

Extreme Events: States Adapt Water Supply Approaches

# Flooding and Water Planning in Nebraska

AWRA's National Leadership Institute  
5<sup>th</sup> Annual Workshop for State Officials

November 6, 2019

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**NEBRASKA**  
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# NEBRASKA

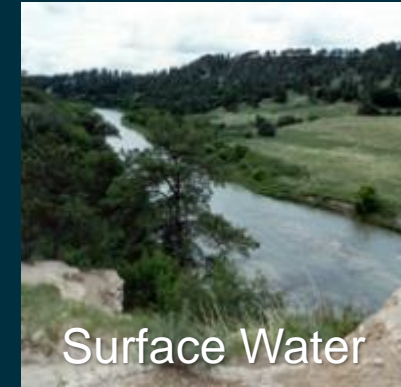
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Providing the sound science and support for managing Nebraska's most precious resource



Water Planning  
and Integrated  
Management



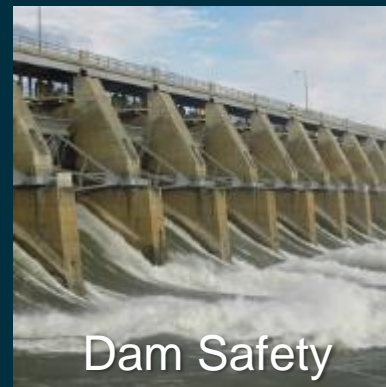
Surface Water



Groundwater



Floodplain  
Management



Dam Safety



Field Offices

# NEBRASKA

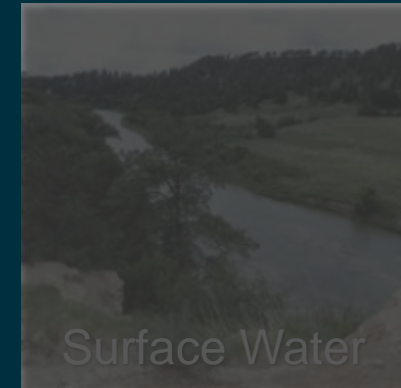
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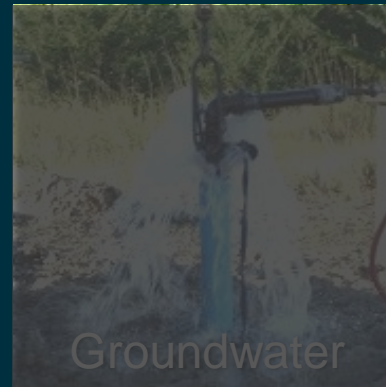
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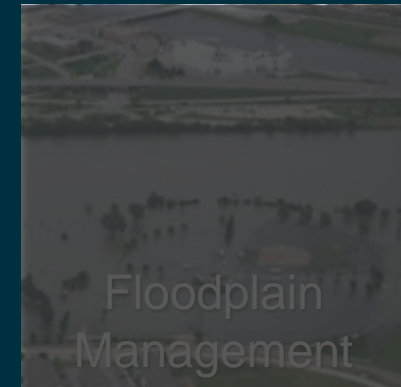
Water Planning  
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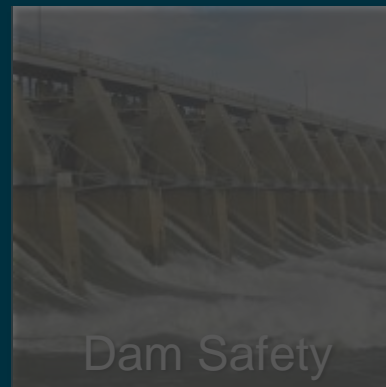
Surface Water



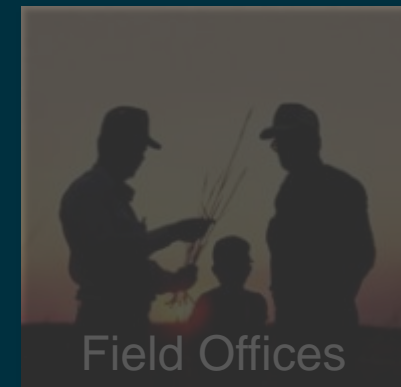
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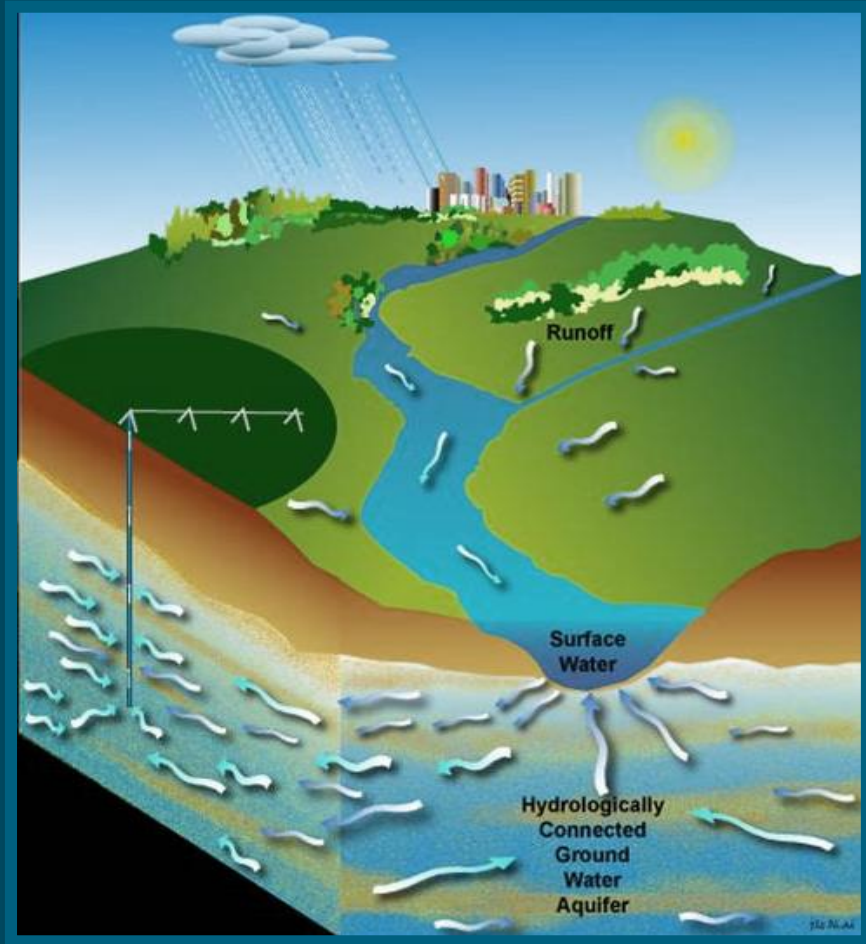
Field Offices

# Water Planning in Nebraska

State water planning process

Integrated management plans & basin-wide plans

# Regulation and administration of water supplies in Nebraska



## Surface water

- Regulated by NeDNR
- Prior appropriations

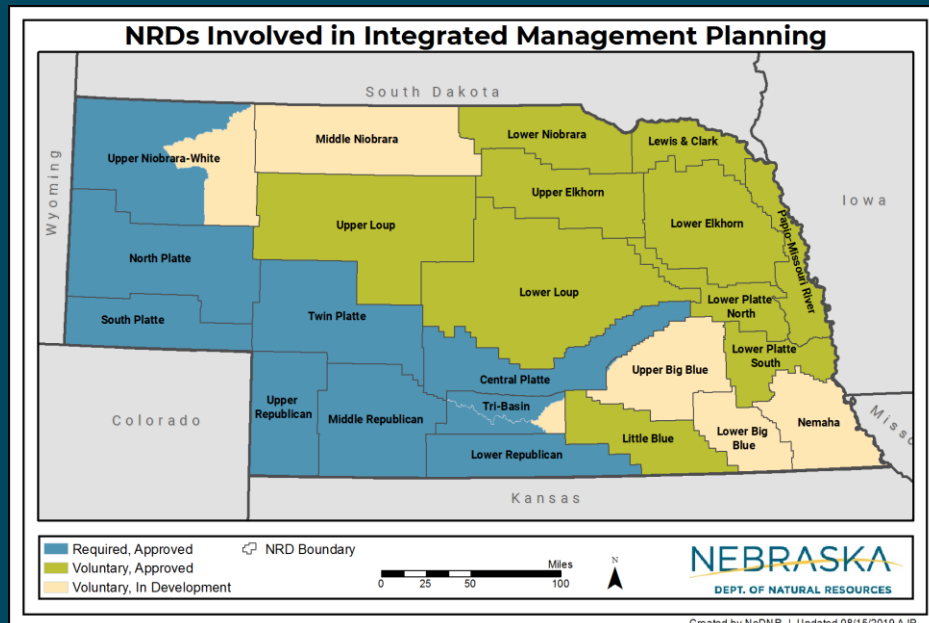


## Groundwater

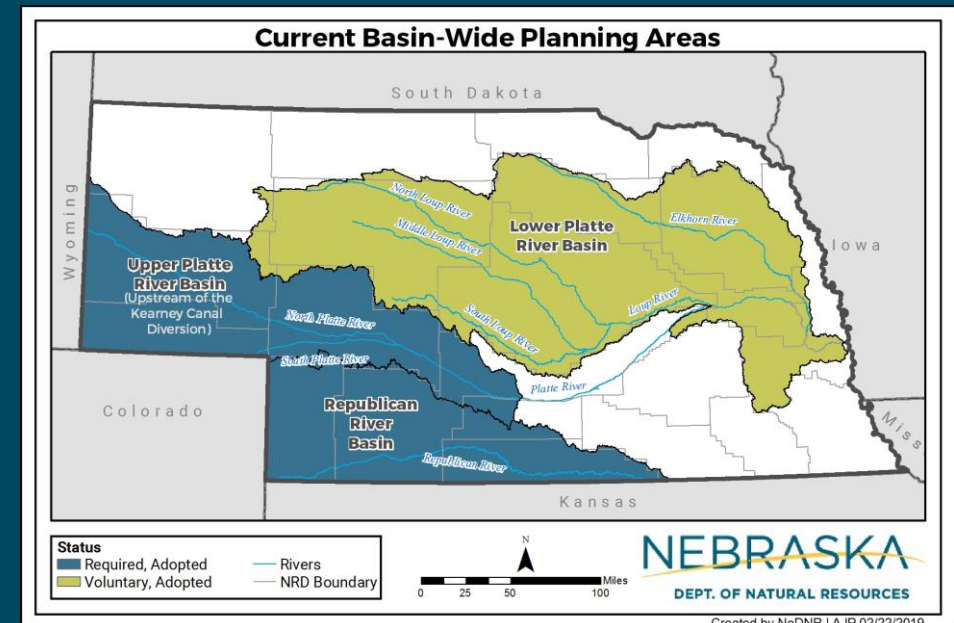
- Regulated by Natural Resources Districts (NRDs)
- Correlative rights

# Nebraska's decentralized water planning framework

## Integrated management plans (IMPs)



## Basin-wide plans



A state water planning process, not a state water plan

# Purpose

...An integrated management plan shall include... Clear goals and objectives with a purpose of **sustaining a balance between water uses and water supplies**

so that the **economic viability, social and environmental health, safety, and welfare** of the river basin, subbasin, or reach

can be **achieved and maintained** for both the near term and the long term...

from *Neb. Rev. Stat. § 46-715 (2)*



# IMPs and basin-Wide plans are adaptive





# Flooding and Conjunctive Management

Examples from the Platte River

# Conjunctive water management

## ➤ What?

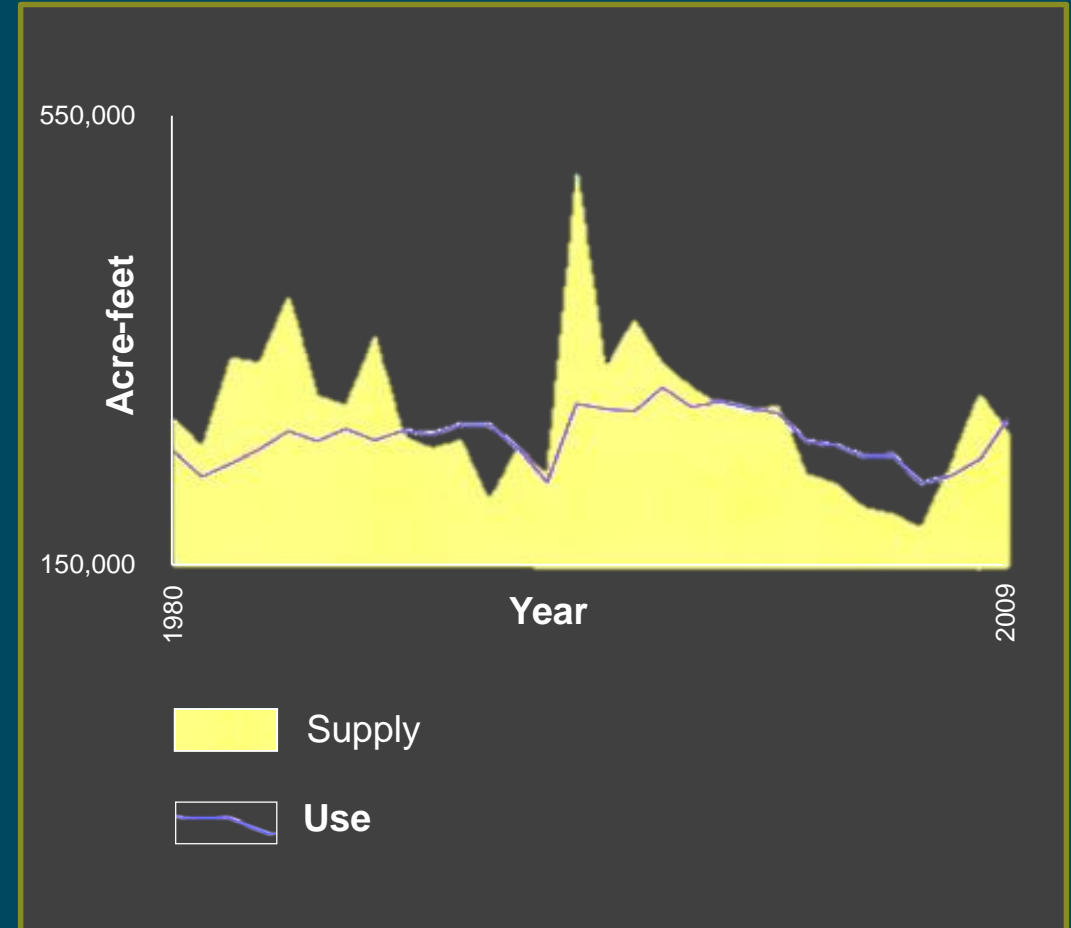
- An **adaptive** process
- Uses the **connection** between surface water and groundwater to **maximize water use** while **minimizing impacts** to streamflow and groundwater levels

## ➤ Why?

- To **increase the overall water supply** of a region
- To improve the **reliability** of that supply

## ➤ How?

- **Use** or **store** surface water when plentiful
- Rely more on groundwater when dry



# Examples of conjunctive water management projects

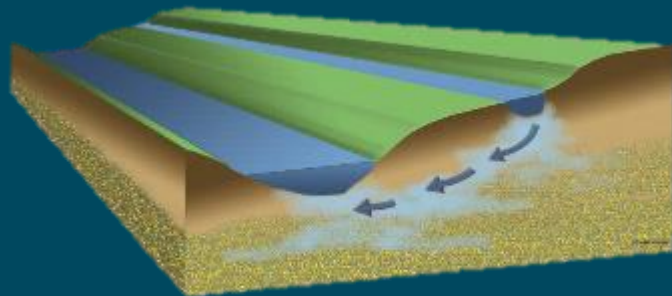
- Augmentation projects
- Water leasing arrangements
- Canal rehabilitation
- Capturing excess flows
- Broad scale recharge
- Slurry wall reservoirs



North Dry Creek Streamflow Augmentation Project, TBNRD

# Upper Platte River

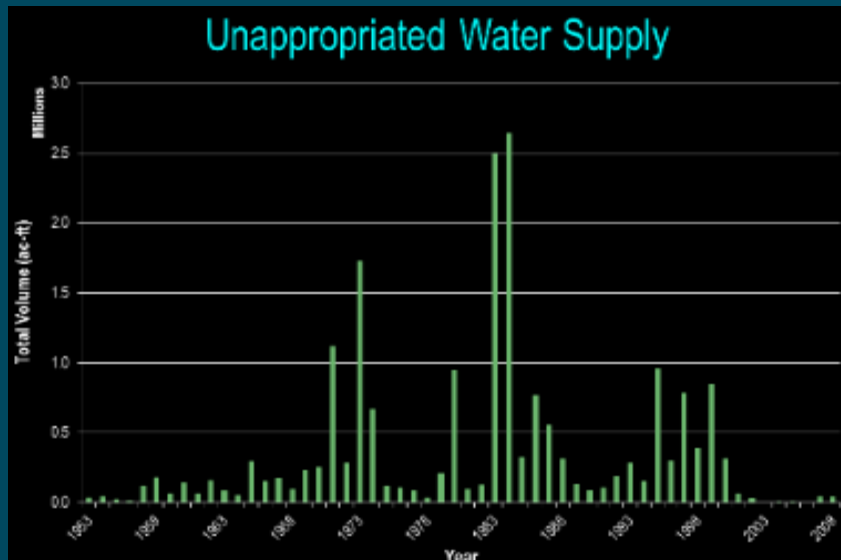
- Inflows from CO and WY
- Fully allocated
  - Offset depletions since 1997 and new uses
  - Instream flow needs
- Occasionally excess flows are available
- Underlain by Ogallala Aquifer and alluvial aquifers
- Extensive canal infrastructure (most are unlined)



Lake Canal Stream

# Tool development

- Analysis of unappropriated surface water
- Water leasing contract templates
- Conceptual design standard for a conjunctive management project



# 2011 pilot project

- High flows in spring through fall
  - Anticipated due to heavy snowpack
  - North Platte, South Platte, Platte
- NeDNR coordinated with NRDs, Irrigation Districts/Canal Companies to divert excesses
- Process
  - Acquisition of permits
  - Contracts
  - Monitor

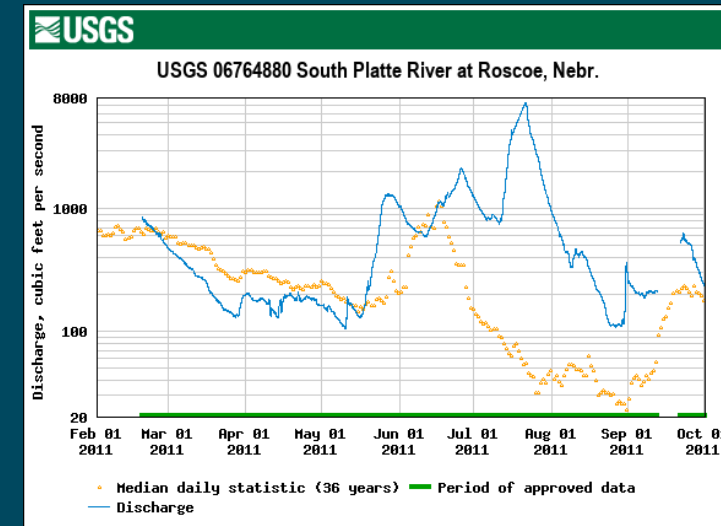
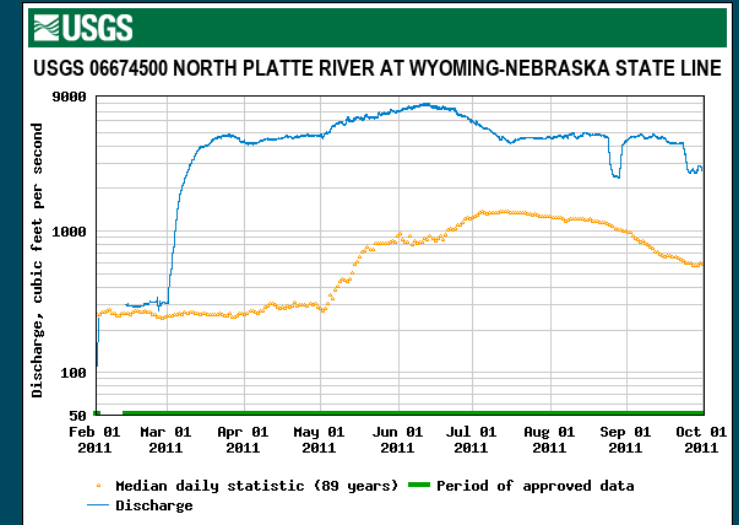
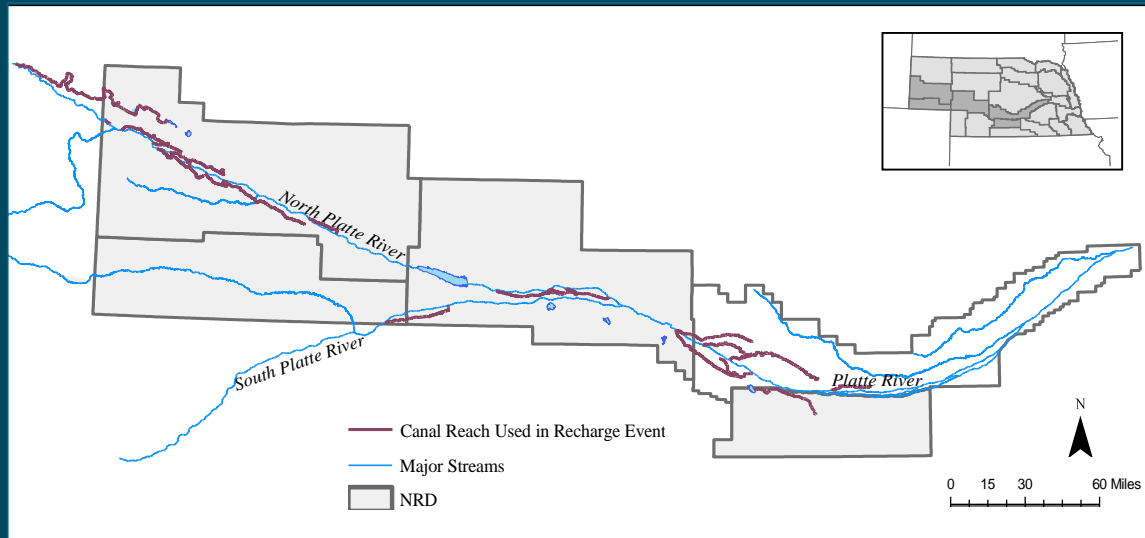


# 2011 pilot project

## 23 Canals and 5 NRDs

- Diversion Total 145,500 acre-ft
- Recharge Total 96,000 acre-ft

Also helped mitigate flooding impacts in the basin



# Fall 2013 flood flows

South Platte River at North Platte, NE



24 hours



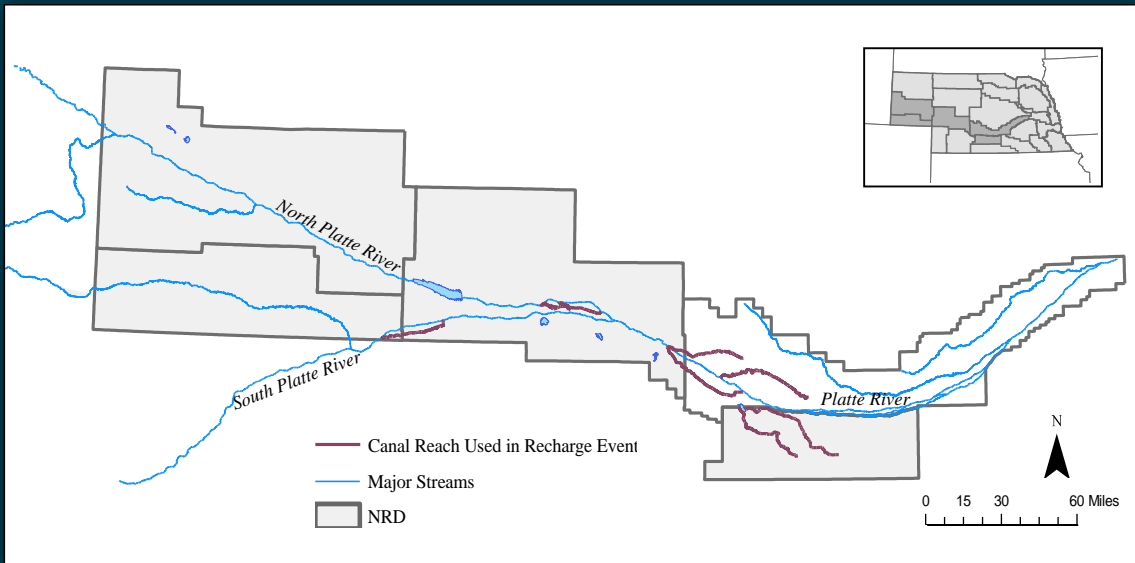
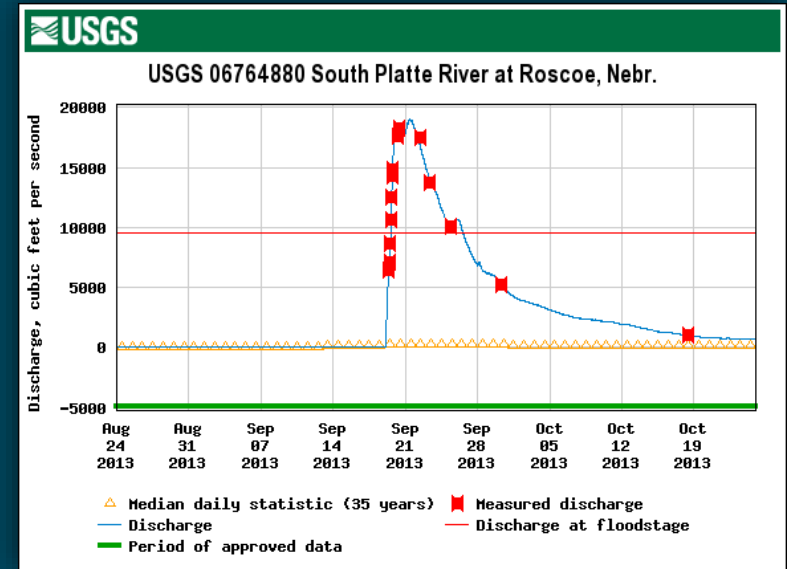


# Fall 2013 flood flows

## 9 Canals and 4 NRDs

**Diversion Total**      **27,300 acre-ft**

**Recharge Total**      **21,800 acre-ft**

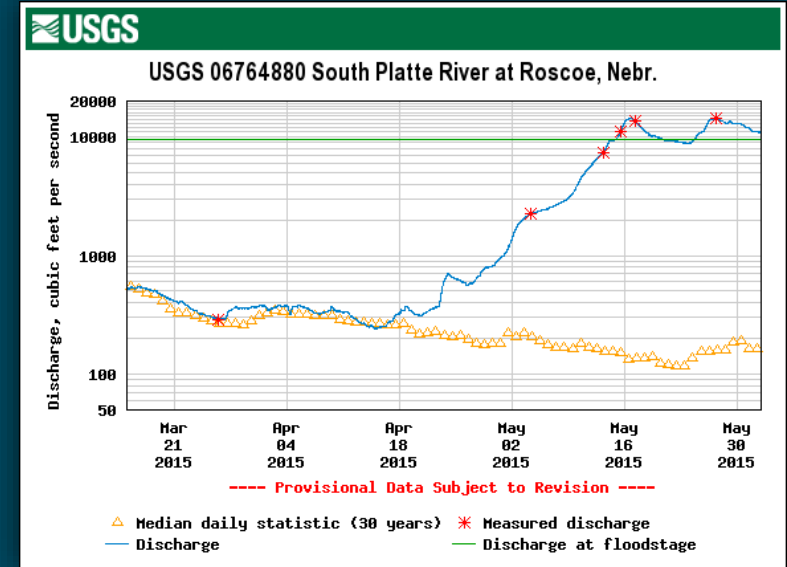
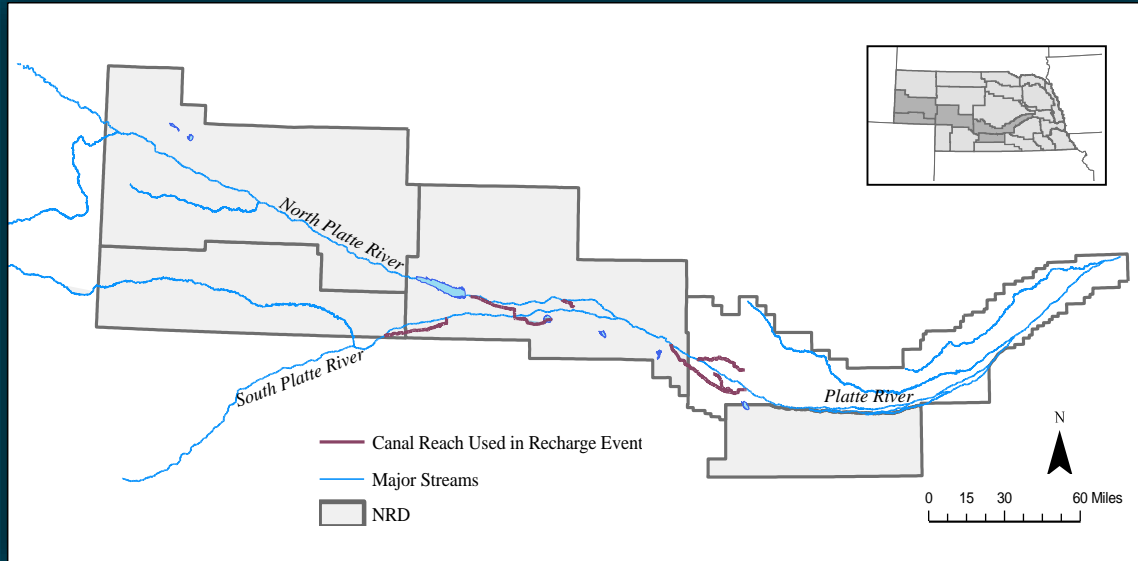


# Spring 2015 flood flows

7 Canals and 4 NRDs

**Diversion Total 17,600 acre-ft**

**Recharge Total 11,100 acre-ft**



# Additional recharge diversions

Canal Name	Total Diversion (AF) 2016	Total Diversion (AF) 2017	Total Diversion (AF) 2018
Western Canal	14826		
North Platte Canal	9246		
Paxton-Hershey Canal	7828		
Suburban Canal	6045		
Phelps Canal	6909	4916	4259
E65 Canal	1368	1665	1393

# Summary of excess flow diversions

- Process in place
- Totals since 2011:
  - Over 260,000 af diverted
  - Over 176,000 af of recharge
- Benefits
  - Reduces the need for additional regulations
  - Creates greater resiliency in future periods
  - Accretions will benefit Platte River flows for many years into the future



# Conjunctive water management – future activities

- Expand implementation
- Adapt strategies based on management goals
- Support continued investment in maintaining and enhancing infrastructure
- Sound science and monitoring to support management decisions
- Decision Support System to maximize excess flow recharge benefits

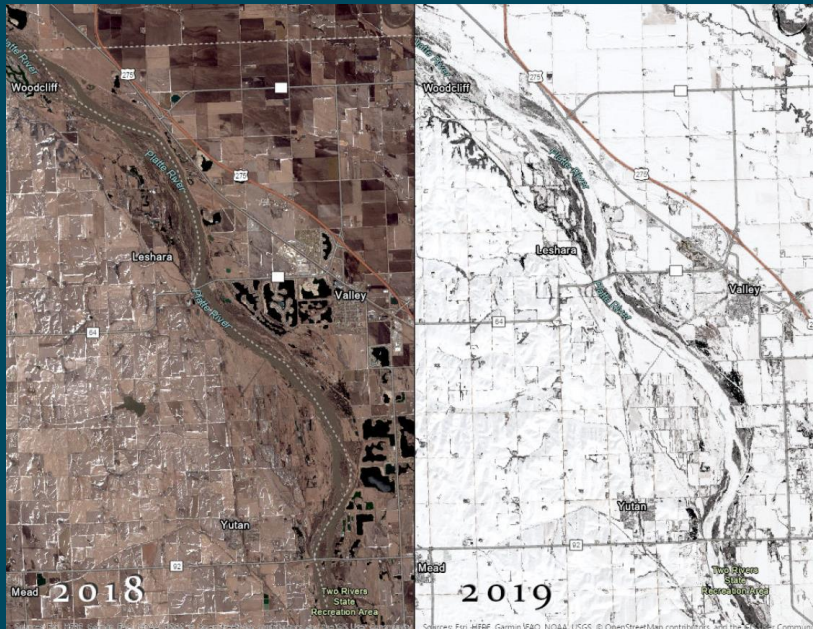


# 2019 Flooding

Winter Storm Ulmer

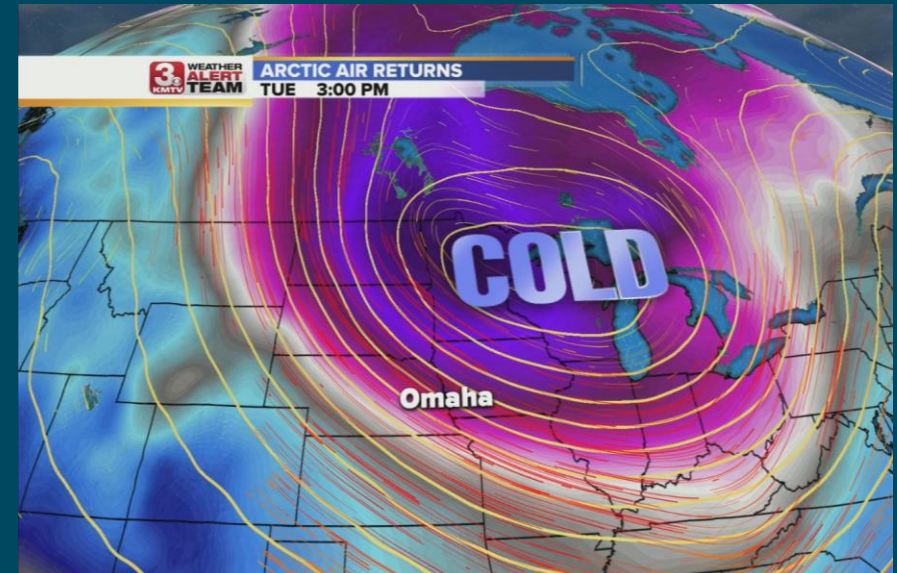
Bomb Cyclone

# Conditions before the storm

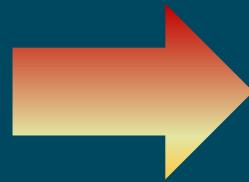
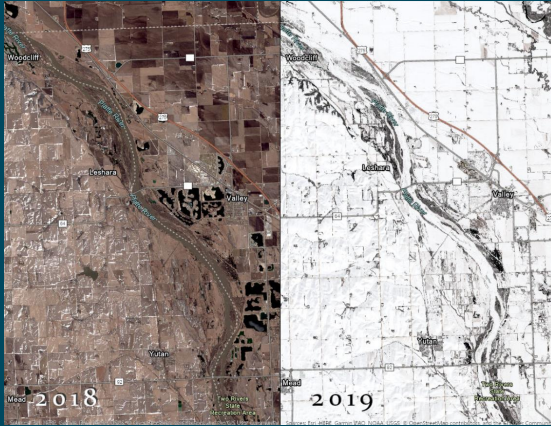


**Record snowfall** across much of Nebraska  
January – March 2019

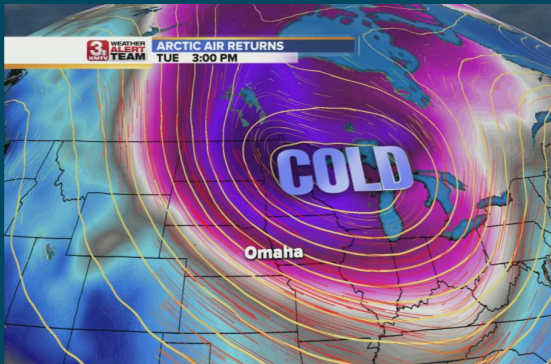
**Prolonged below-average temperatures**  
February 2019 – one of the 10 coldest on record  
Colder than average temperatures continued until March 12  
Led to **deep frost depth**



# Rapid warming March 13

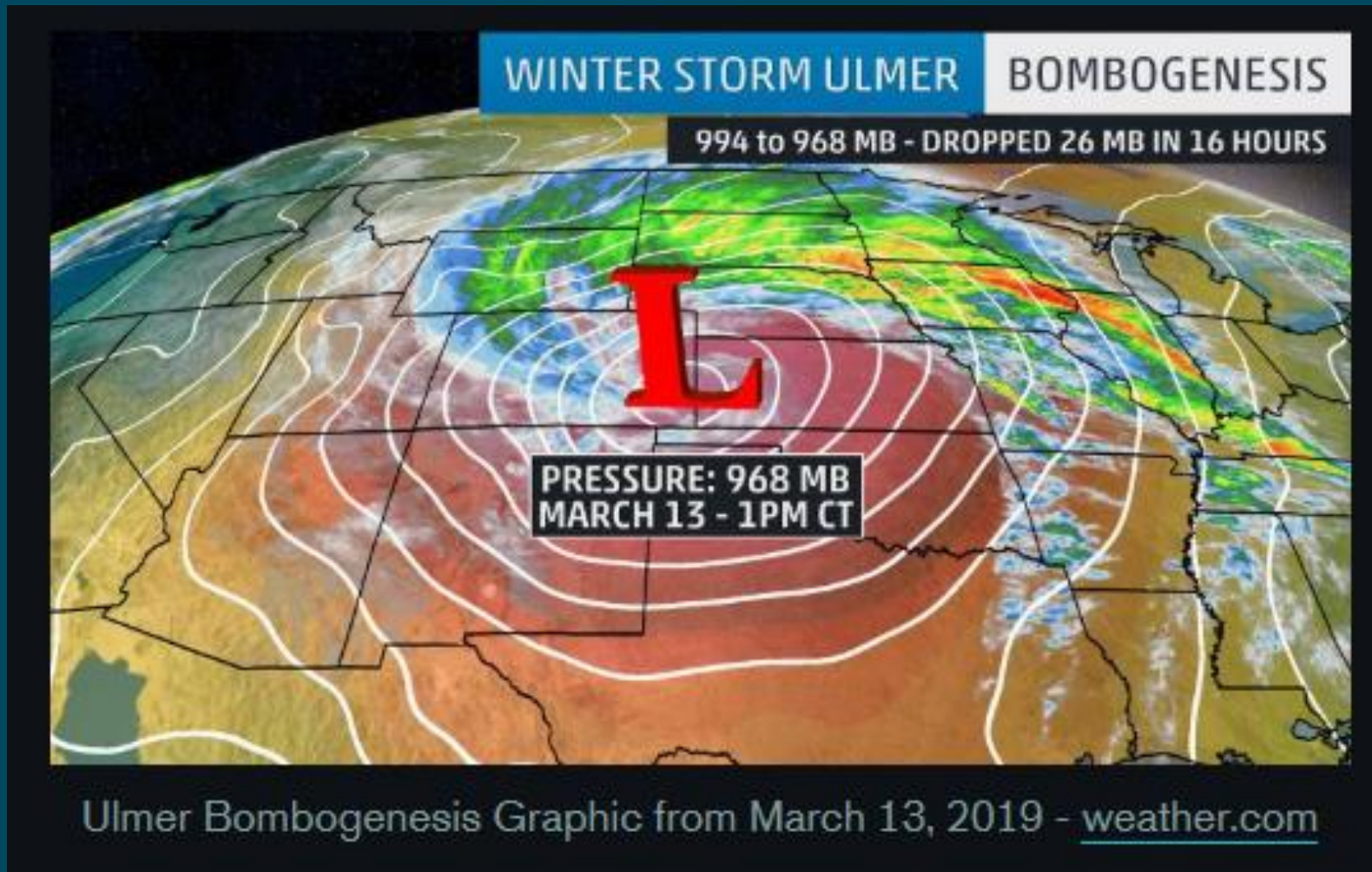


Accelerated  
thawing and  
melting

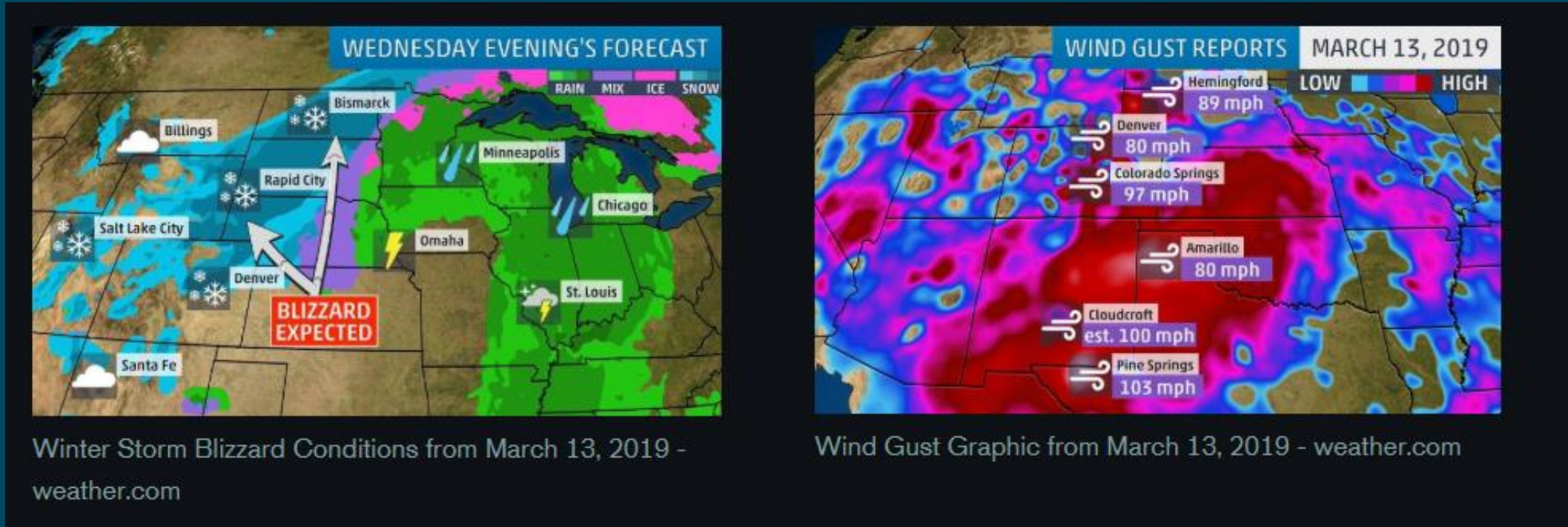




# Bombogenesis

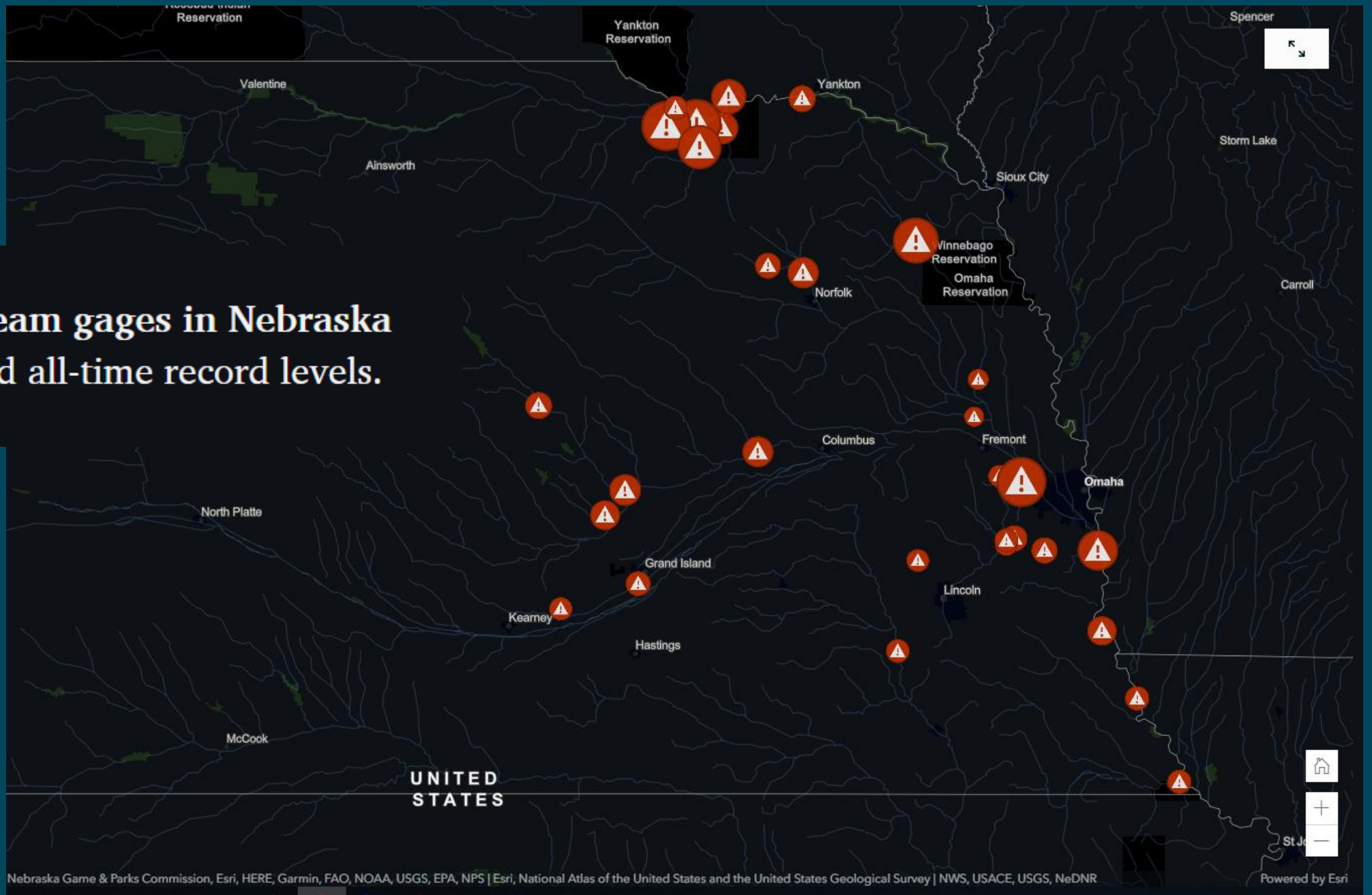


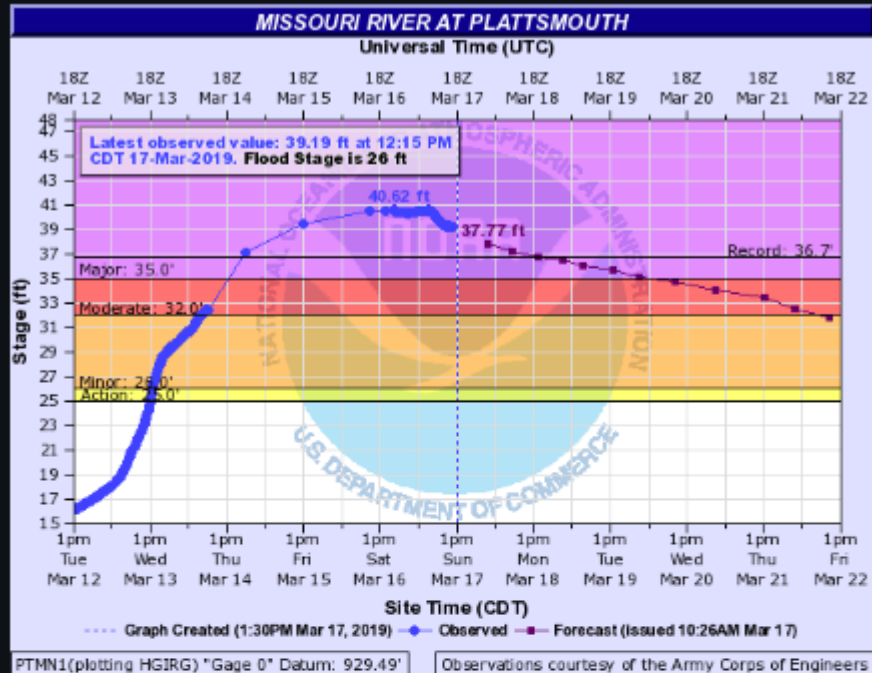
# Winter Storm Ulmer, March 13 – 14



Across the state: wind, widespread rainfall, and heavy snow

30 stream gages in Nebraska reached all-time record levels.

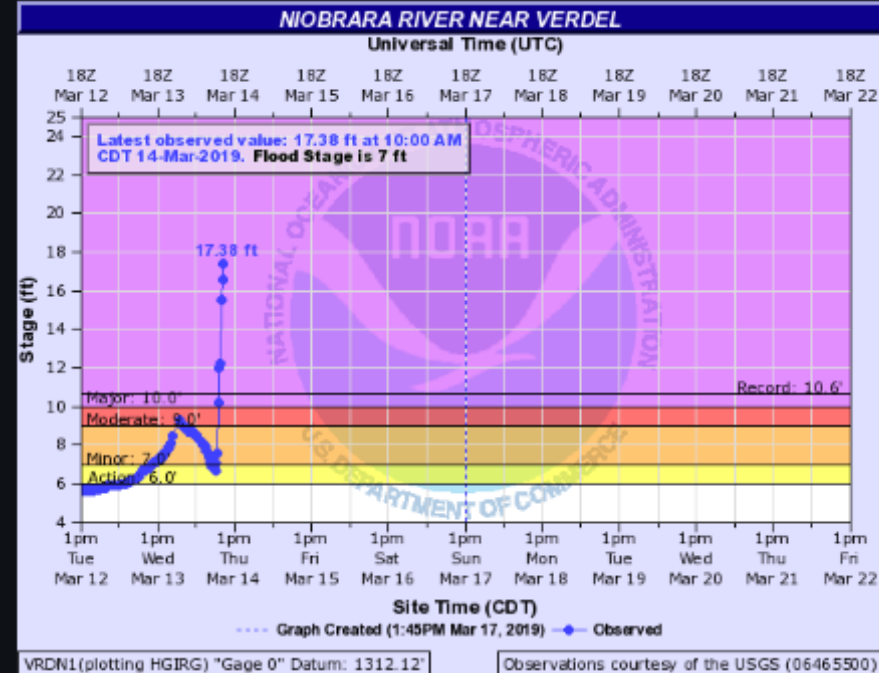




NWS Advanced Hydrologic Prediction Stage Chart - Missouri River at Plattsmouth, NE

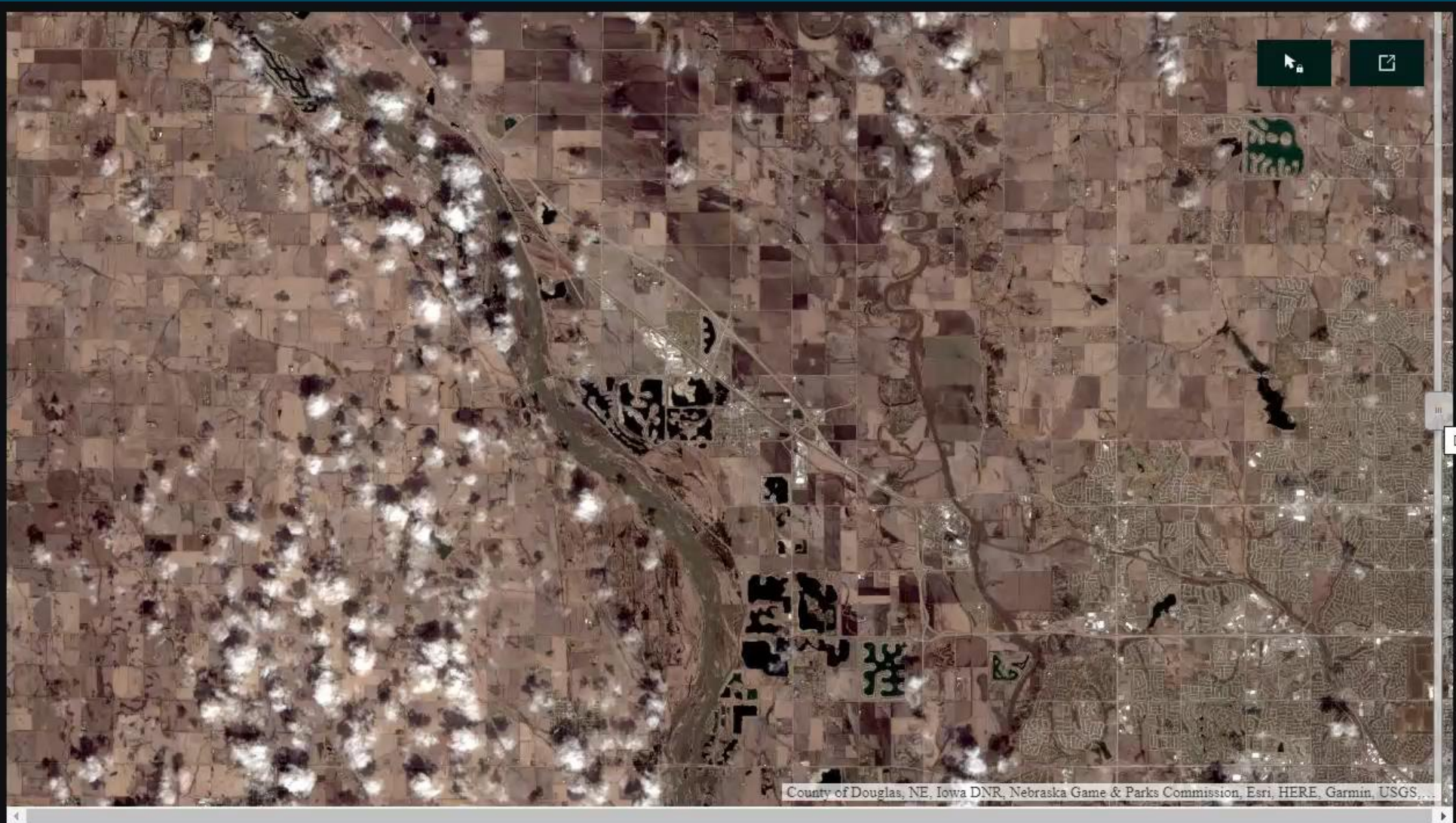
The Missouri River at Plattsmouth (above) recorded a crest of 40.62 feet.

*Nearly 4 feet over the previous record set in 2011.*

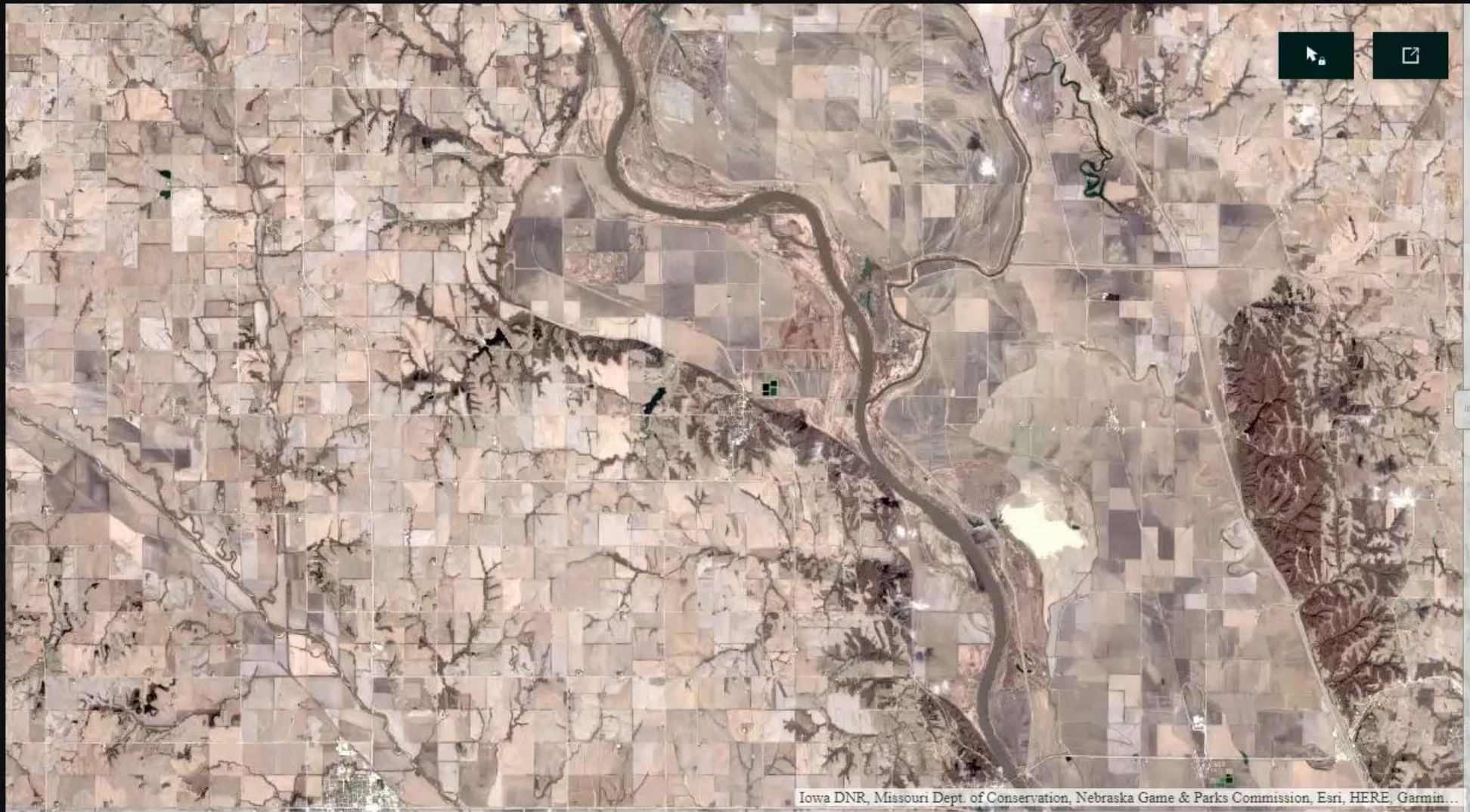


NWS Advanced Hydrologic Prediction Stage Chart - Niobrara River near Verdel, NE

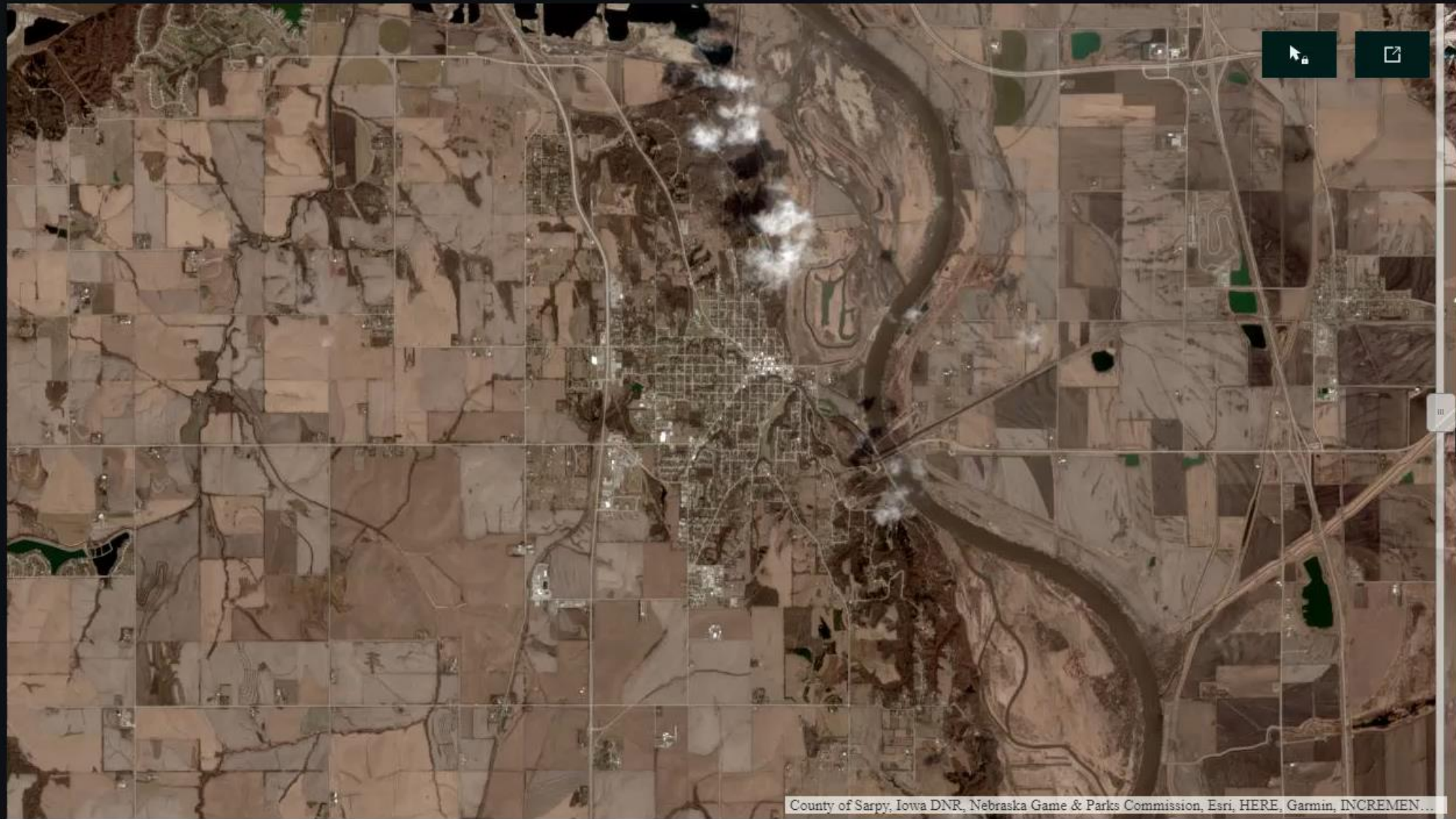
The Niobrara River crested at 6.8 feet above the previous record stage near Verdel, NE.



Flooding near Valley, NE



Flooding near Peru, NE



Flooding along 1-29 South of Omaha, NE



Large sheets of ice and sediment destroyed roads, levees and bridges that came in contact.

Ice on the Niobrara River measured 18 inches to 24 inches thick before the storm. Some ice chunks were estimated to have weighed as much as 3 tons.

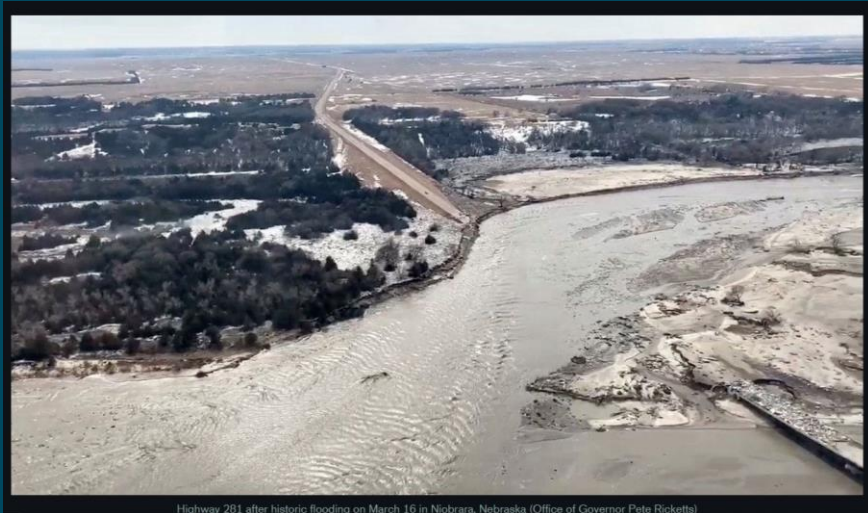


Collapsed bridge along the Niobrara River South of Naper, Nebraska



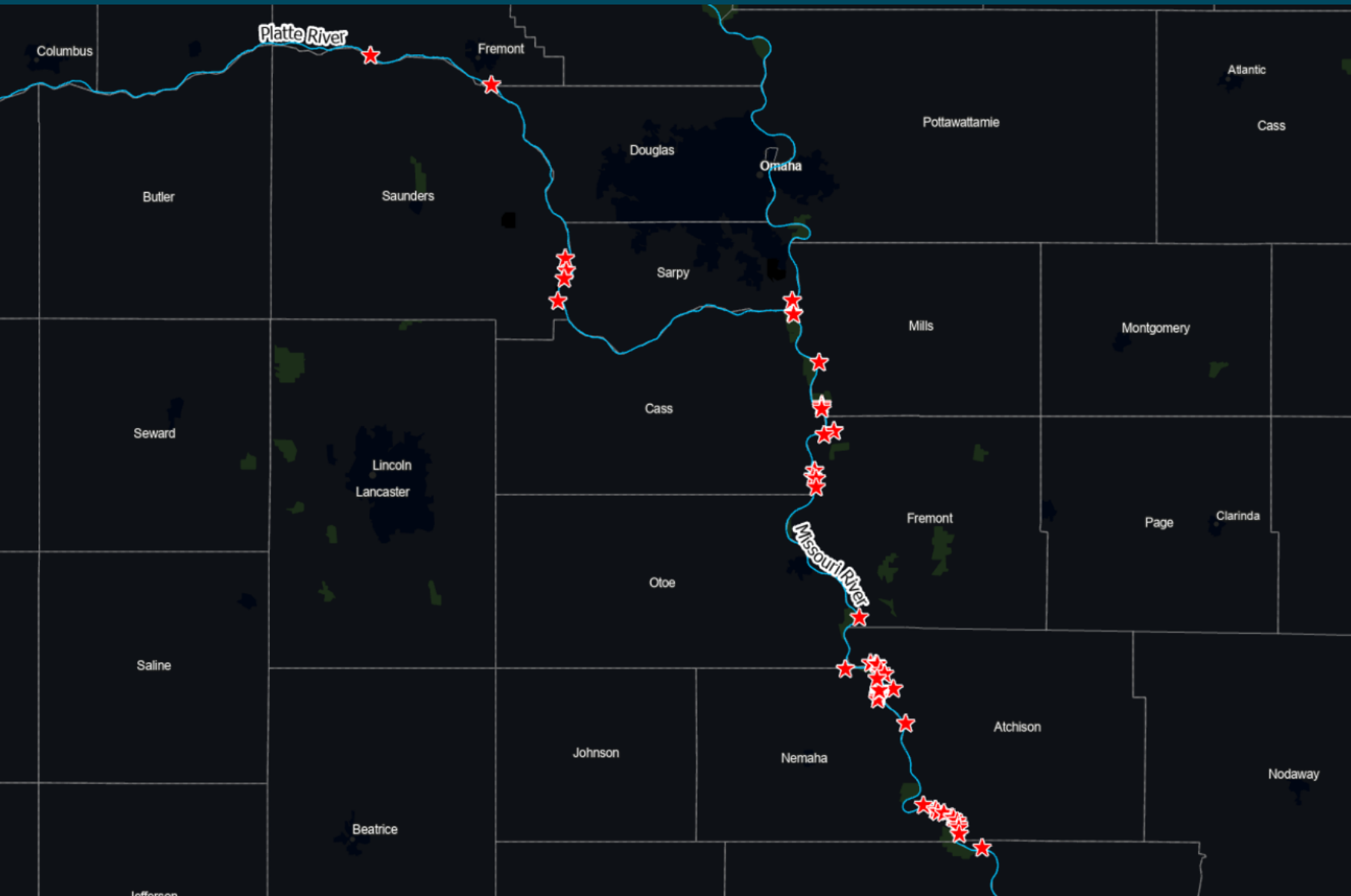


# Infrastructure damage



Highway 281 after historic flooding on March 16 in Niobrara, Nebraska (Office of Governor Pete Ricketts)





41 Breaches and nearly 350 miles of levees were damaged during the flood event.



National Guard Equipment becomes stranded after levee is breached.

Levees along the Platte and Missouri rivers received the most damage as both river systems reached record heights.



# Infrastructure damage



High rainfall and more flooding through summer and fall

# Future benefits

- Very little groundwater pumped this year
- Extensive groundwater recharge during the flooding
- Long-term benefits to the aquifer, for many years to come

# Flooding and future water planning efforts

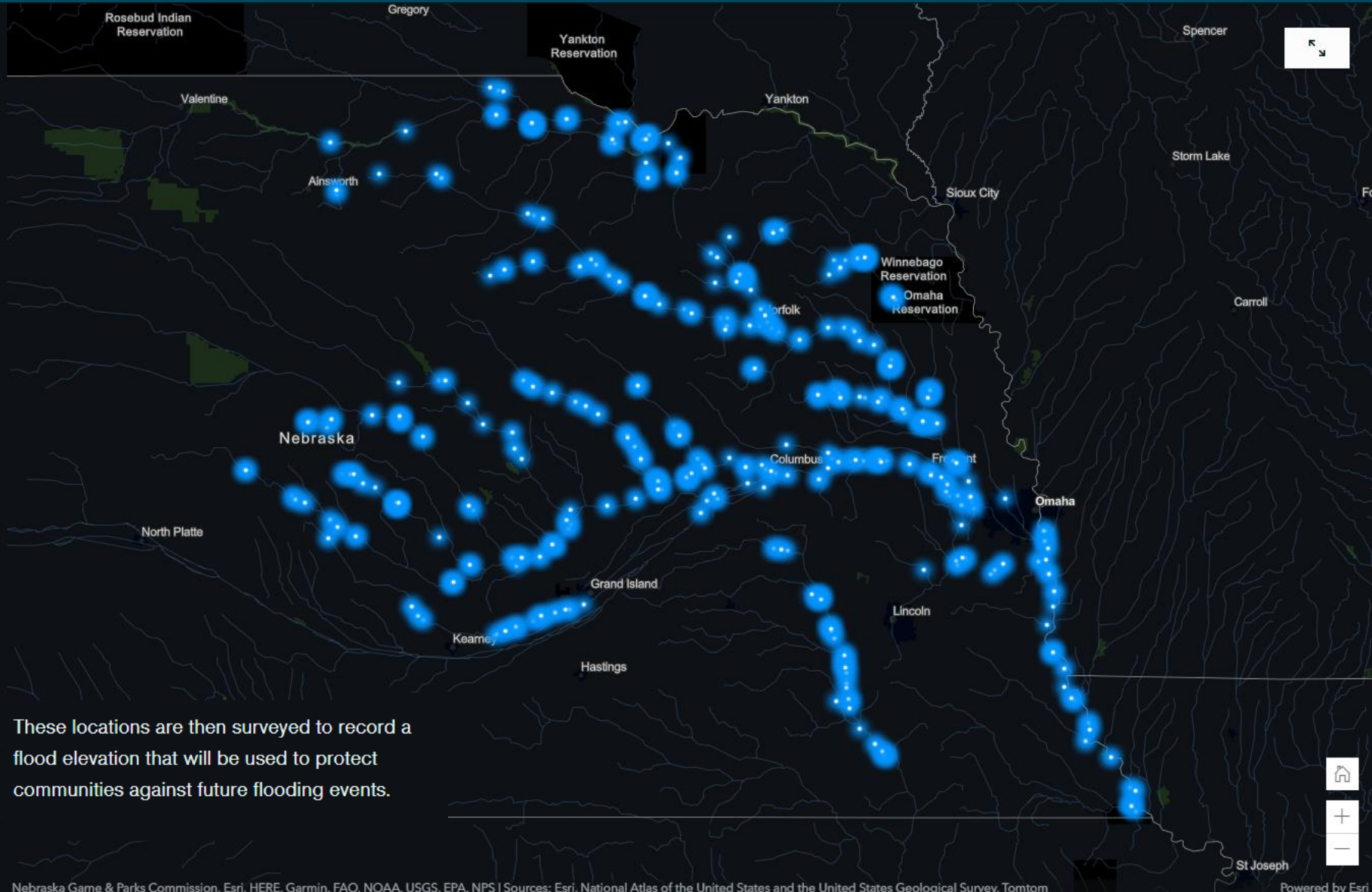
- Develop new flood maps and specifications

Visual evidence left behind by the high flood waters was recorded in a collaborative effort by several agencies.



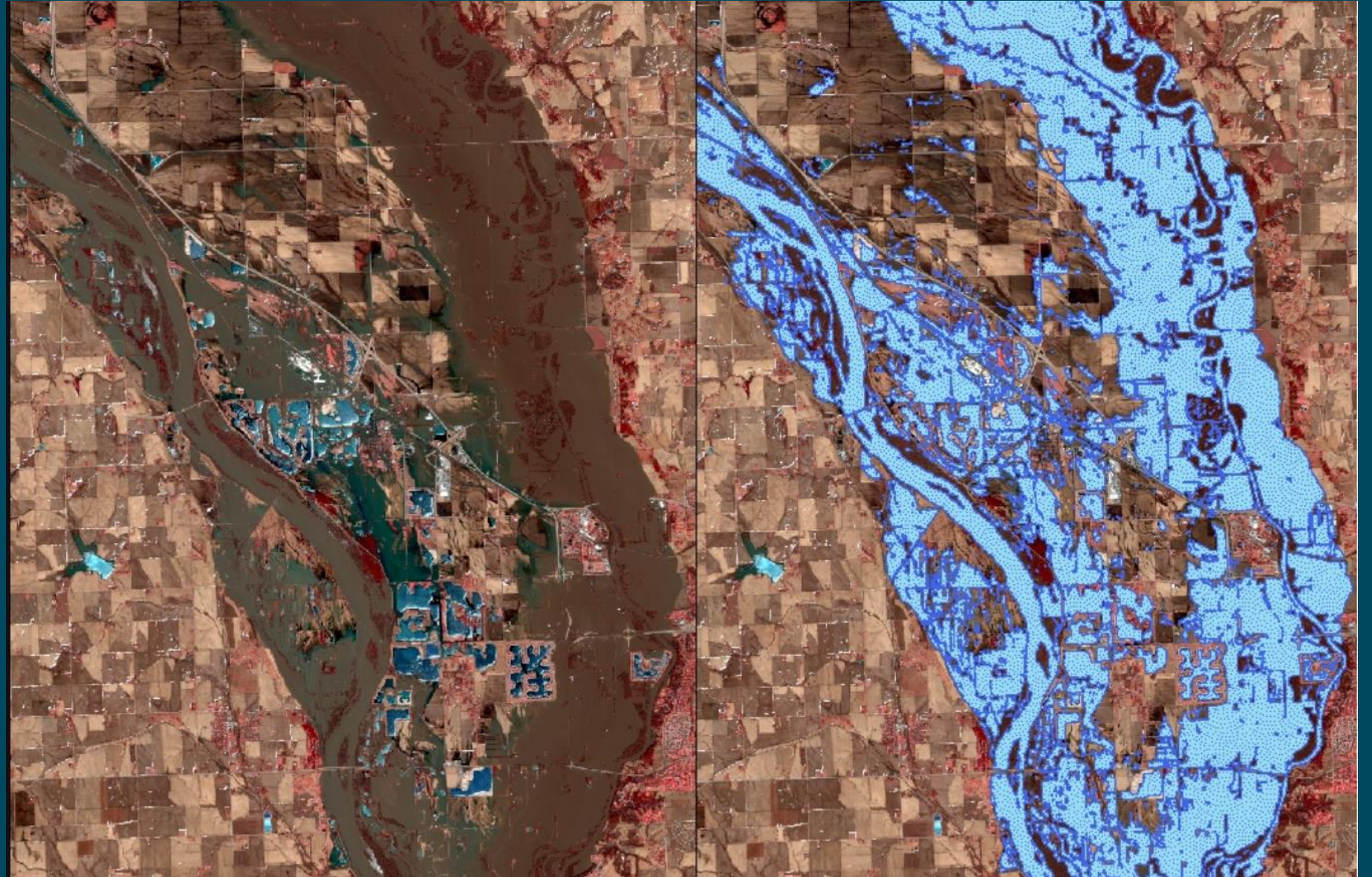
High Water Mark observed in Nebraska City, Nebraska.

- More than 700 High Water Marks were collected by the Nebraska Department of Natural Resources (NeDNR), USGS, USACE, NRCS, Lower Loup NRD and several local communities.

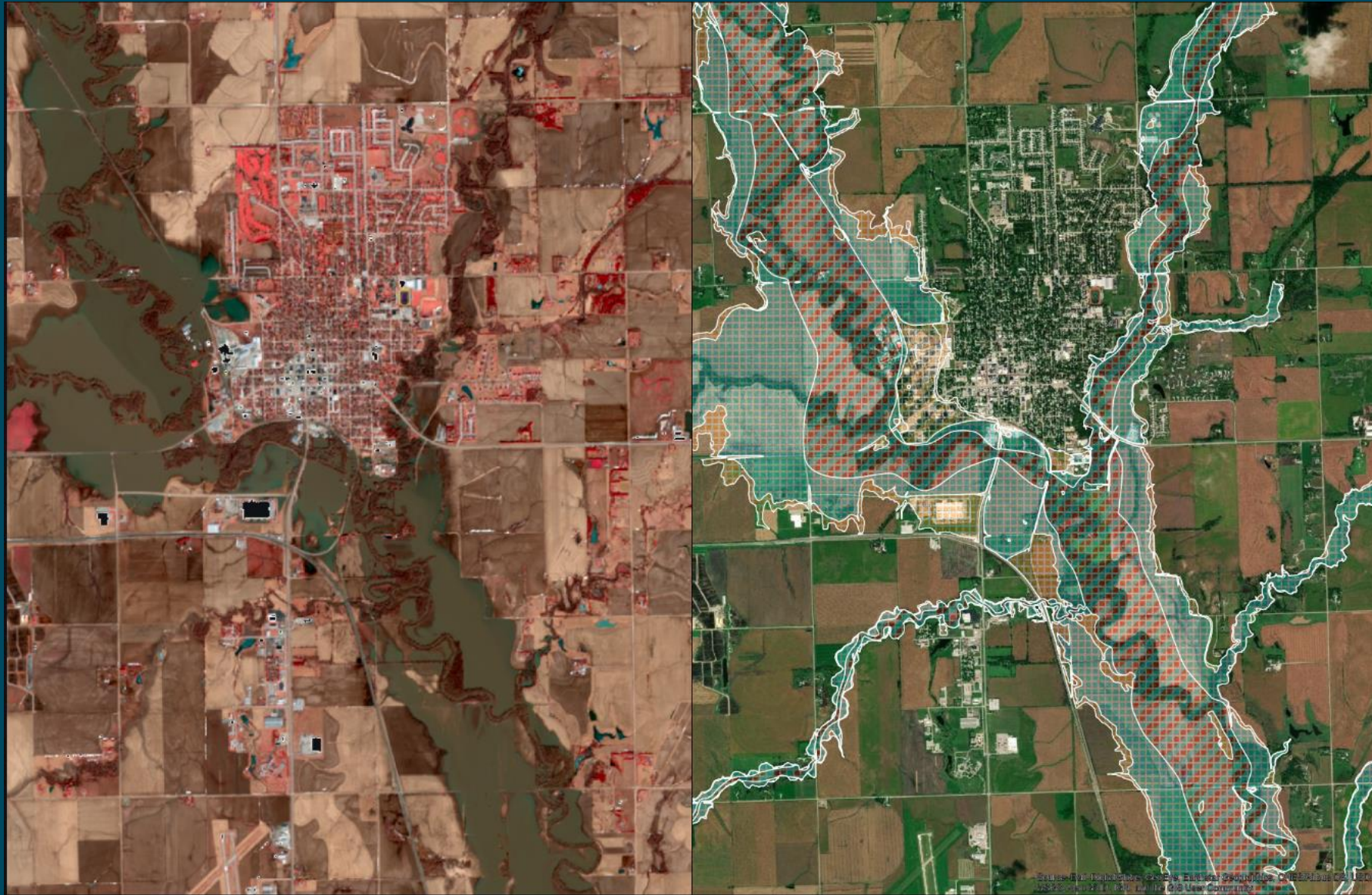


These locations are then surveyed to record a flood elevation that will be used to protect communities against future flooding events.

Created flood inundation digital boundaries to record the extent of the flood







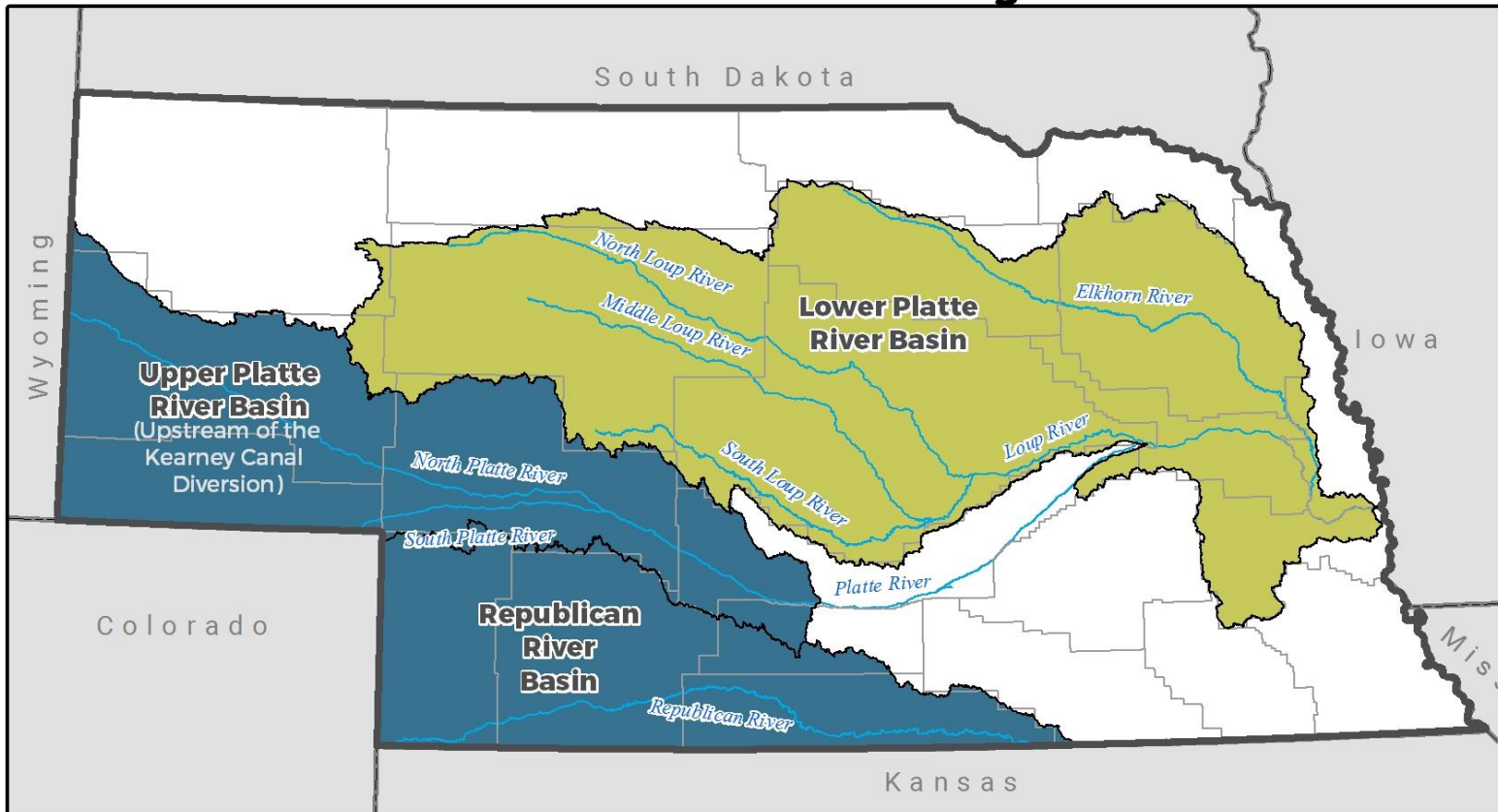
Compared actual  
flooding with  
existing floodplain  
maps

# Flooding and future water planning efforts

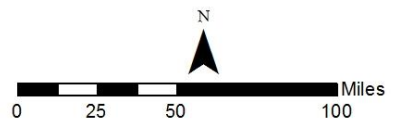
- Develop new flood maps and specifications
- Consider the potential for increased climate variability
  - What if floods become more frequent?
  - What if we experience prolonged drought?
- Diversify water sources
- Missouri River management
  - Governor seeking greater state role in river management and policies
  - Increasing coordination and dialog with neighboring states

# Drought Planning in Nebraska

## Current Basin-Wide Planning Areas



Status	
<span style="display:inline-block; width:15px; height:10px; background-color:darkblue; border:1px solid black;"></span> Required, Adopted	<span style="display:inline-block; width:15px; border-bottom:1px solid lightblue;"></span> Rivers
<span style="display:inline-block; width:15px; height:10px; background-color:lightgreen; border:1px solid black;"></span> Voluntary, Adopted	<span style="display:inline-block; width:15px; border-bottom:1px solid gray;"></span> NRD Boundary



Created by NeDNR | AJP 02/22/2019

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# THANK YOU

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# Story map

➤ <https://storymaps.arcgis.com/stories/9ce70c78f5a44813a326d20035cab95a>