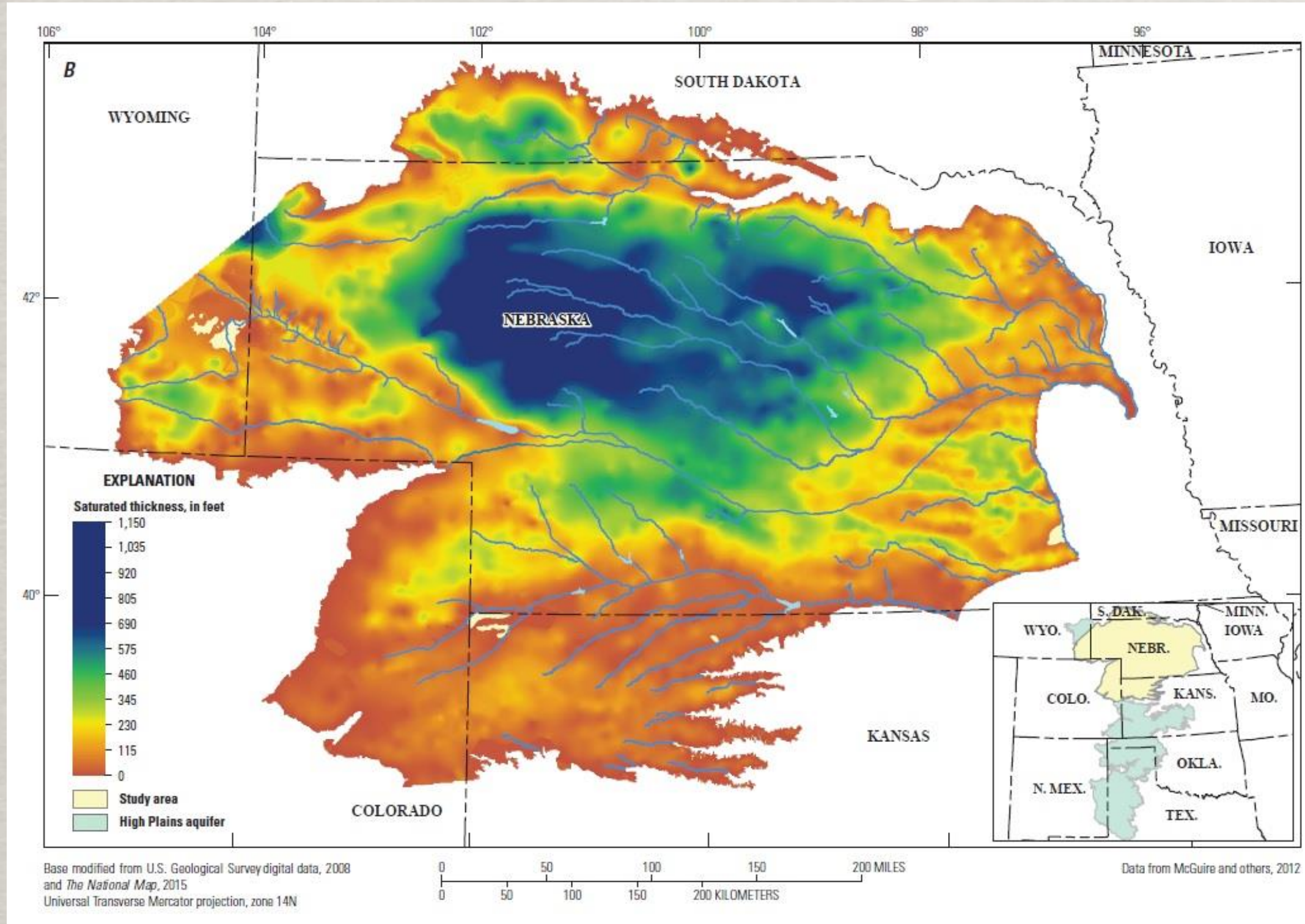


- MONITORING PROVIDES INFORMATION ABOUT THE CURRENT CONDITION OF THE AQUIFER.
- AQUIFER CONDITION VARIES DEPENDING WITH...
 - SATURATED THICKNESS
 - DEPTH TO WATER
 - WITHDRAWAL MAGNITUDE
 - RECHARGE
 - PERMEABILITY
 - ...OTHER FACTORS

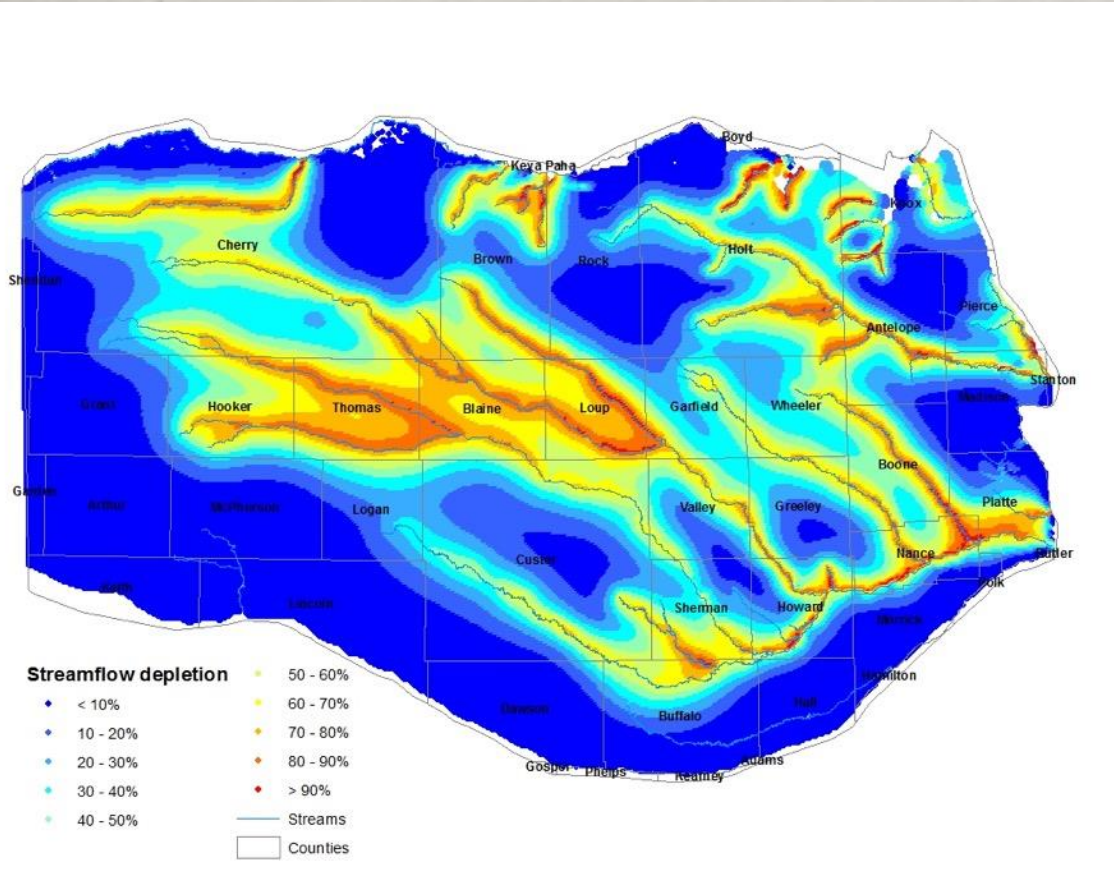
USGS Nebraska Water Science Center Groundwater Modeling Capabilities



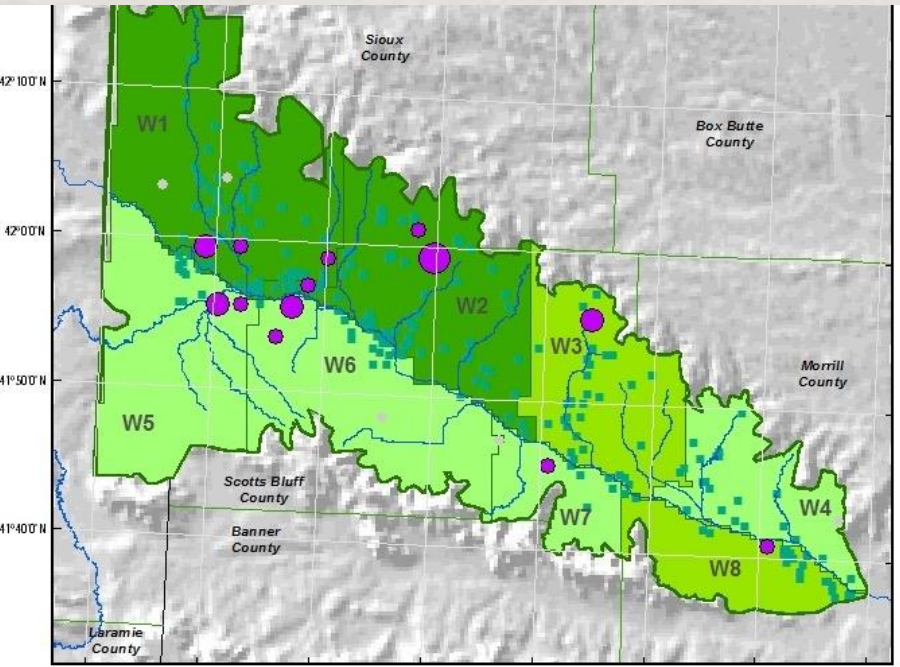
Northern High Plains Model



- ✿ HIGH PLAINS GROUNDWATER AVAILABILITY AND SUSTAINABILITY STUDY
- ✿ DEVELOPED TO...
 - ✿ QUANTIFY AVAILABLE WATER
 - ✿ CREATE A TOOL TO FORECAST AQUIFER RESPONSES IN THE FUTURE TO HUMAN AND ENVIRONMENTAL STRESSES



Elkhorn-Loup Model



Base from U.S. Geological Survey digital data, 1:633,000
 Lambert Conform Conic projection
 Standard parallel 41° 30' N and 42° 20' N
 Central meridian 103° 04' W
 Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83)

Explanation

Intentional recharge sites

dry_cfs

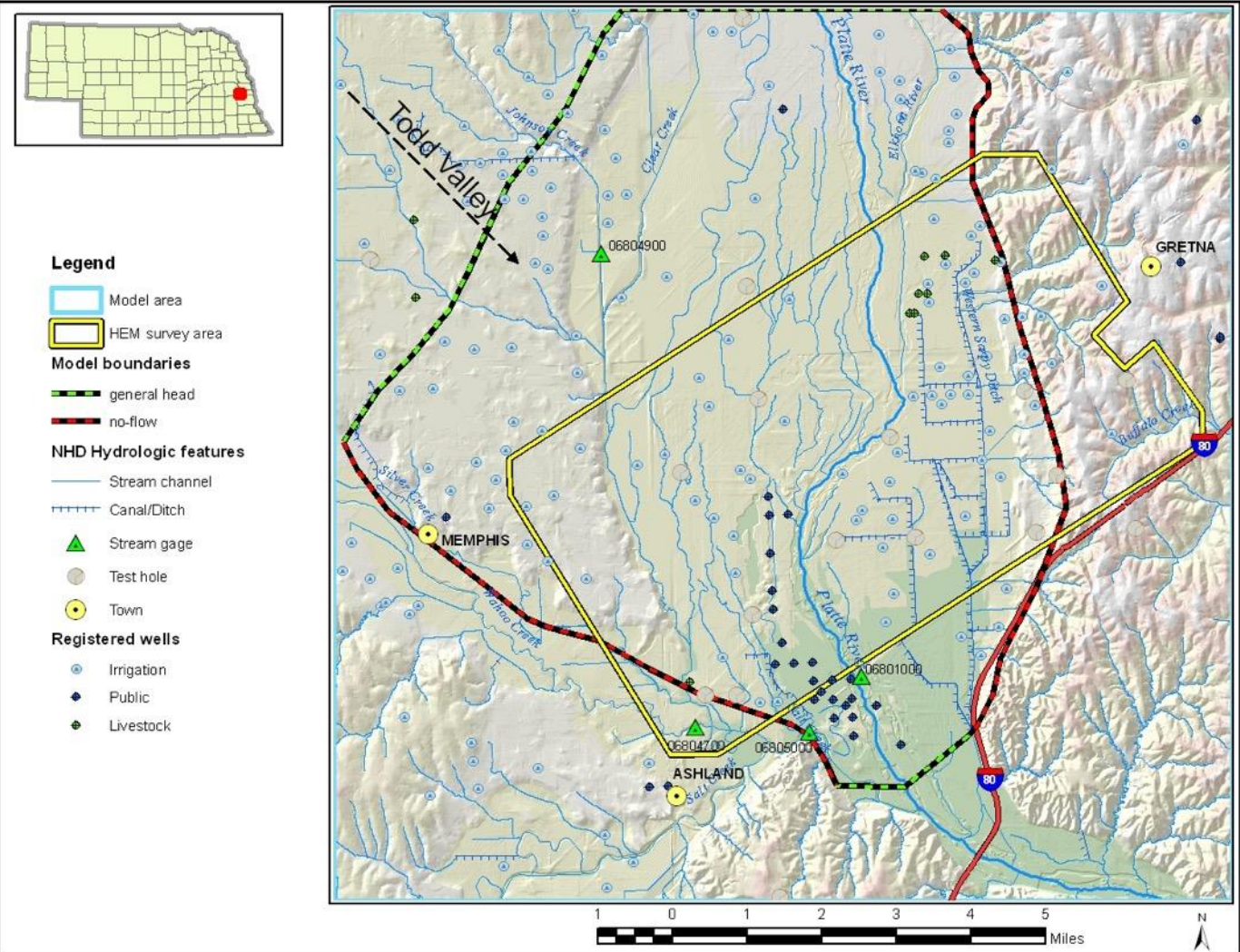
- Not used
- 2 - 5
- 5 - 8
- Greater than 8

Well management zones

Pumping rate reduction, in cubic feet per second

- W3 1 - 2
- W4 3 - 4
- Equal to or greater than 5

Analysis wells

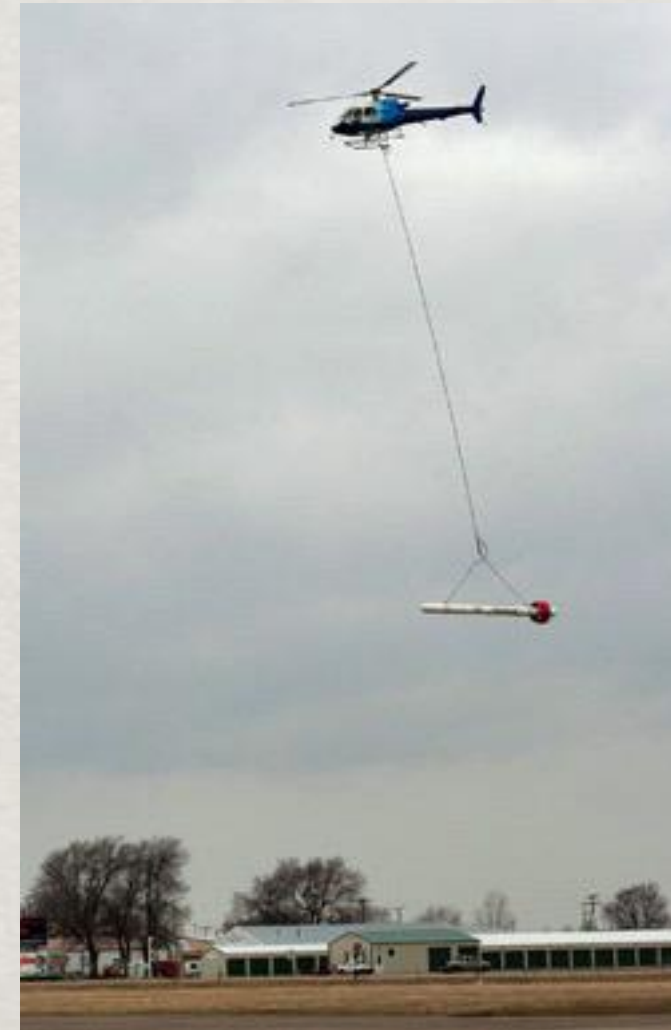


Ashland Model

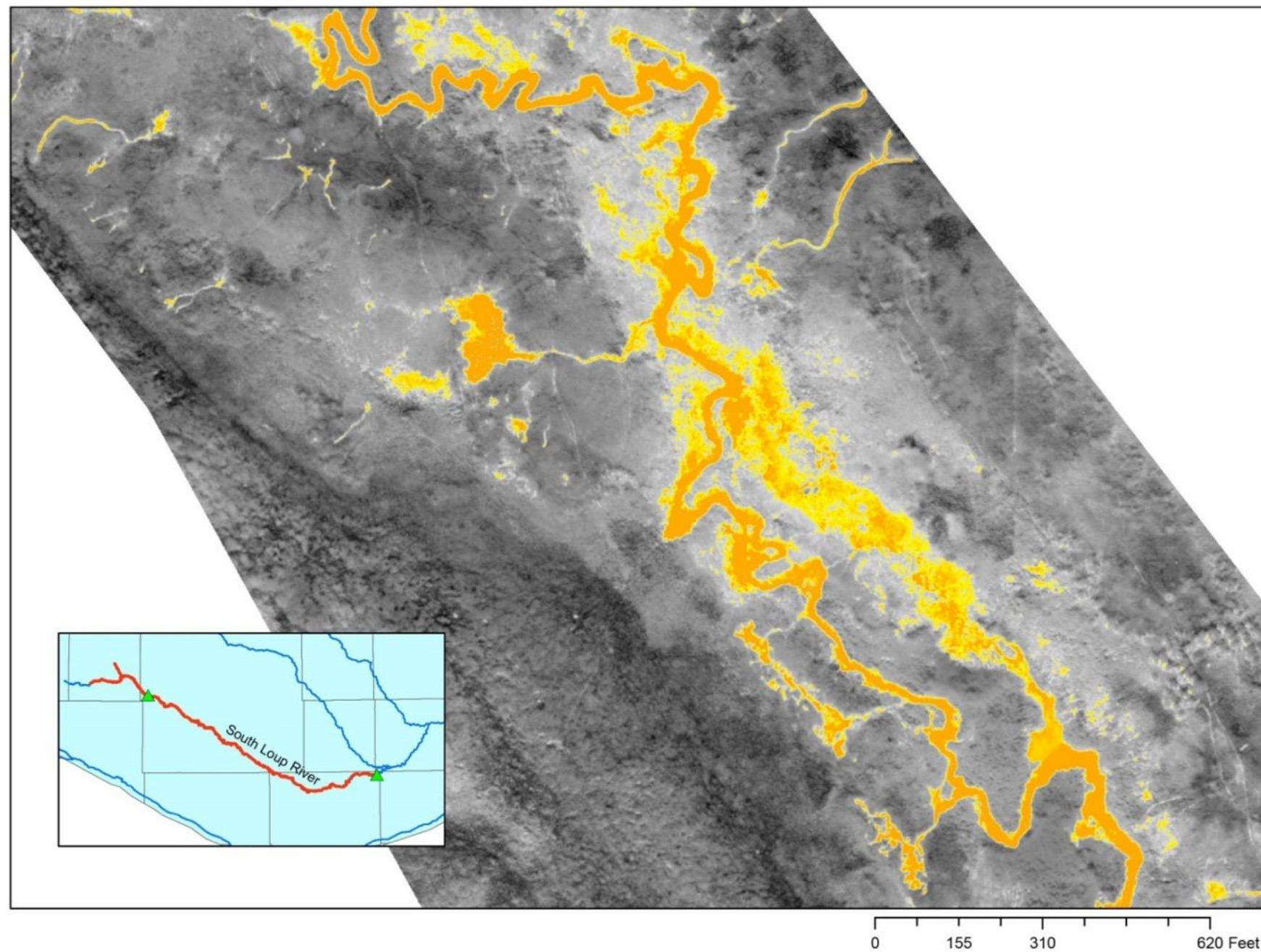
North Platte Optimization Model

Hydrogeologic Framework Support

- ✿ TEST HOLES
- ✿ GEOPHYSICAL STUDIES
 - ✿ 2-D RESISTIVITY
 - ✿ MARINE RESISTIVITY
 - ✿ MICROGRAVITY
- ✿ LIDAR
- ✿ AERIAL THERMAL INFRARED
- ✿ GROUNDWATER/SURFACE WATER INTERACTION



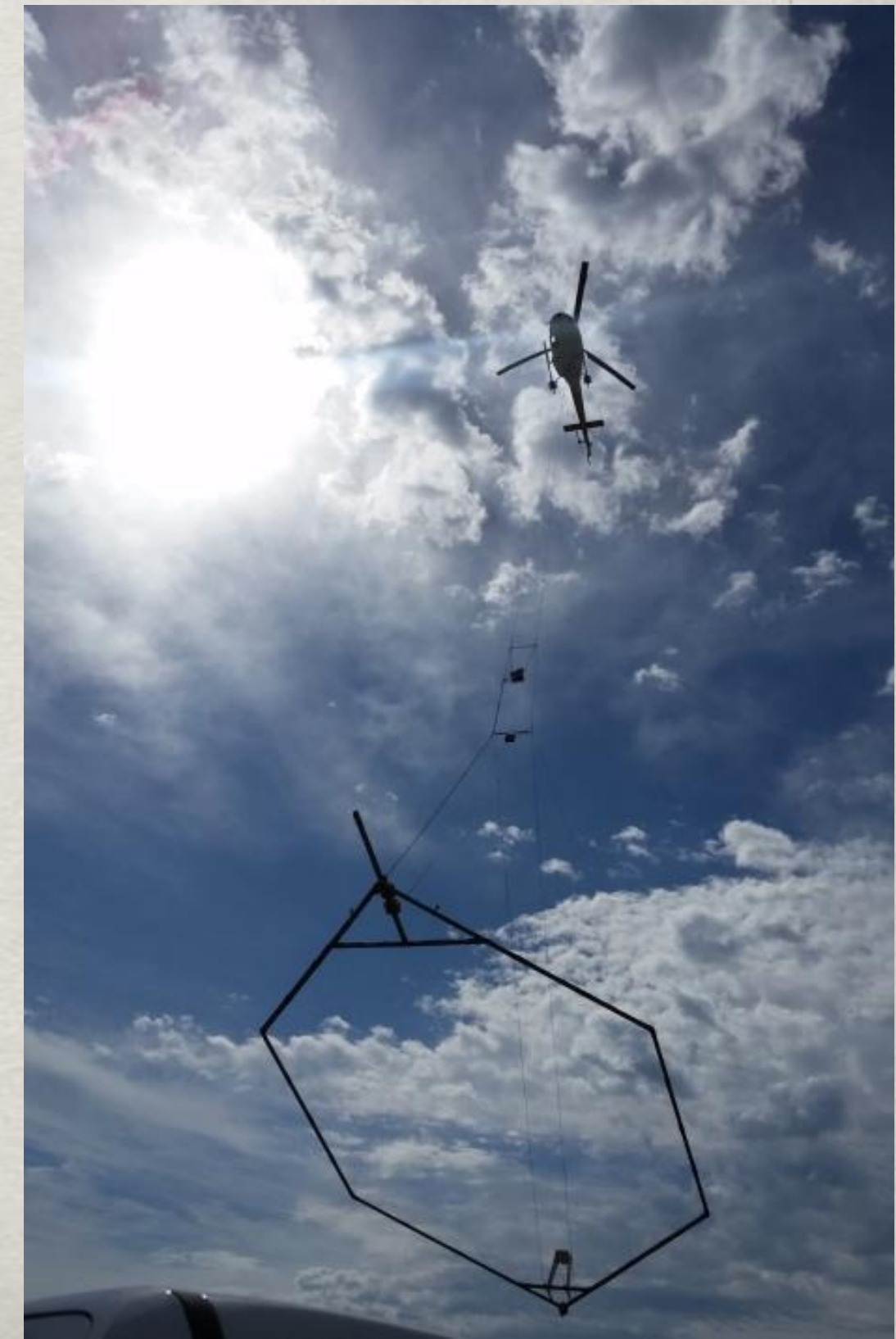
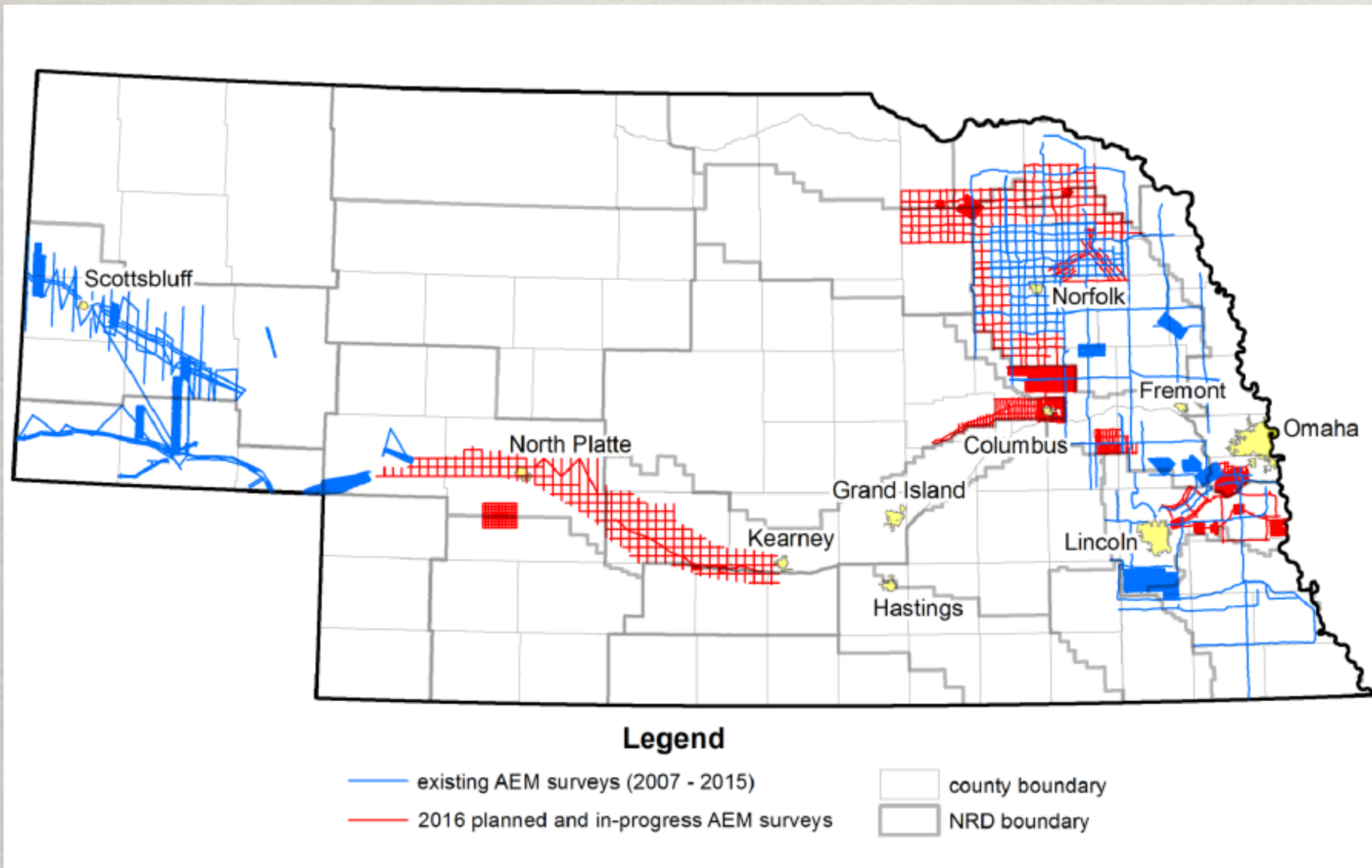
Aerial thermal infrared mapping



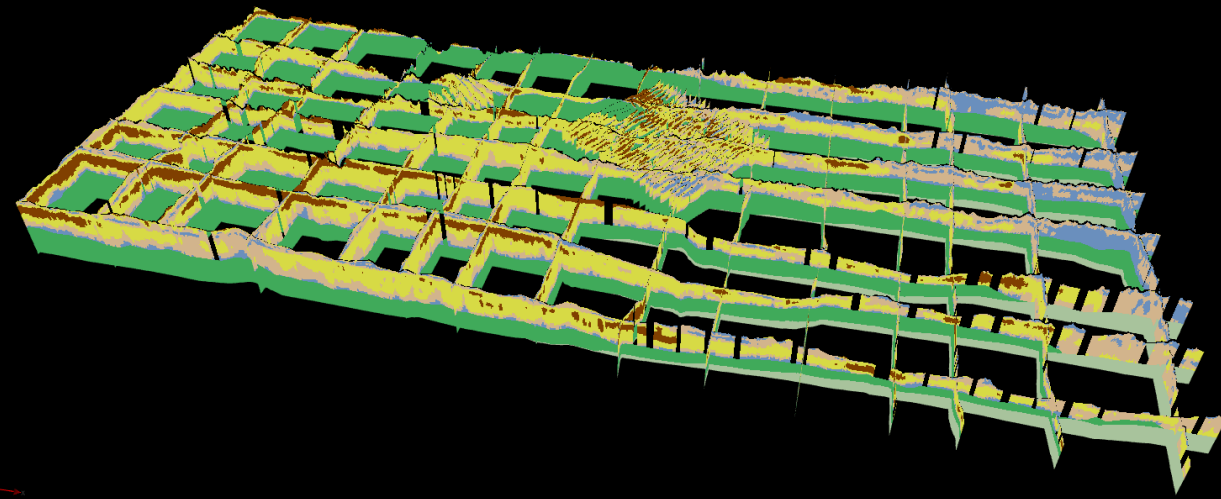
- ✿ IDENTIFY LOCATIONS OF FOCUSED GROUNDWATER DISCHARGE
- ✿ ASSESS SPATIAL PATTERNS FOR ENTIRE STREAM SYSTEMS (SUPPLEMENT SEEPAGE RUNS)
- ✿ RAPID DATA COLLECTION, EXTREMELY COST-EFFECTIVE



Airborne Electromagnetic (AEM) Surveys



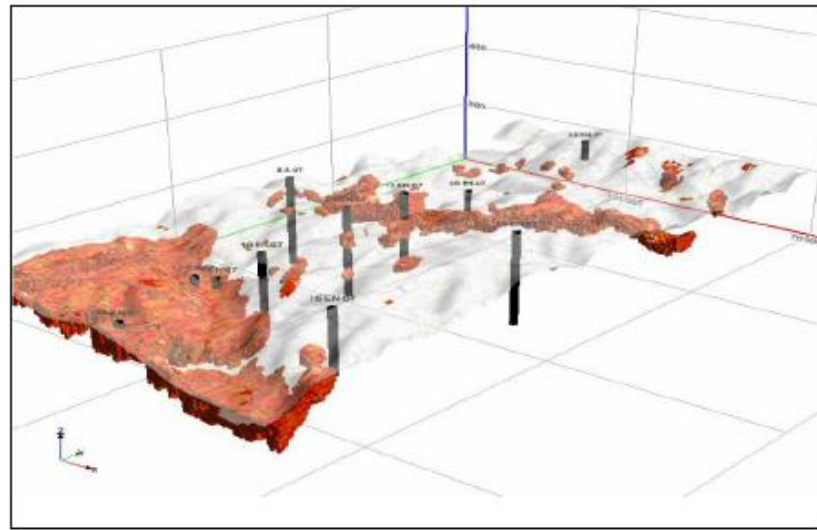
Nebraska GeoCloud: Airborne Electromagnetic Data Integration



- 10 NRD SPONSORS, USGS, CSD
- INVENTORY AND ASSEMBLE ALL AEM AND SUPPORTING DATA (TEST HOLE LOGS, MAPS, REPORTS, ETC.), MAKE AVAILABLE IN A CLOUD-BASED ONLINE PLATFORM
- COMPLETE A PAIR OF HYDROGEOLOGIC STUDIES TO RECOMMEND BEST USES OF AEM FOR GROUNDWATER MANAGEMENT

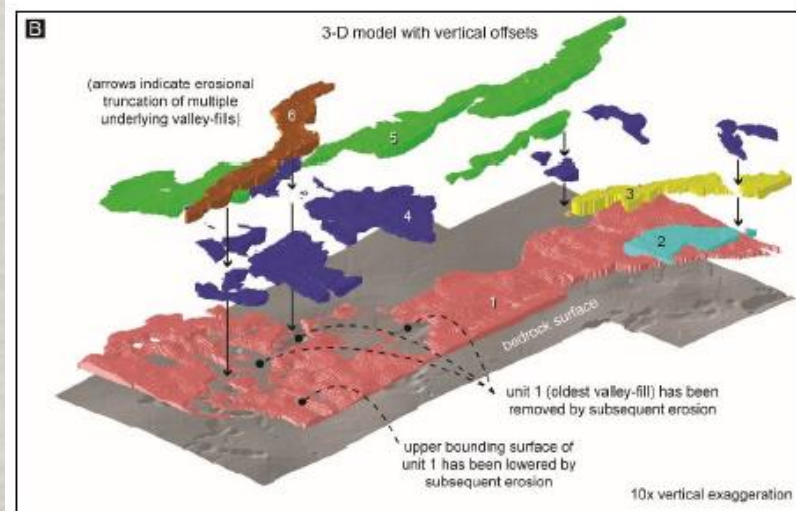


Assemble and Distribute Once



Initial interpretation

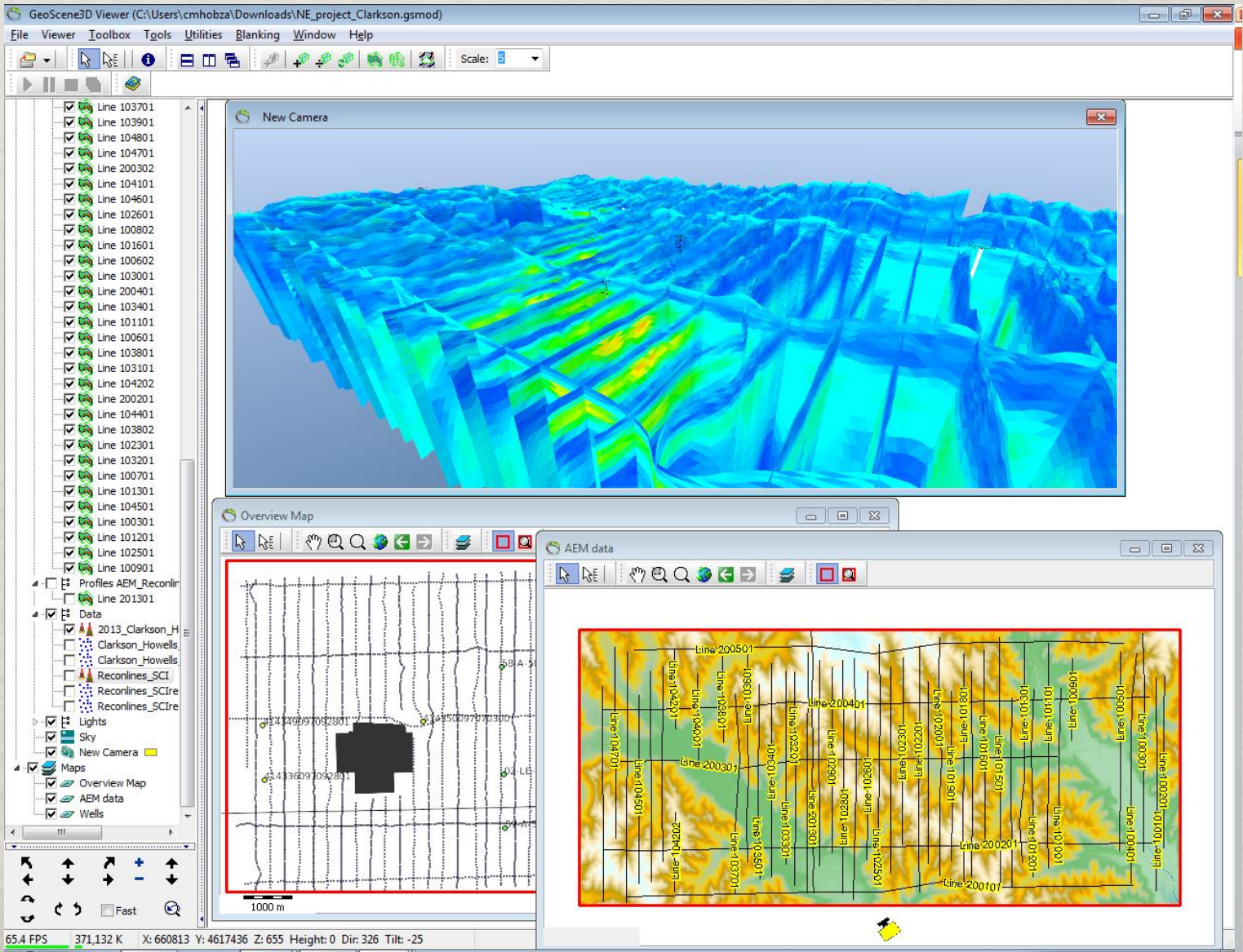
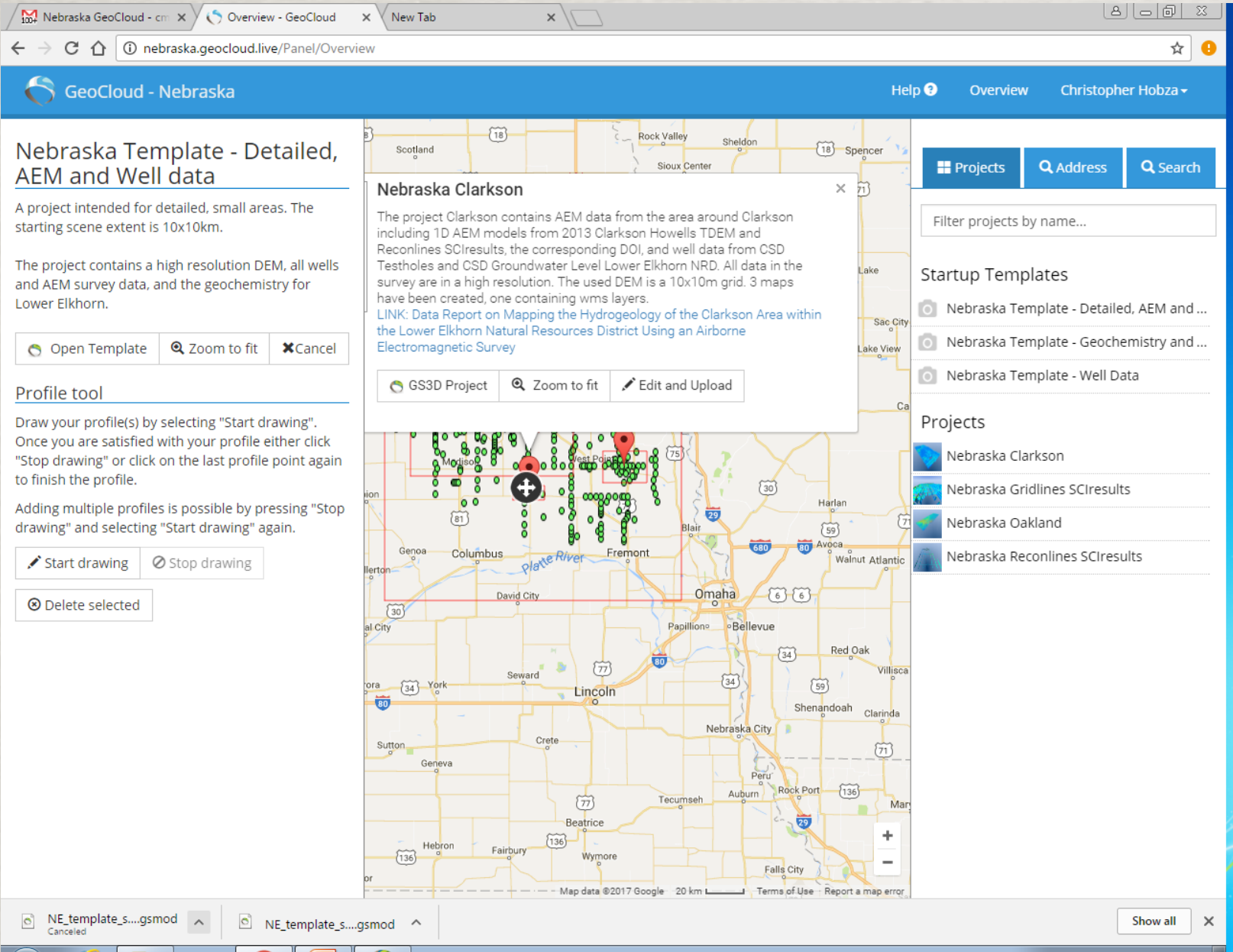
From Smith and others, 2011



Detailed hydrogeological model for geological survey research



GeoScene3D Viewer



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