

# Upper Niobrara Basin Integrated Modeling Update

*Niobrara Compact Meeting  
October 8, 2013 – Conference Call*

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Integrated Water Management Division  
Nebraska Department of Natural Resources



# Overview

- Project Purpose & Goals
- Modeling Approach
- Project Status
- Results & Application

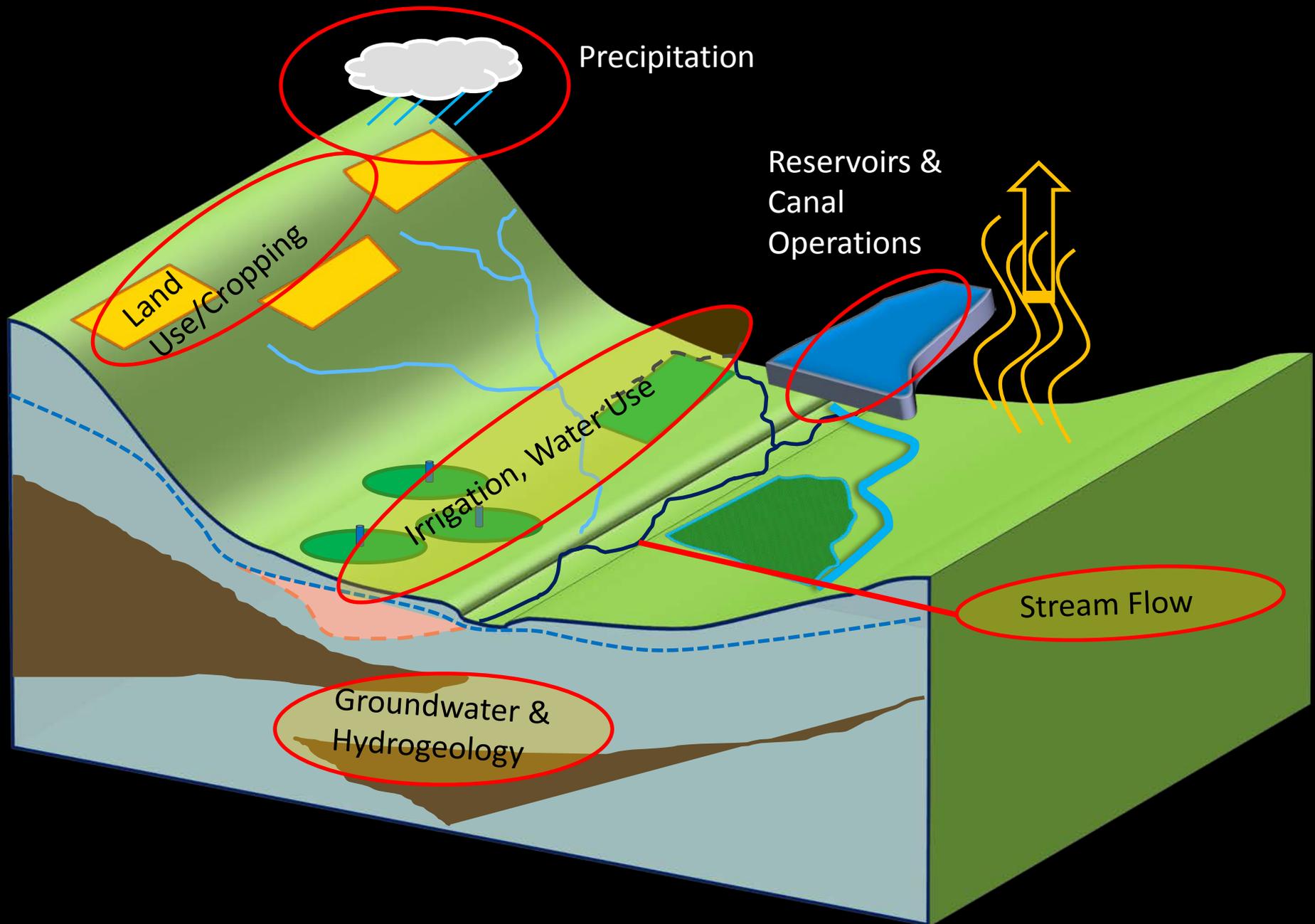
# Purpose

- A tool to inform management of groundwater and surface water
  - Needs to:
    - Establish base for forward-looking analysis
    - Be capable of evaluating conjunctive management scenarios
  - Requires such things as:
    - Quantifying uses, demands, supplies
    - Quantify and assess impacts to Niobrara River, groundwater from historic development

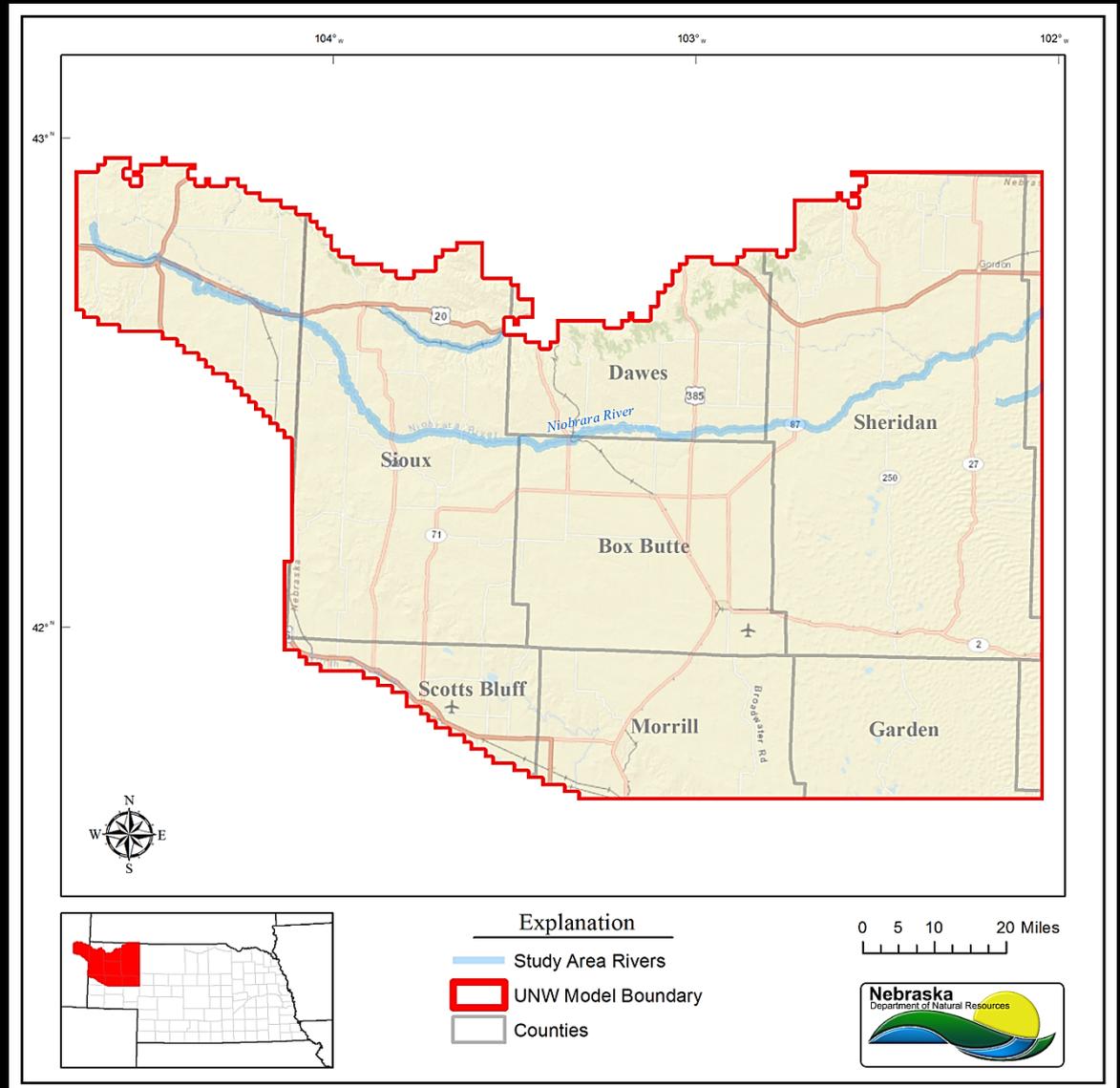
# Additional Purposes

- Satisfy US Bureau of Reclamation WaterSMART grant
  - Modeling for upper Niobrara basin a part of basin-wide efforts
  - Tools to assess regional, basin water supply and management

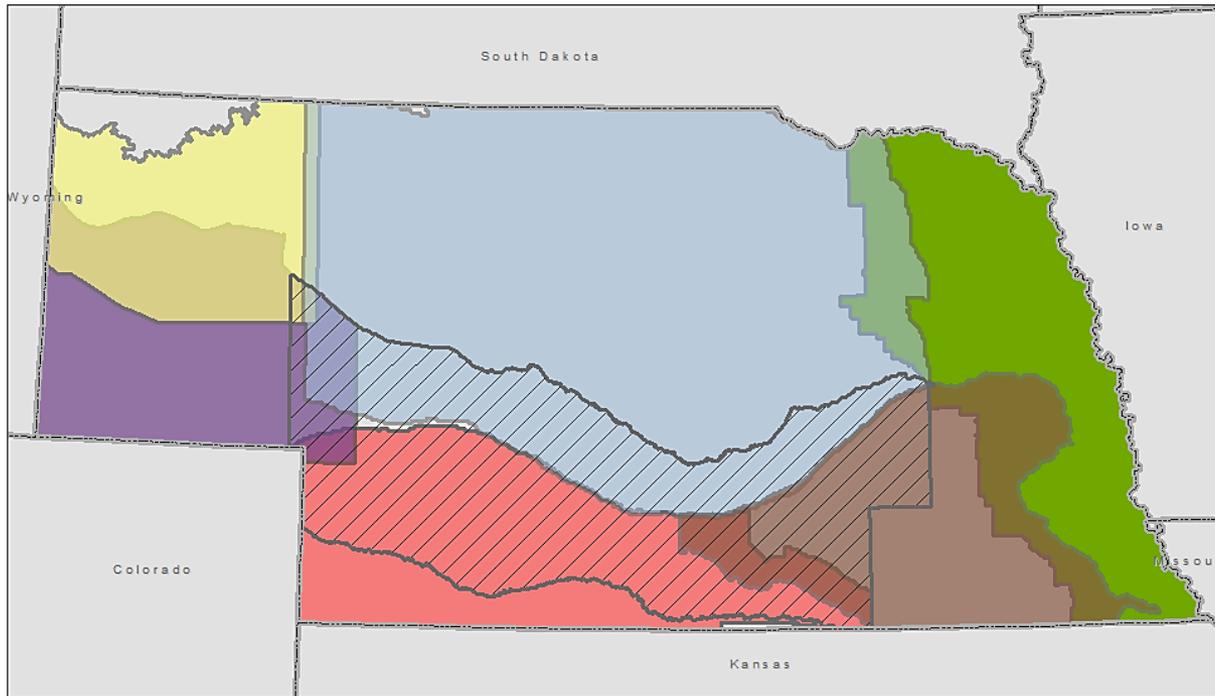
# **Integrated Model: Concept & Construction**



# Upper Niobrara White Basin Model Area

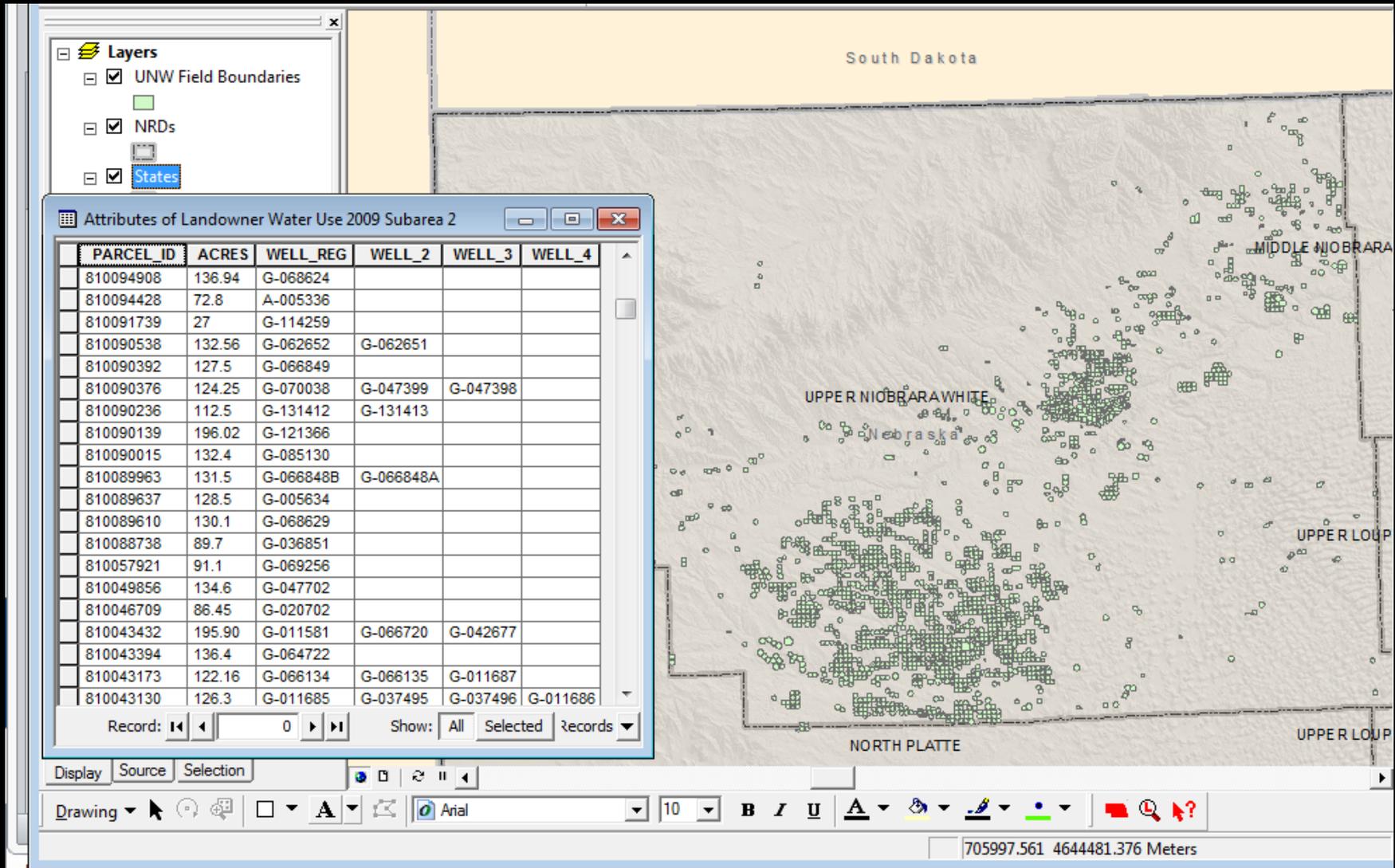


## Model and Study Areas

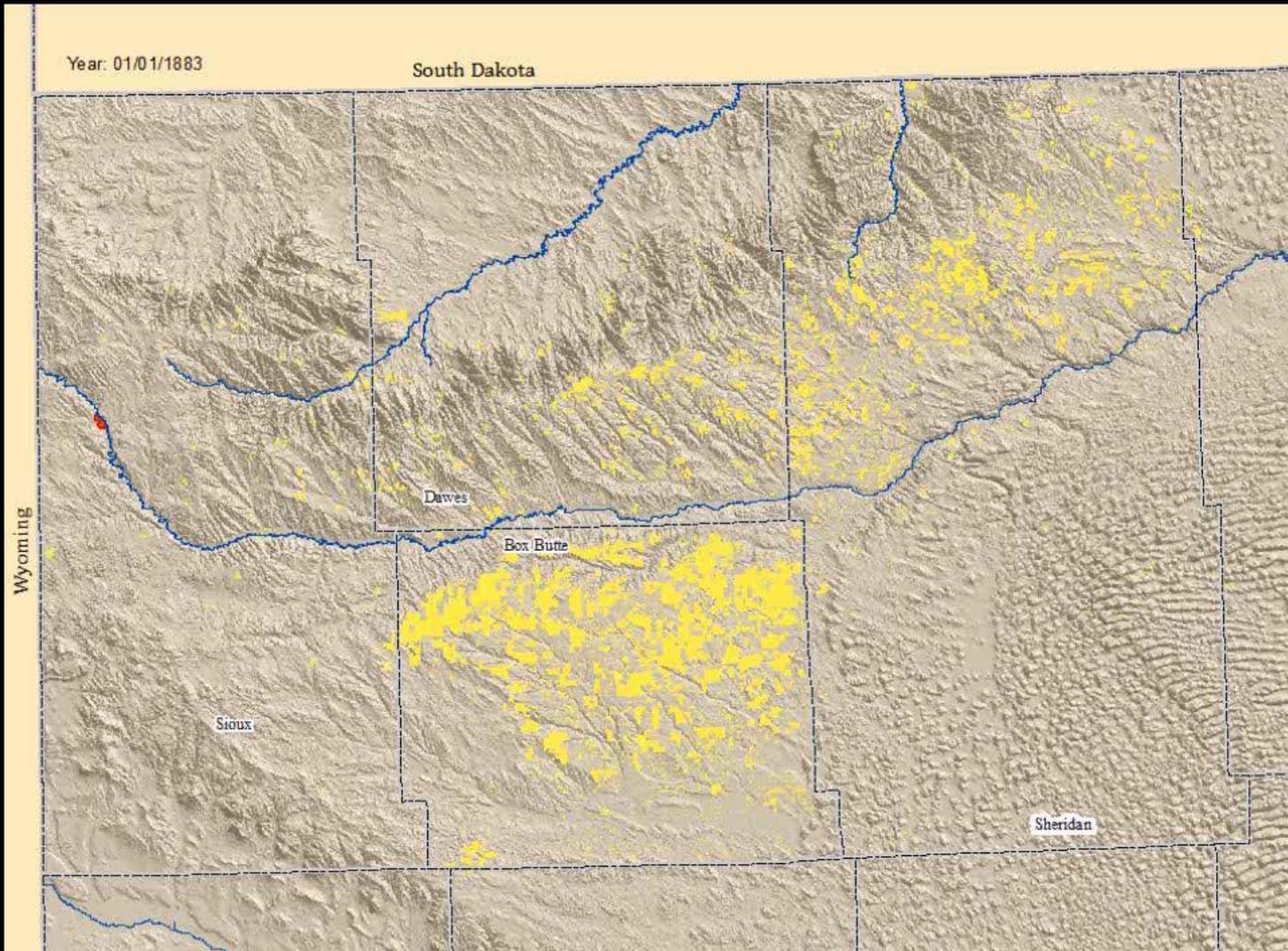


**DNR  
Model  
Areas**

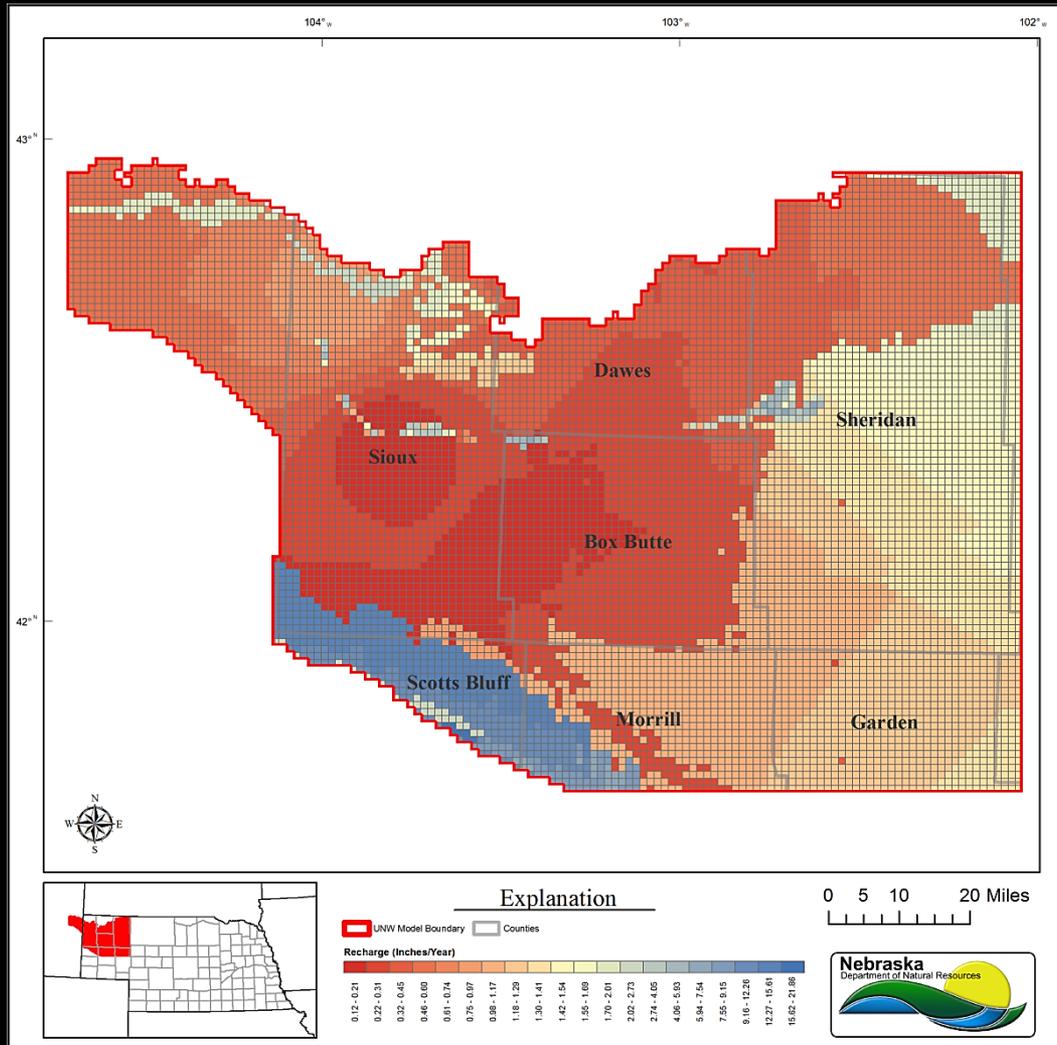
# UNWNRD Certified Acres Dataset



# Modeling Concept: At the Land Surface

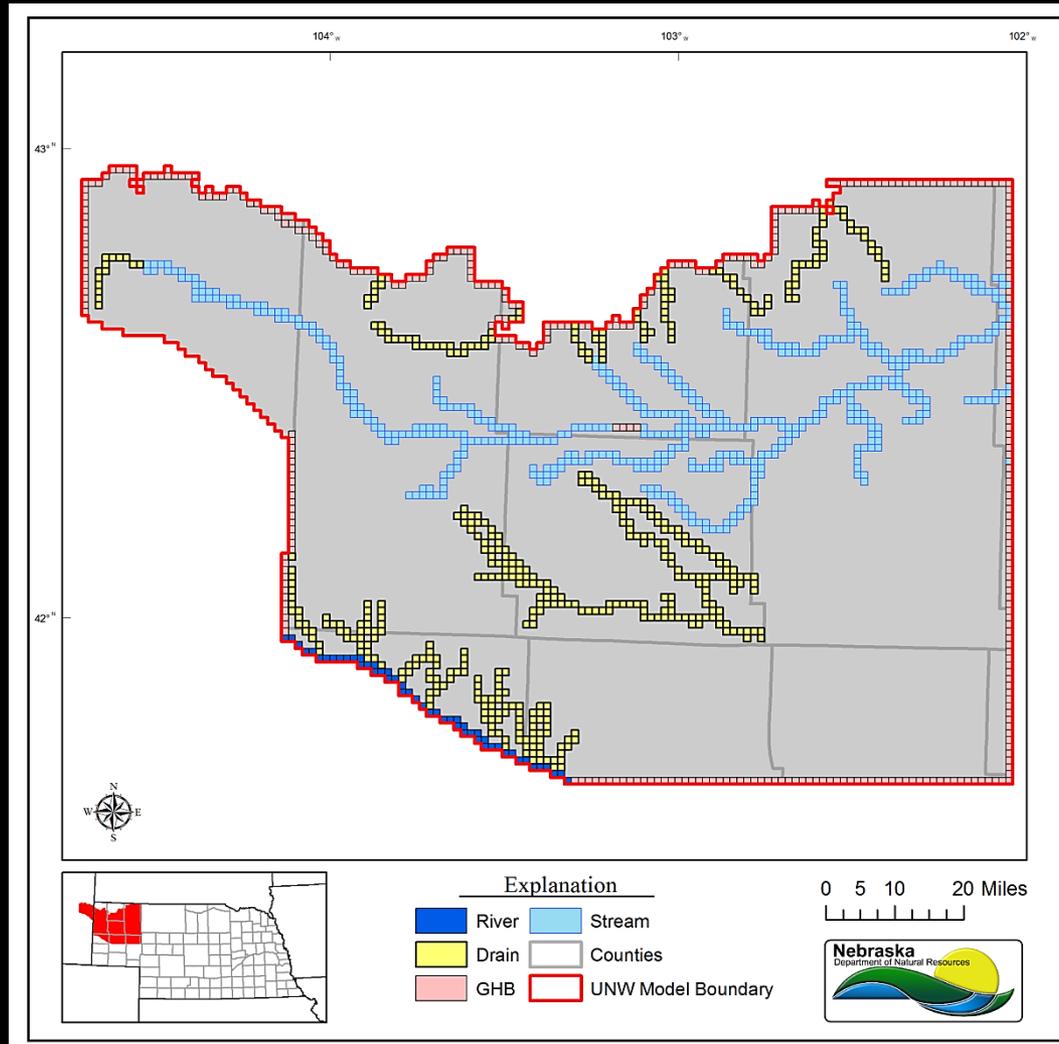


# Recharge



**Models:**  
**MODFLOW & Stella**

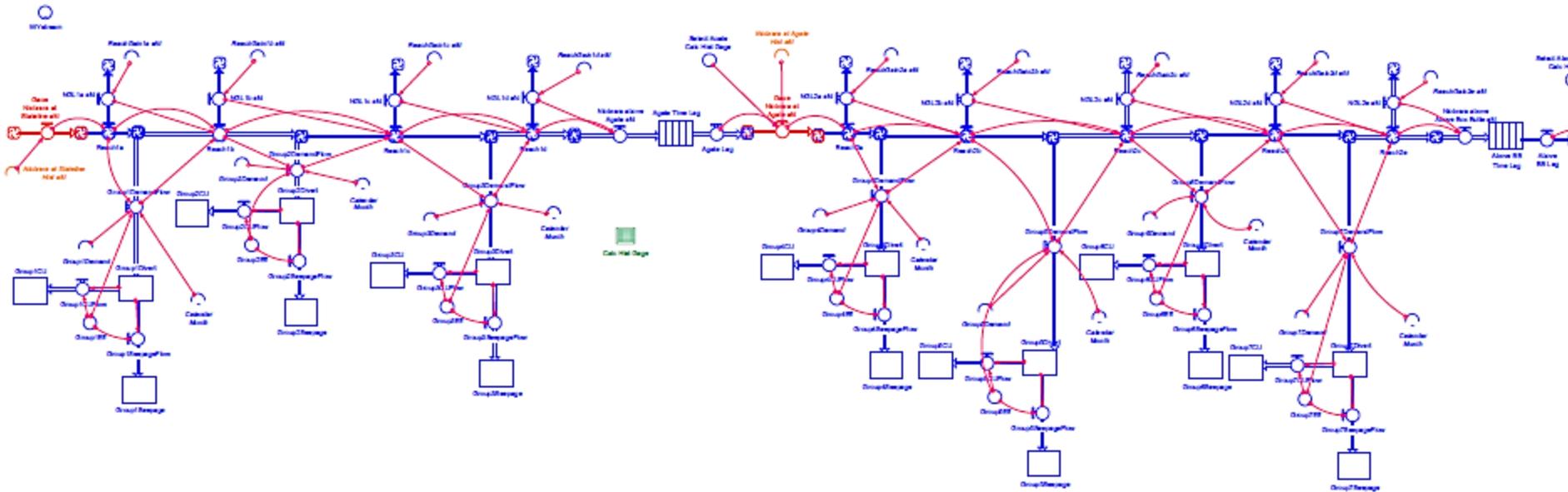
# Model Boundaries



# Modeling Concept: In the Rivers, Canals

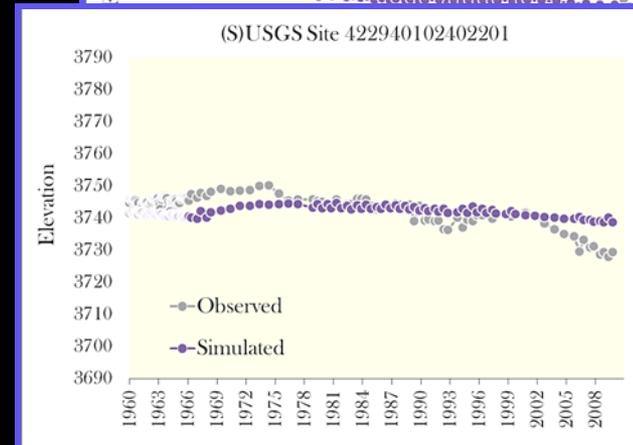
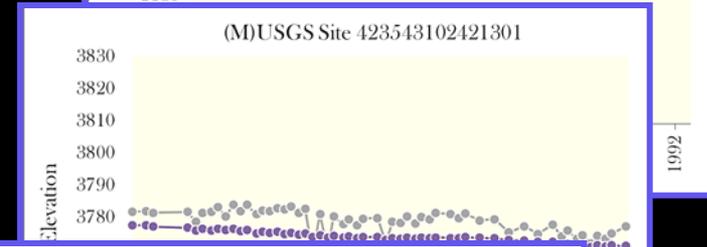
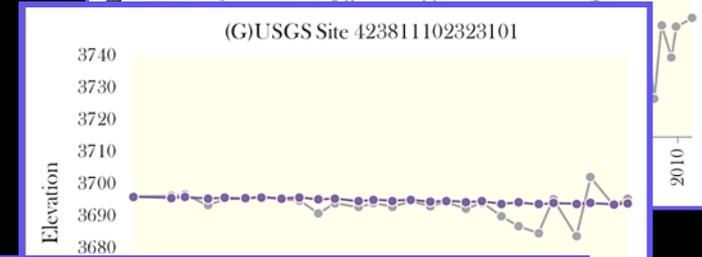
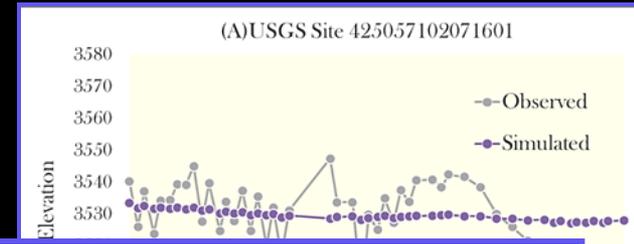
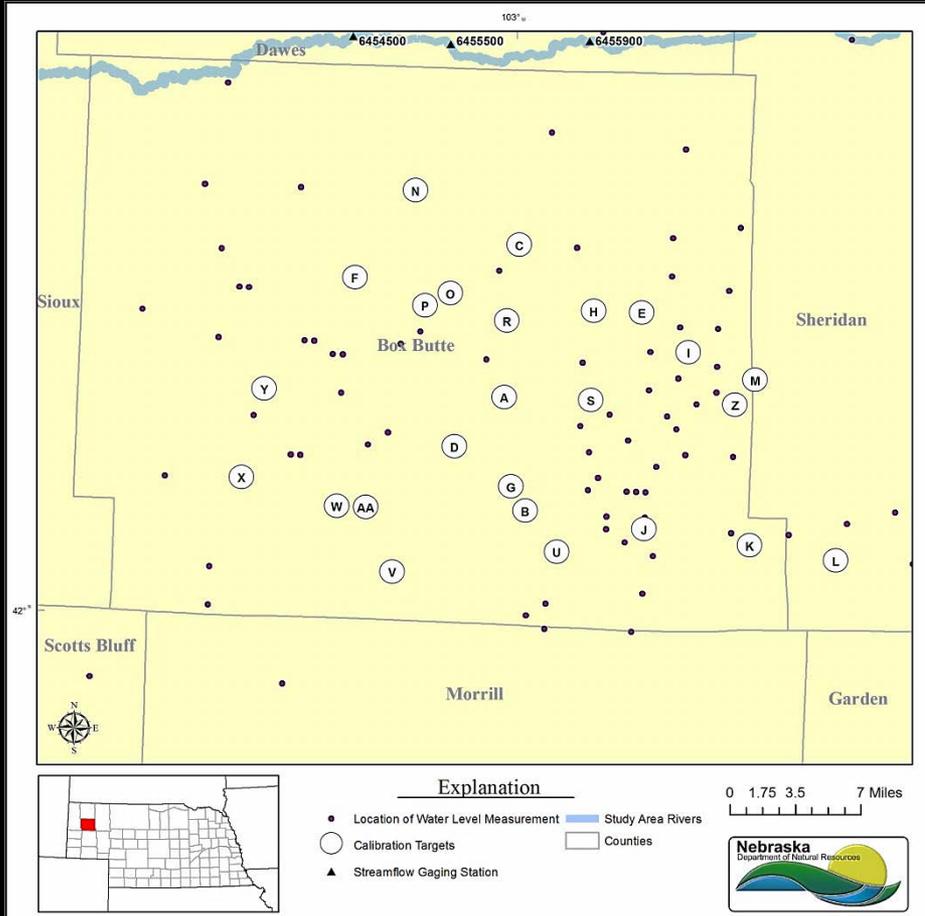
- STELLA operations
  - Track how surface water is stored and moved through canal and reservoir infrastructure
    - *Track/simulate diversions*
    - *Estimate Box Butte Reservoir operations*
  - Feedback to CROPSIM, groundwater models

# Modeling Concept: In the Rivers, Canals

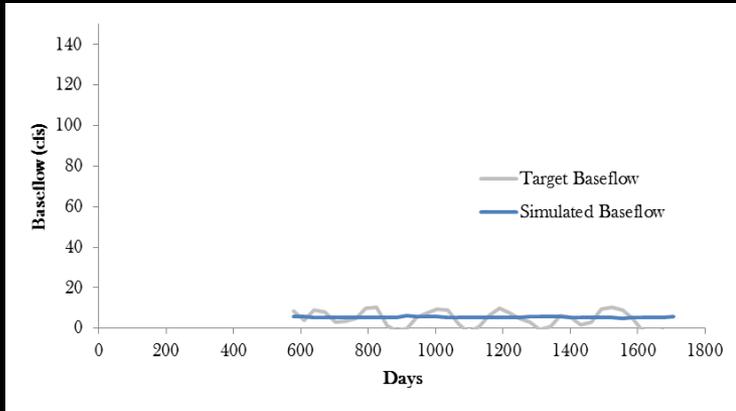


# Model & Project Status

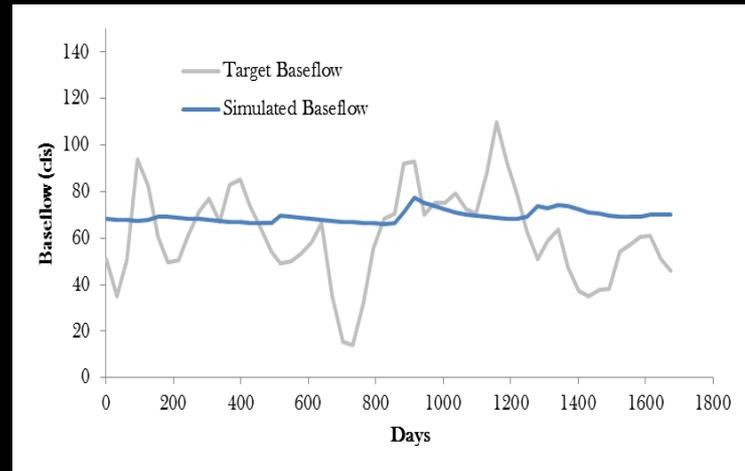
# Calibration



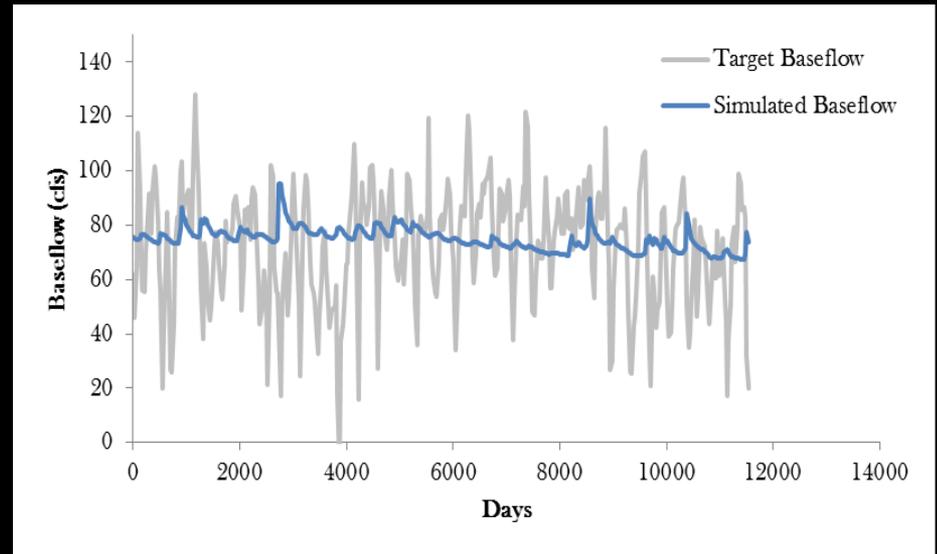
# Calibration



Simulated baseflow versus target baseflow gain in the Duncan to Hay Springs reach



Simulated baseflow versus target baseflow gain in the Hay Springs to Gordon reach

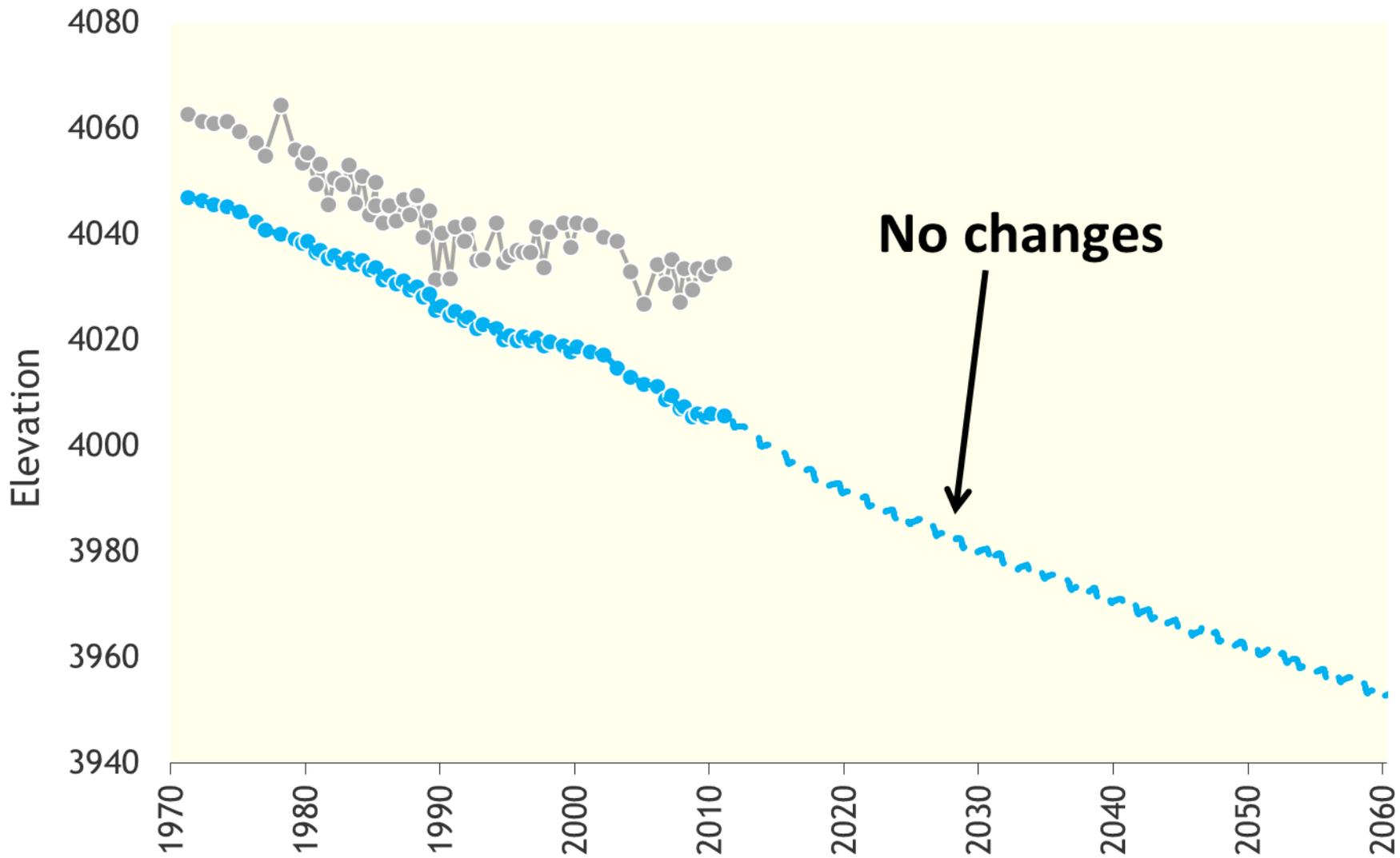


Simulated baseflow versus target baseflow gain in the above Box Butte to above Gordon reach

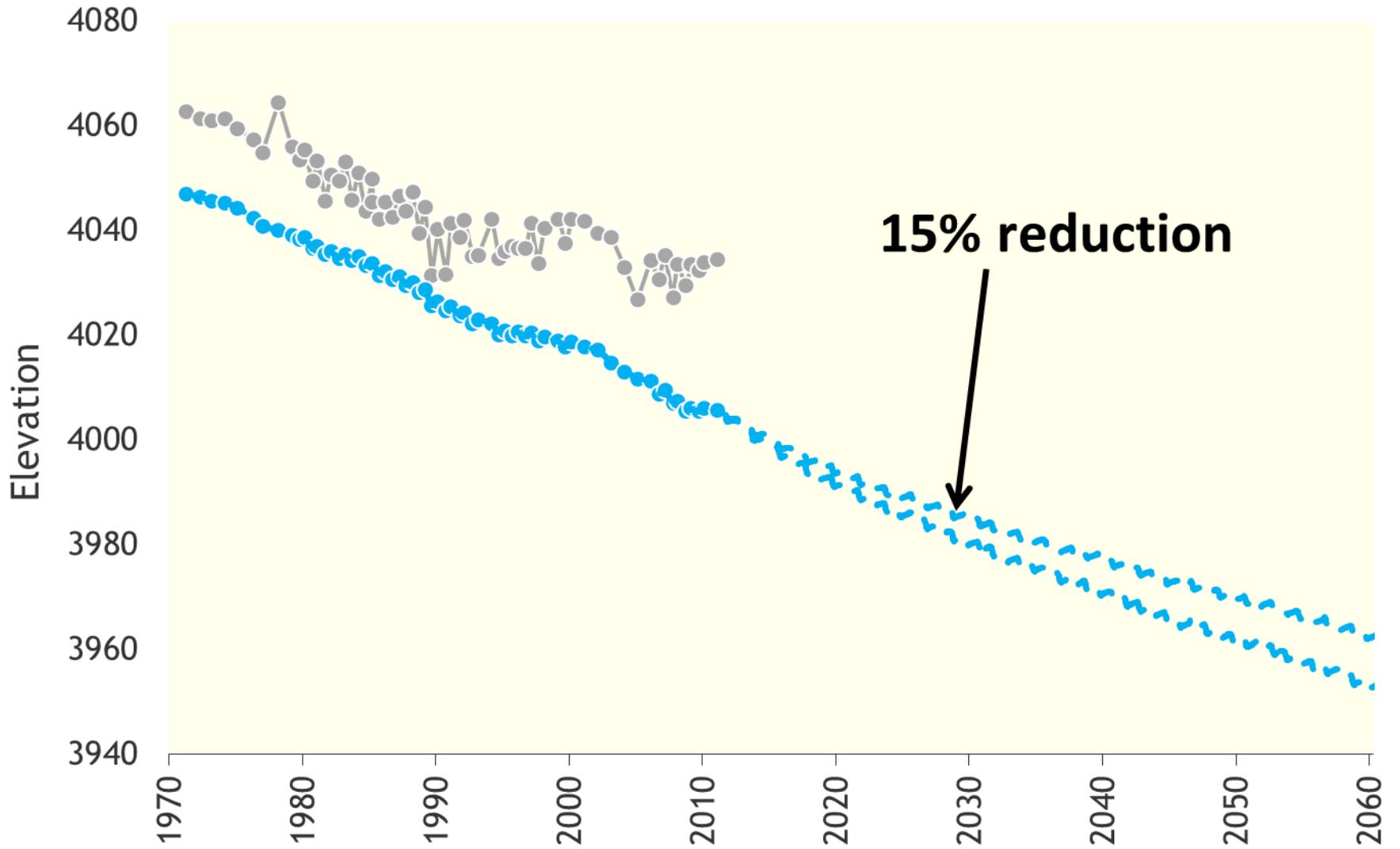
**Analysis:**

**Ok, so what does it mean?**

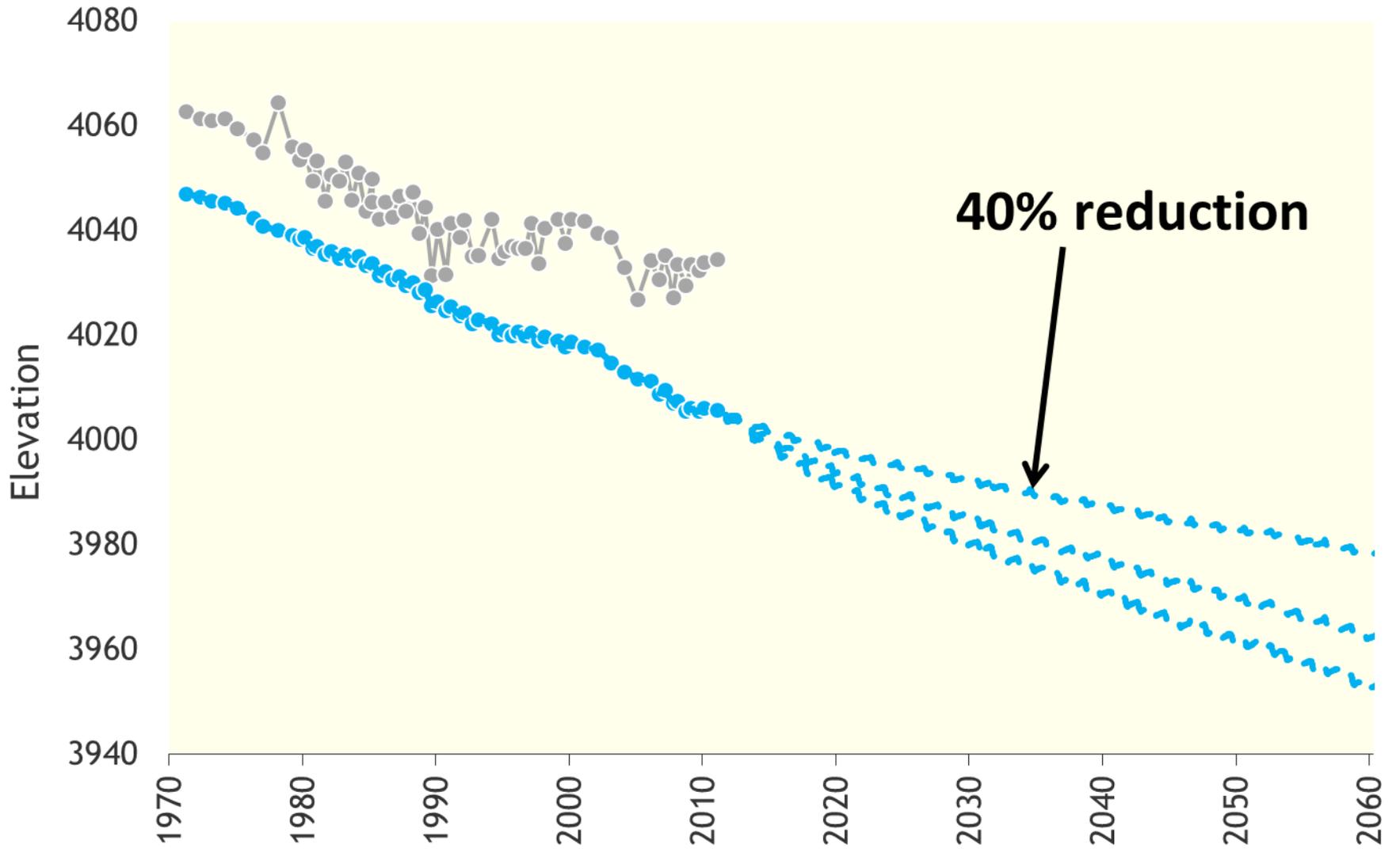
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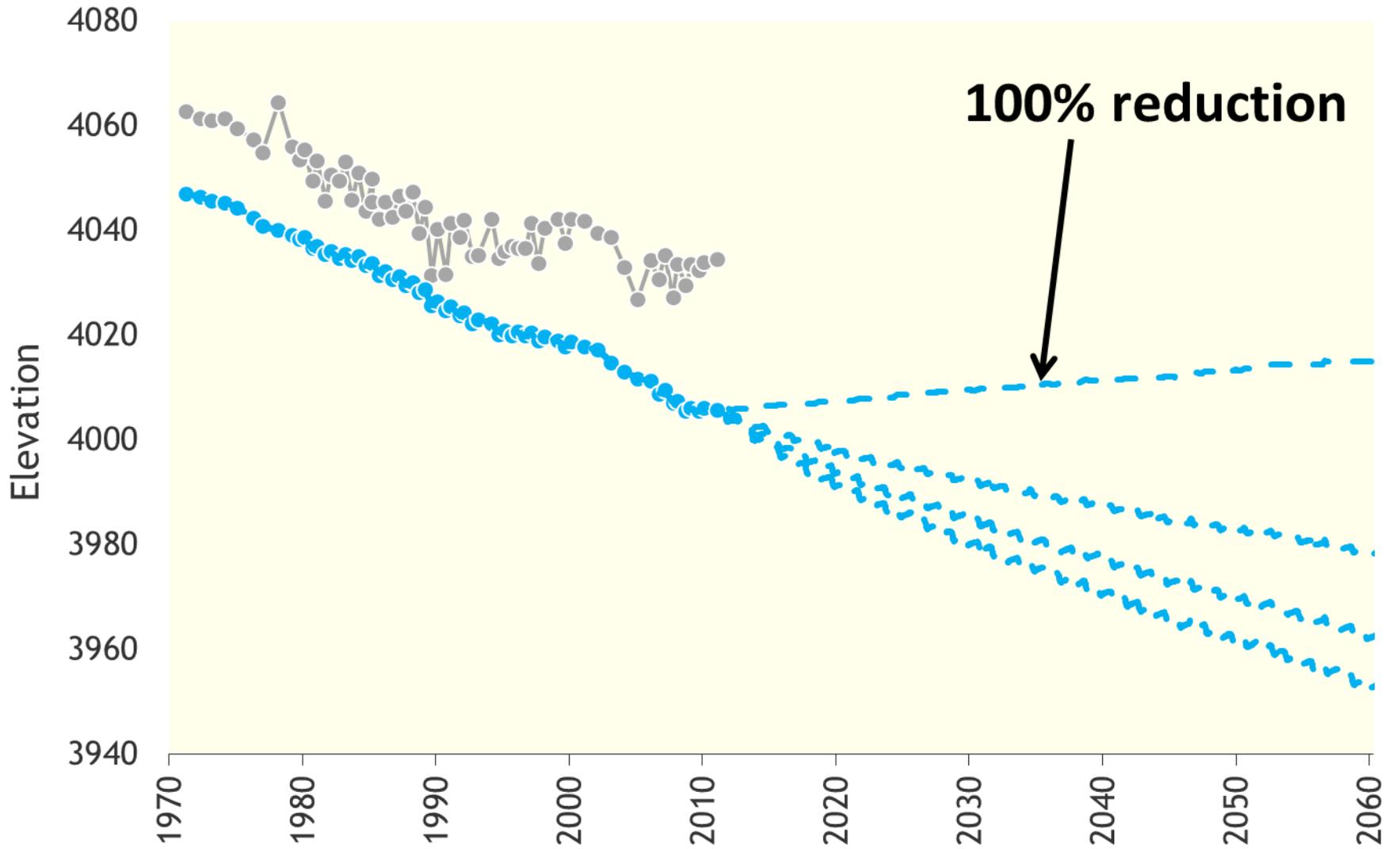
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# INSIGHT

Integrated Network of Scientific  
Information & GeoHydrologic Tools

# INSIGHT

- Summary of statewide & basin/sub-basin data

- ✓ Supply
- ✓ Demand
- ✓ Nature & Extent of Use
- ✓ Balance

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HOME ABOUT **STREAM FLOW** MODELING DATA

**Explore the Loup Basin**

Use this page to get started using the INSIGHT data and information.

Begin by exploring chart information for the Loup basin on the tab area below. If you'd rather learn more about one of the Loup's sub-basins, use your mouse to hover over the map to the right and click on the sub-basin you want to learn more about.

If you prefer to see the names of the basins in a list, click on the down arrow located to the right of the SELECT BASIN area to see a menu of basin names. Clicking on one of these basin names has the same effect as clicking on the basin in the map.

**INSIGHT**  
An Integrated Network of Scientific Information & Geohydrologic Tools

HOME ABOUT **STREAM FLOW** MODELING DATA

**Getting Started with INSIGHT**

Use this page to get started using the INSIGHT data and information.

Begin by exploring chart information for the state of Nebraska on the tab area below. If you'd rather learn more about one of the state's basins, use your mouse to hover over the map to the right and click on the basin you want to learn more about.

Note that the map has some greyed-out areas. These areas, including the White Hat, Platte, Lodgepole Creek and Republican basins have limited data and are currently not available. Keep in mind that state totals do not include the data from these basins. Be sure to check back later for updates which may include this information.

Finally, if you prefer to see the names of the basins in a list, click on the down arrow located to the right of the SELECT BASIN area to see a menu of basin names. Clicking on one of these basin names has the same effect as clicking on the basin in the map.

**SELECT BASIN**

- Big Blue
- Elkhorn
- Little Blue
- Lodgepole Creek
- Loup
- Lower Platte
- Missouri Tributaries
- Nemaha
- Northern
- Platte
- Republican
- White Hat

**Supply Demand Nature & Extent of Use**

**Chart: Precipitation Volume and Rate** Season: Annual

**Water Supply**

The water supply for the state of Nebraska is composed of several different sources. For example, precipitation is one of the sources of Nebraska's water supply.

However, other sources include the water that already exists in the rivers that originate in the neighboring states of Wyoming, Colorado and Kansas.

In addition, water exists under ground (called aquifers) in aquifers. To access groundwater, consumers of that water use wells and pumps.

Also, Nebraska accumulates and manages a supply of surface water, in reservoirs, which allows for a continuous supply to be available throughout the year.

The Loup Basin is located in central Nebraska, and is entirely contained within the state. The Loup Basin, with an area of approximately 14,200 square miles, has more area in Nebraska than any other basin.

At its farthest western extent, the Loup Basin boundary is about halfway between Alliance, Nebraska, and Hyannis, Nebraska, in Sheridan and Garden Counties. The Loup River headwaters are about seven miles northwest of Hyannis, Nebraska. The basin is defined as draining to the confluence of the Loup River and Beaver Creek, about 25 miles upstream from Columbus, Nebraska. The Loup River extends beyond the basin boundary to its junction with the Platte River at Columbus, Nebraska.

According to the 2010 U.S. Census, the largest city in the basin is Broken Bow, with a population of about 3,600. In descending order, the next largest cities include St. Paul (2,300), Ord (2,100), Ravenna (1,400), and Fullerton (1,300).

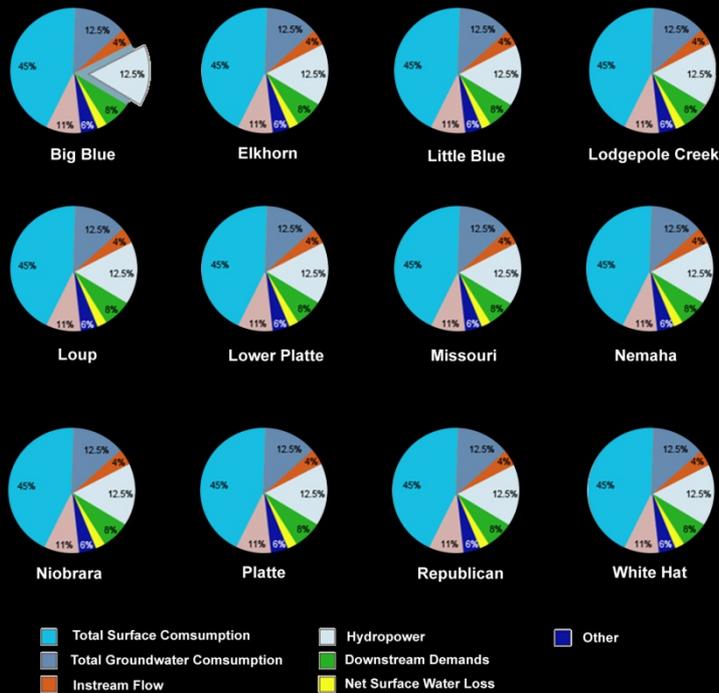
The topography of more than half of the upstream end of the Loup Basin consists of sand hills, which are sand dunes stabilized in place by a grass cover. The downstream portion of the basin consists mostly of dissected plains, with small areas of upland plains. The upland plains are land that is flat to gently rolling and dissected plains are where streams have cut into former plains creating hilly land with steep slopes and sharp ridge crests, along with remnants of the plains on the hillsides. There are several valleys in the Loup Basin, which are the flat-lying areas along the Loup River and its major tributaries.

The primary aquifer in the Loup Basin is the Ogallala Formation, which consists of poorly sorted, generally unconsolidated clay, silt, sand, and gravel. The Ogallala Formation is part of a vast system of

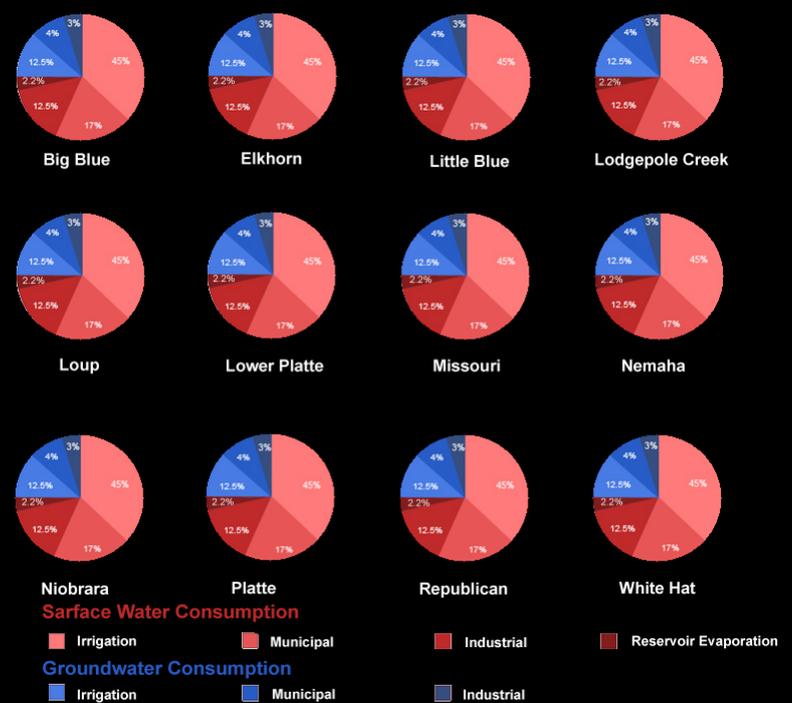
The charts on this slide depict fictitious data.

# INSIGHT

## Average Long-Term Total Demand by Basin by Category



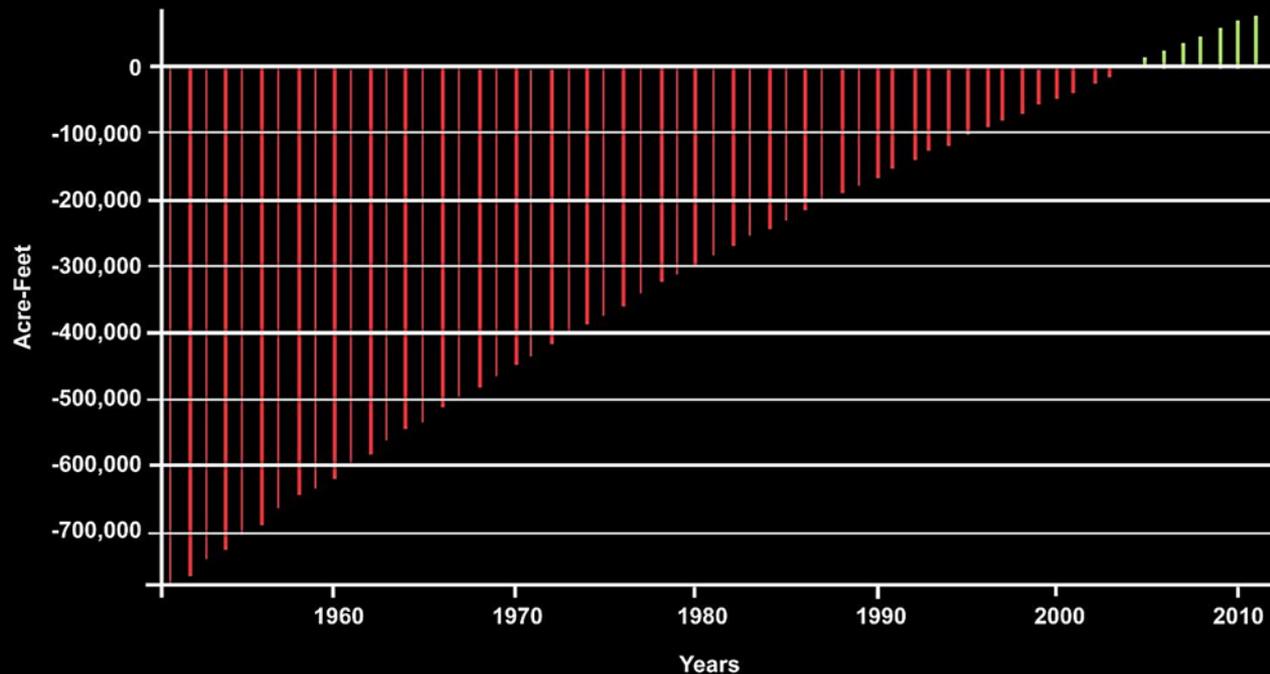
## Average Long-Term Surface Water Consumption and Groundwater Consumption by Basin by Category



The charts on this slide depict fictitious data.

# INSIGHT

Near-Term Balance of Basin Water Supplies and Total Demands



*\*INSIGHT will include long-term & projected balance data as well.*

*The chart on this slide depicts fictitious data.*

# Project Status

- Peer Review--Complete
- Final Report--Available prior to end of year
- WaterSMART--Alternative identification
- INSIGHT Web Portal
  - Assess Data, Summaries, and Information