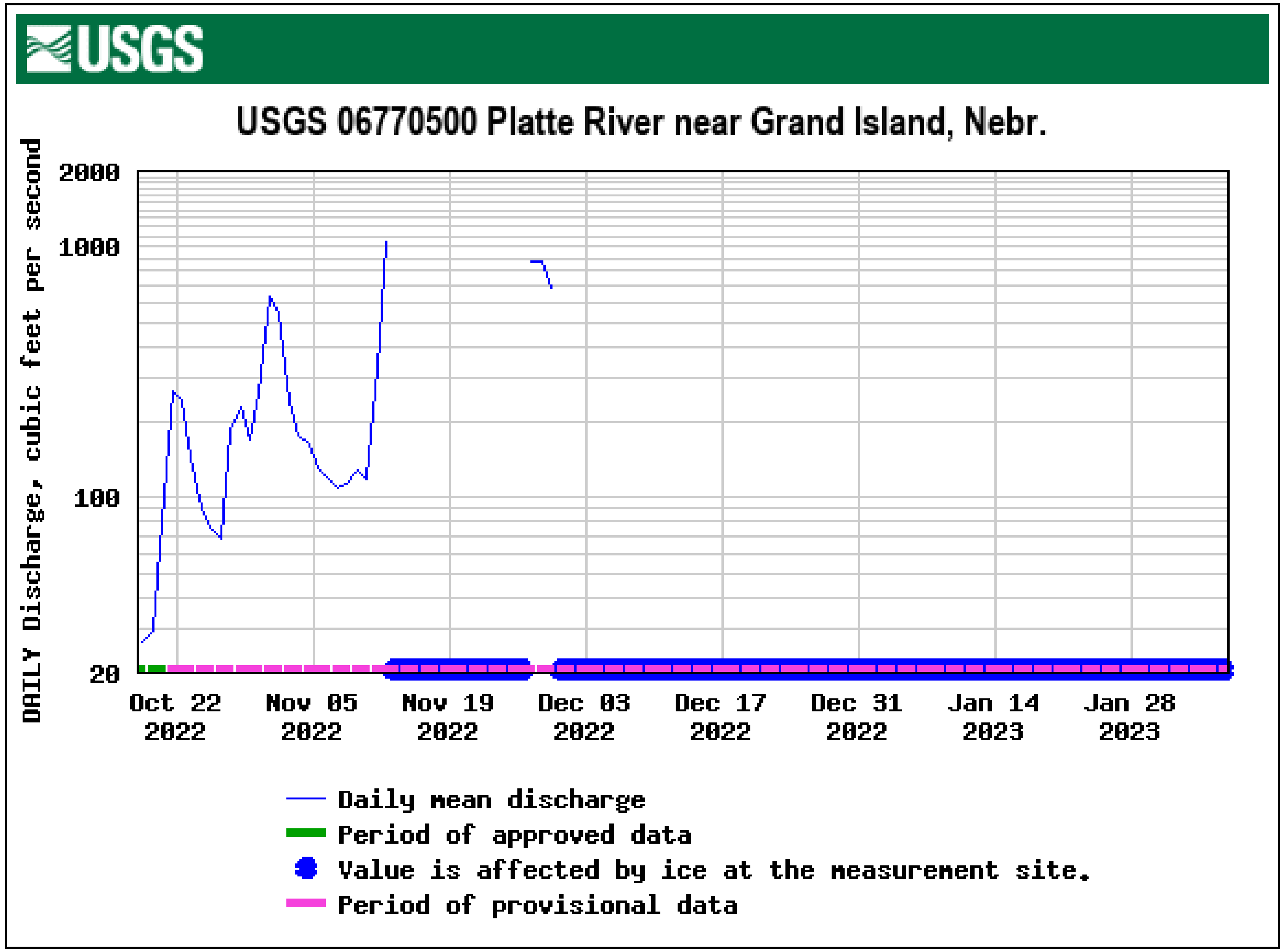
Platte Basin Hydrology Update

PRRIP Water Advisory Committee

February 7, 2023

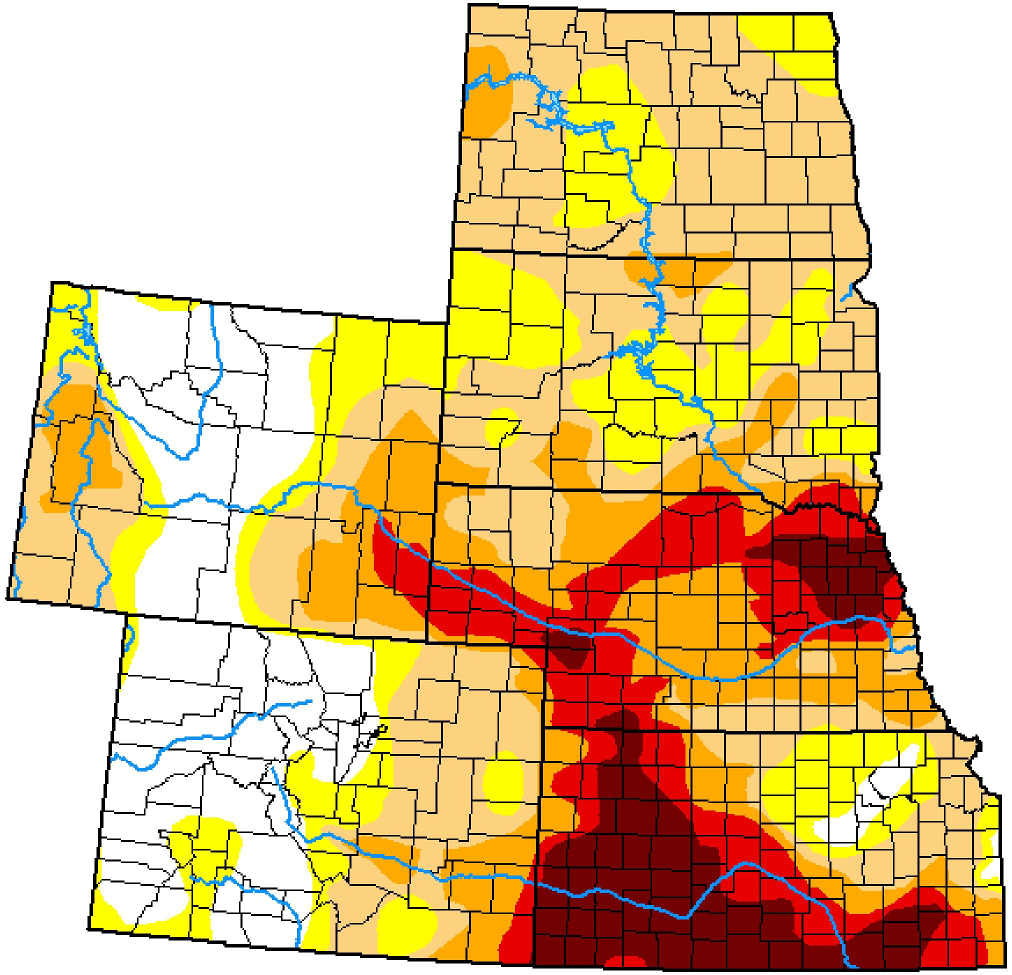
Ed Weschler, E.I.

Flow updates: Ice!



U.S. Drought Monitor

High Plains



January 31, 2023

(Released Thursday, Feb. 2, 2023)

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	16.96	83.04	64.72	33.25	17.12	7.57
Last Week 01-24-2023	15.12	84.88	64.87	33.80	17.23	7.57
3 Months Ago 11-01-2022	6.16	93.84	76.17	45.63	20.50	7.93
Start of Calendar Year 01-03-2023	13.54	86.46	66.35	37.03	18.35	7.83
Start of Water Year 09-27-2022	7.60	92.40	66.34	33.68	15.17	5.92
One Year Ago 02-01-2022	9.05	90.95	66.11	36.24	6.99	0.00

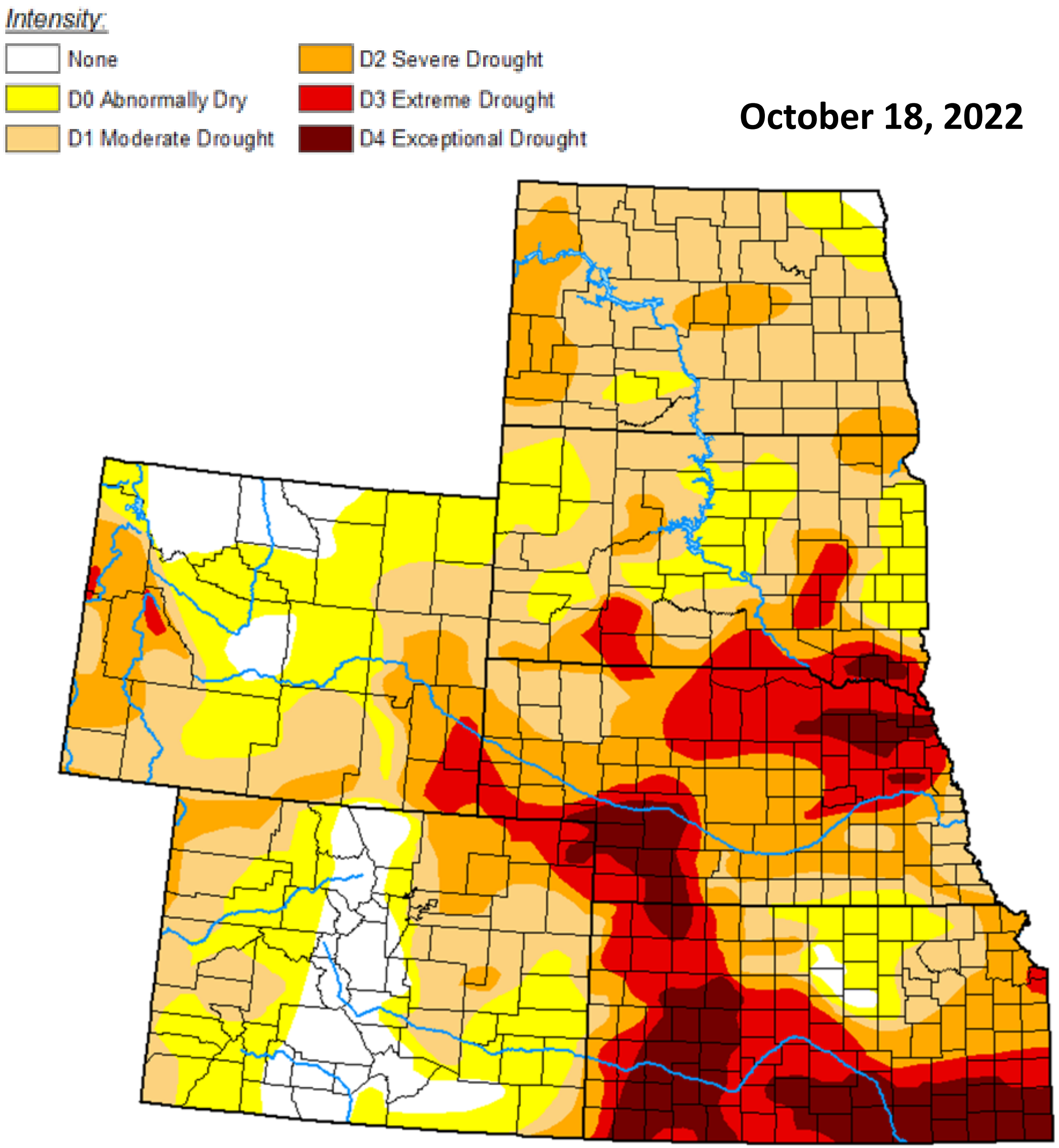
Intensity:

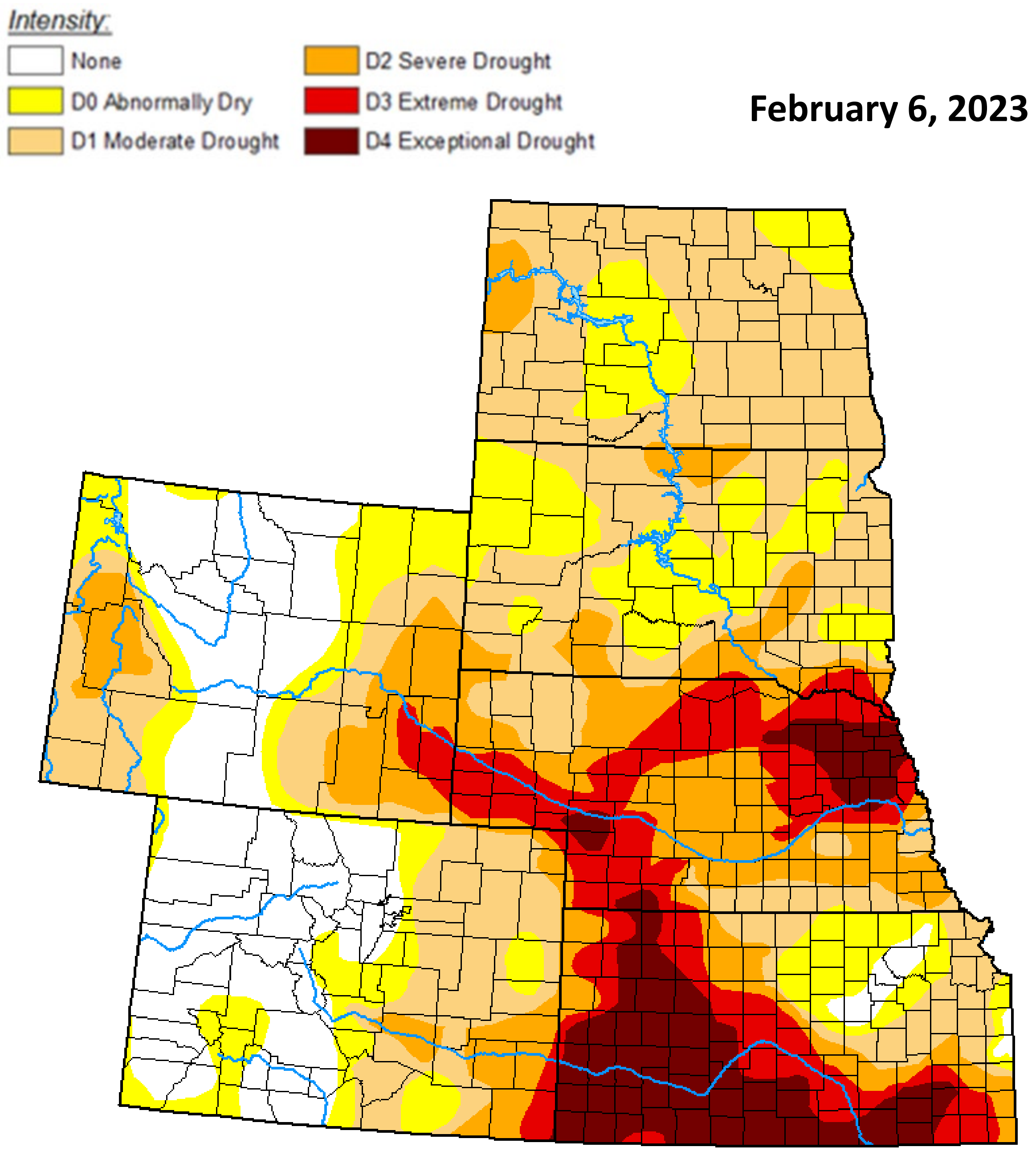
- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

Author:
Rocky Bilotta
NCEI/NOAA

droughtmonitor.unl.edu


Intensity:
None
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
October 18, 2022


Intensity:
None
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
February 6, 2023

Colorado
SNOTEL Current Snow Water Equivalent (SWE) % of Normal

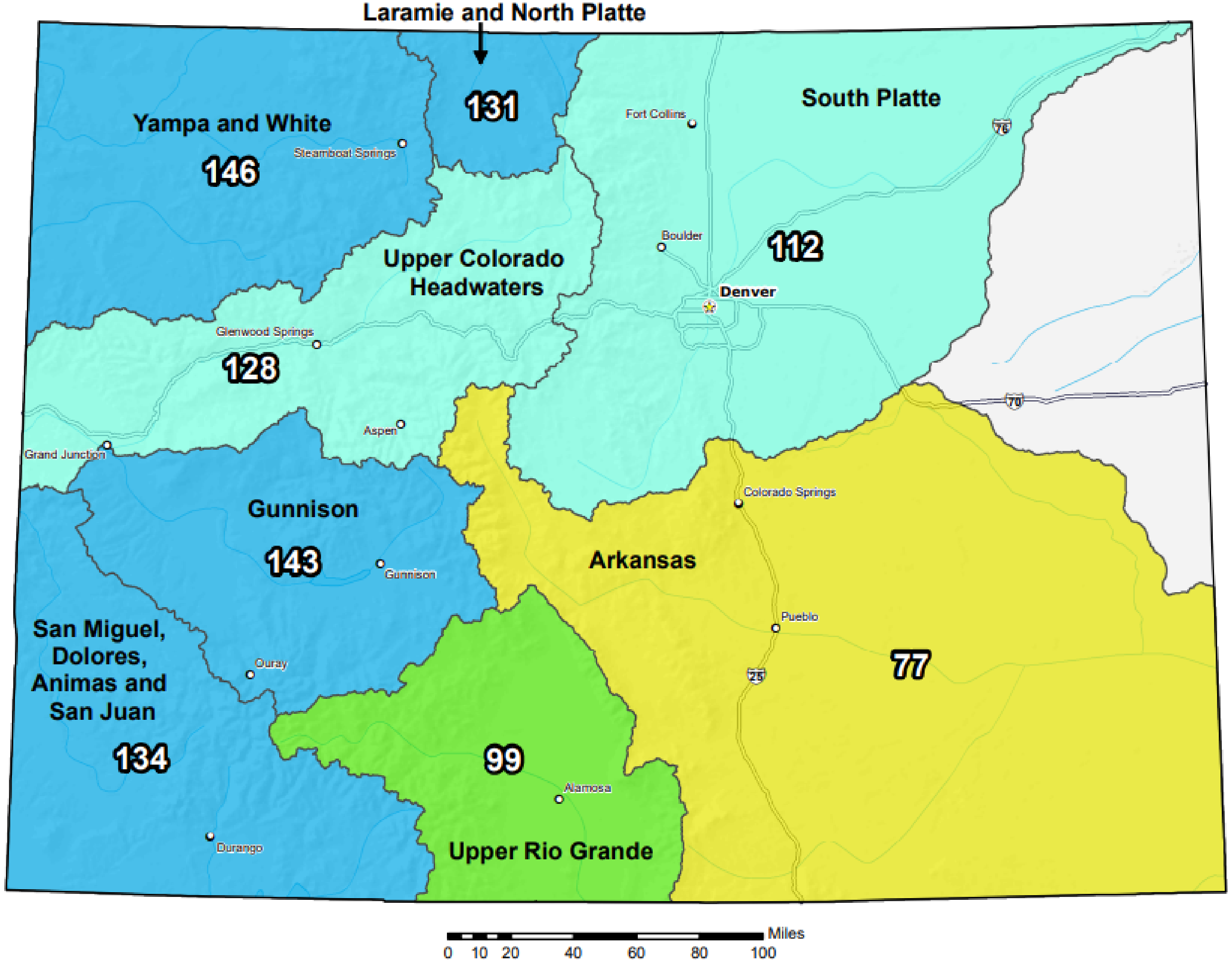
Feb 06, 2023

Current Snow Water Equivalent (SWE) Basin-wide Percent of 1991-2020 Median

- unavailable *
- <50%
- 50 - 69%
- 70 - 89%
- 90 - 109%
- 110 - 129%
- 130 - 149%
- >=150%

** Data unavailable at time of posting or measurement is not representative at this time of year*

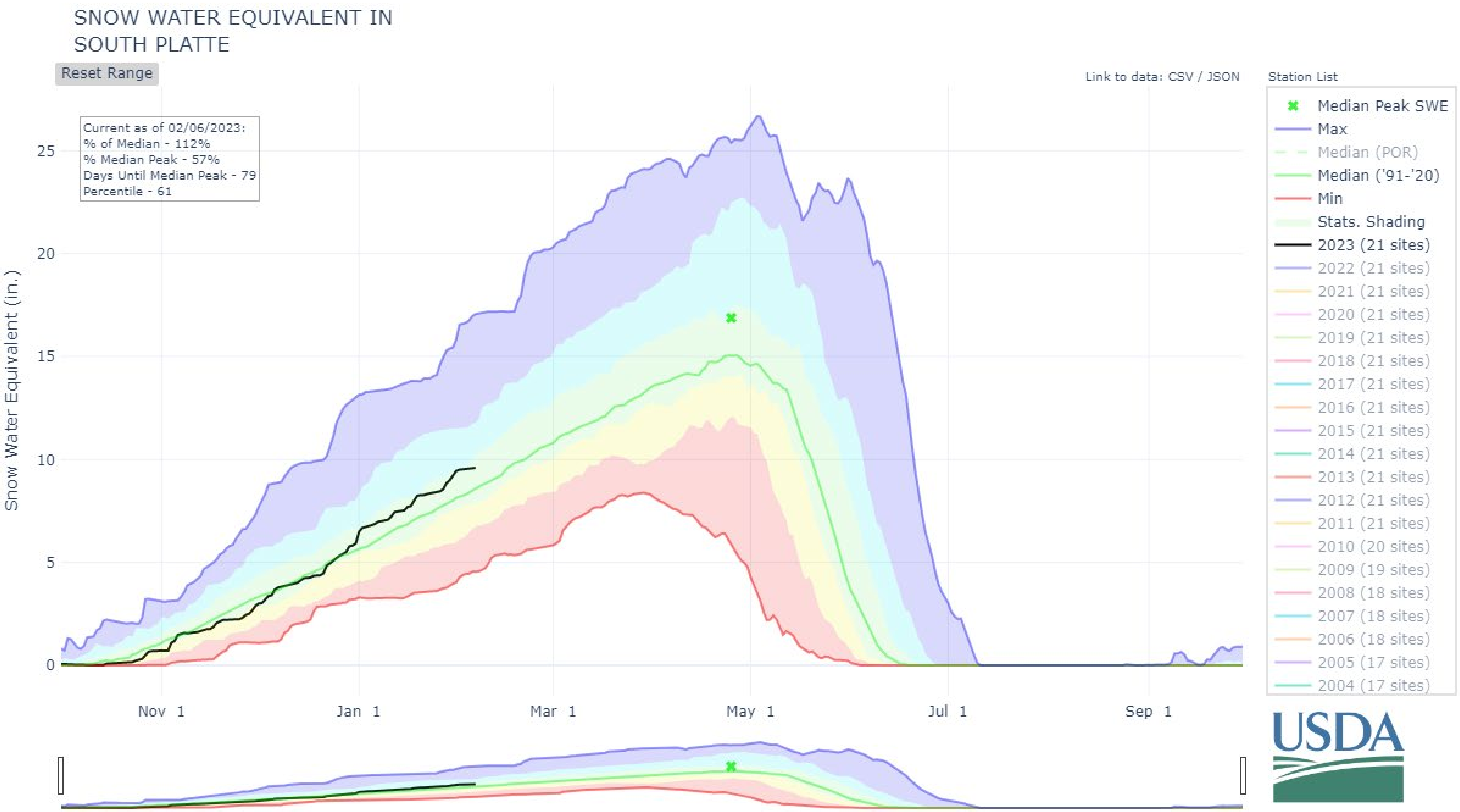
Provisional Data Subject to Revision



USDA NRCS

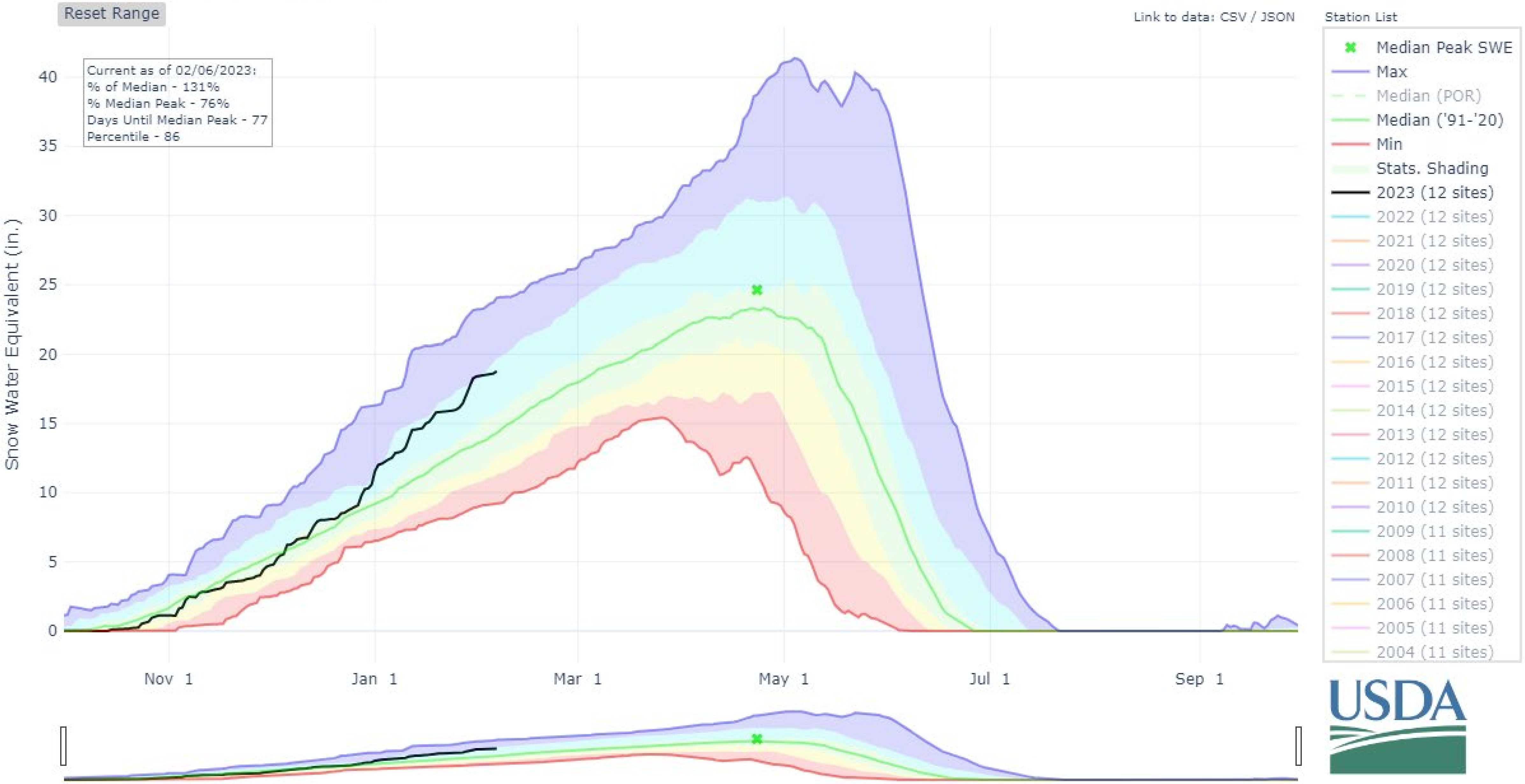
The snow water equivalent percent of normal represents the current snow water equivalent found at selected SNOTEL sites in or near the basin compared to the average value for those sites on this day. Data based on the first reading of the day (typically 00:00).

Prepared by:
USDA/NRCS National Water and Climate Center
Portland, Oregon
https://www.nrcs.usda.gov/wps/portal/wcc/home/



SNOW WATER EQUIVALENT IN
SOUTH PLATTE
Reset Range
Link to data: CSV / JSON
Station List
Current as of 02/06/2023:
% of Median - 112%
% Median Peak - 57%
Days Until Median Peak - 79
Percentile - 61
Snow Water Equivalent (in.)
25
20
15
10
5
0
Nov 1
Jan 1
Mar 1
May 1
Jul 1
Sep 1
Median Peak SWE
Max
Median (POR)
Median ('91-'20)
Min
Stats. Shading
2023 (21 sites)
2022 (21 sites)
2021 (21 sites)
2020 (21 sites)
2019 (21 sites)
2018 (21 sites)
2017 (21 sites)
2016 (21 sites)
2015 (21 sites)
2014 (21 sites)
2013 (21 sites)
2012 (21 sites)
2011 (21 sites)
2010 (20 sites)
2009 (19 sites)
2008 (18 sites)
2007 (18 sites)
2006 (18 sites)
2005 (17 sites)
2004 (17 sites)
USDA

SNOW WATER EQUIVALENT IN LARAMIE AND NORTH PLATTE



Questions?

Elwood Reservoir Projects

2/7/23


Johnson Reservoir
Johnson Lake
Canal
Siphon
Existing Siphon
Capacity = 350 cfs
Elwood Reservoir
Canal Capacity = 650 cfs
Downstream Demand = 500+ cfs
283
23
Google Earth

Elwood Reservoir Background

- Elwood Reservoir was constructed in mid to late 1970s
- Purpose is to supplement canal flows when irrigation demand (up to 500+ cfs) exceeds upstream siphon capacity (350 cfs)
- Water is pumped into Elwood in the spring and released for irrigation
- Maximum water surface elevation of 2607
- Maximum live storage of 25,700 AF
- Maximum total storage of 37,800 AF

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Nebraska Public Power and Irrigation District

Elwood Reservoir Seepage

- In recent years the average water surface elevation has been higher due to recharge
- In summer of 2019 we noticed significant seepage at the Pump Station Dam
- Hired RJH consultants to investigate
- RJH determined that there was potentially unsafe seepage at the Pump Station Dam and the Main Dam when the WSE is above 2597
- Temporary max WSE 2597 until repairs are made

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Nebraska Public Power and Irrigation District


12.05.2019

Elwood Seepage Repair Status

- Maximum WSE temporarily limited to 2597
- Design completed
- State has approved the design
- RJH construction estimate is $4.2 million
- Bids have been received and are being evaluated
  - 3 Bids ranging from $3.8 million to $6.2 million
- Construction to begin after July 17, 2023 and be completed by summer 2024

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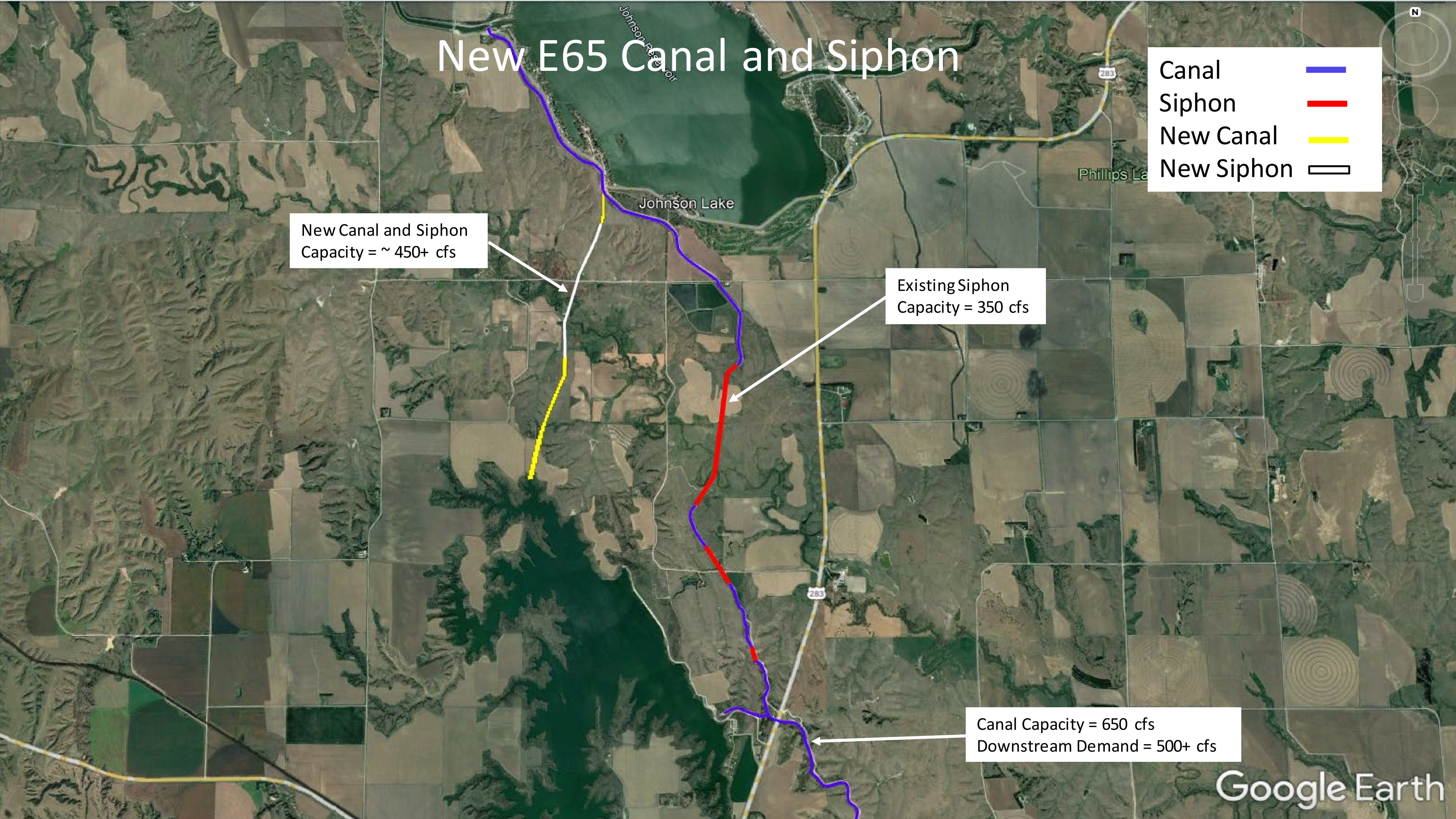
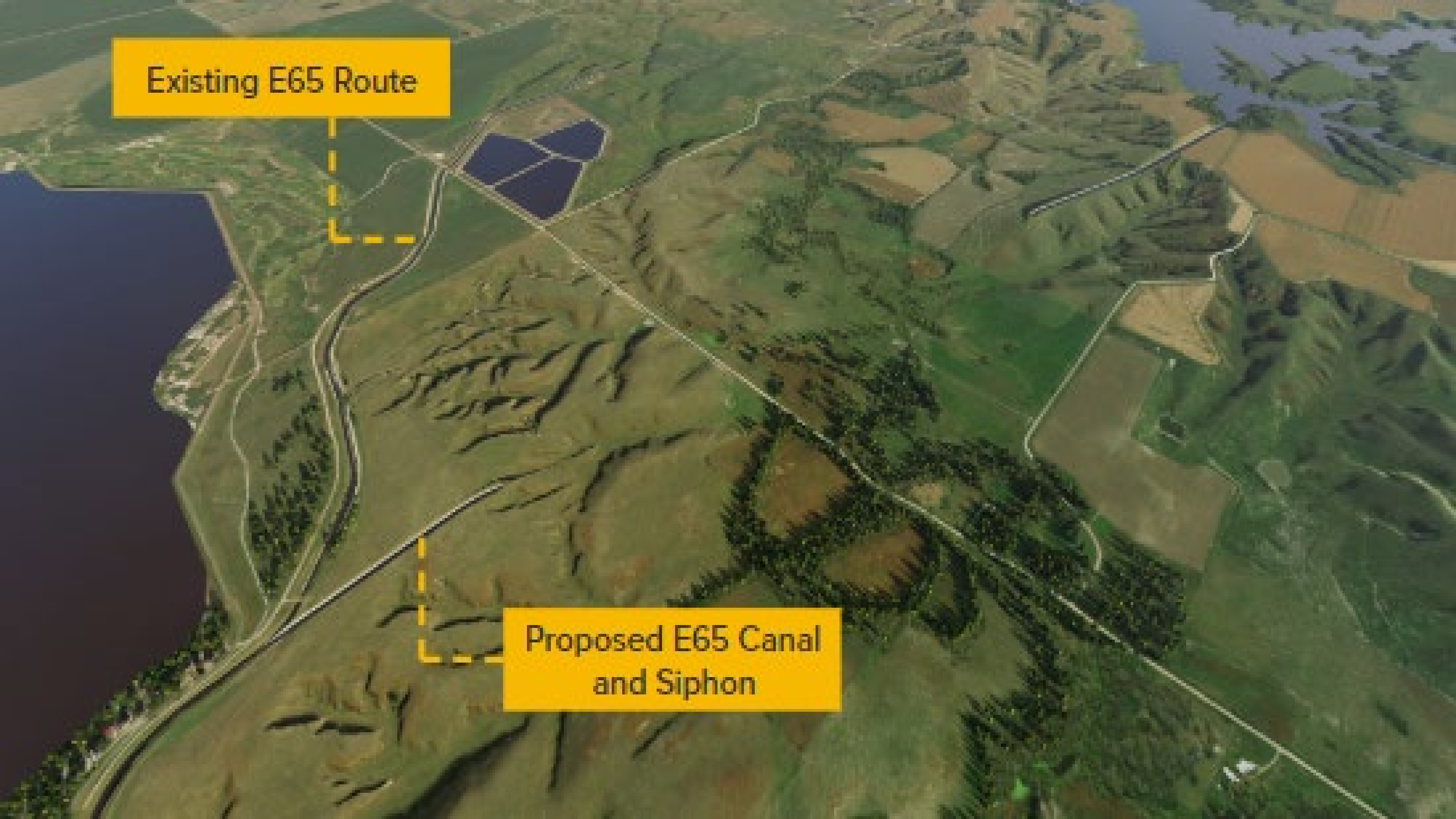
Nebraska Public Power and Irrigation District

New E65 Canal and Siphon




Existing E65 Route
Proposed E65 Canal and Siphon

Existing E65 siphons

- Siphons have been in service for over 80 years
- 78” – 84” steel pipes
- Approximately 7,300 ft in total length
- Capacity is only 350 cfs
- Pipes are near the end of useful life

New E65 Canal and Siphon

- Approximately 5,500 ft of new canal and 5,800 ft of new siphon
  - New alignment is approximately 2 miles shorter than existing
- ~102” outside diameter fusion welded HDPE pipe for the siphon
- Gravity flow water into Elwood instead of pumping
- Capacity is estimated at approximately 450+ cfs
  - Increase conveyance to better meet irrigation demand
    - Increase amount of storage availability in Elwood (ie. Recharge)
- Save water by allowing Central to capture rejected irrigation water in Elwood after rains

CENTRAL Nebraska Public Power and Irrigation District

New E65 Canal and Siphon Status

- Feasibility Study completed by JEO
- Estimated Construction cost of $15 million
- Applied for and received a Water Sustainably Fund Grant for $8.9 million
- Received 3 proposals
- Central selected JEO/HDR to design the project
- Design anticipated to be completed January 2024
- Construction beginning early 2024
- Project anticipated to be completed by the end of 2024

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Nebraska Public Power and Irrigation District

Questions?

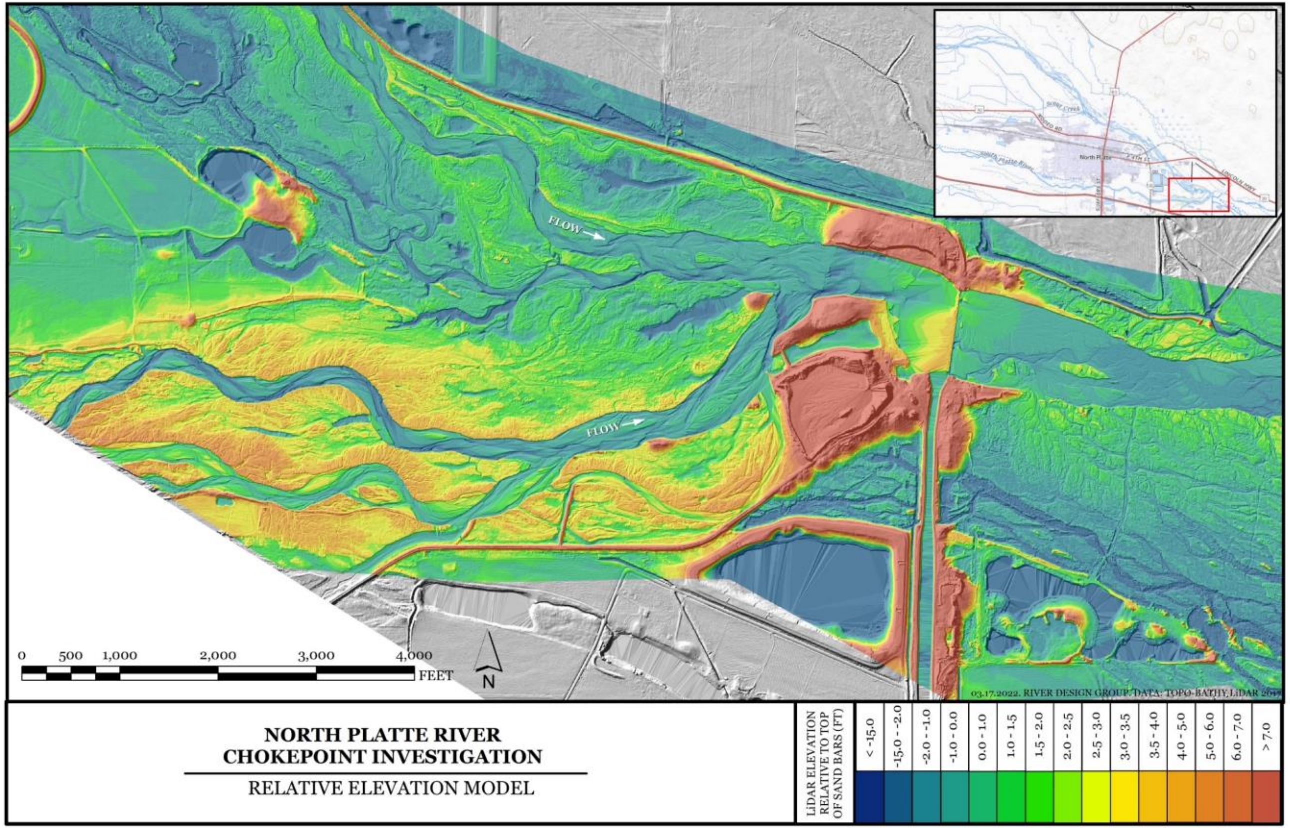
North Platte River Chokepoint Investigation

RDG Study & Final Report

WAC Meeting

February 7, 2023

Melissa M Mosier



Audubon

Pre-Study Scoping & Social Science

Scope of VESPR's RFP refined by:

- Conversations with NEMA
- Conversations with NeDNR Floodplain
- Preliminary interviews with North Platte community members

Parallel social science study

- Investigating community connections and perceptions of the rivers
- Looking for overlap between potential chokepoint solutions and community needs
- Broadening funding pool for future work

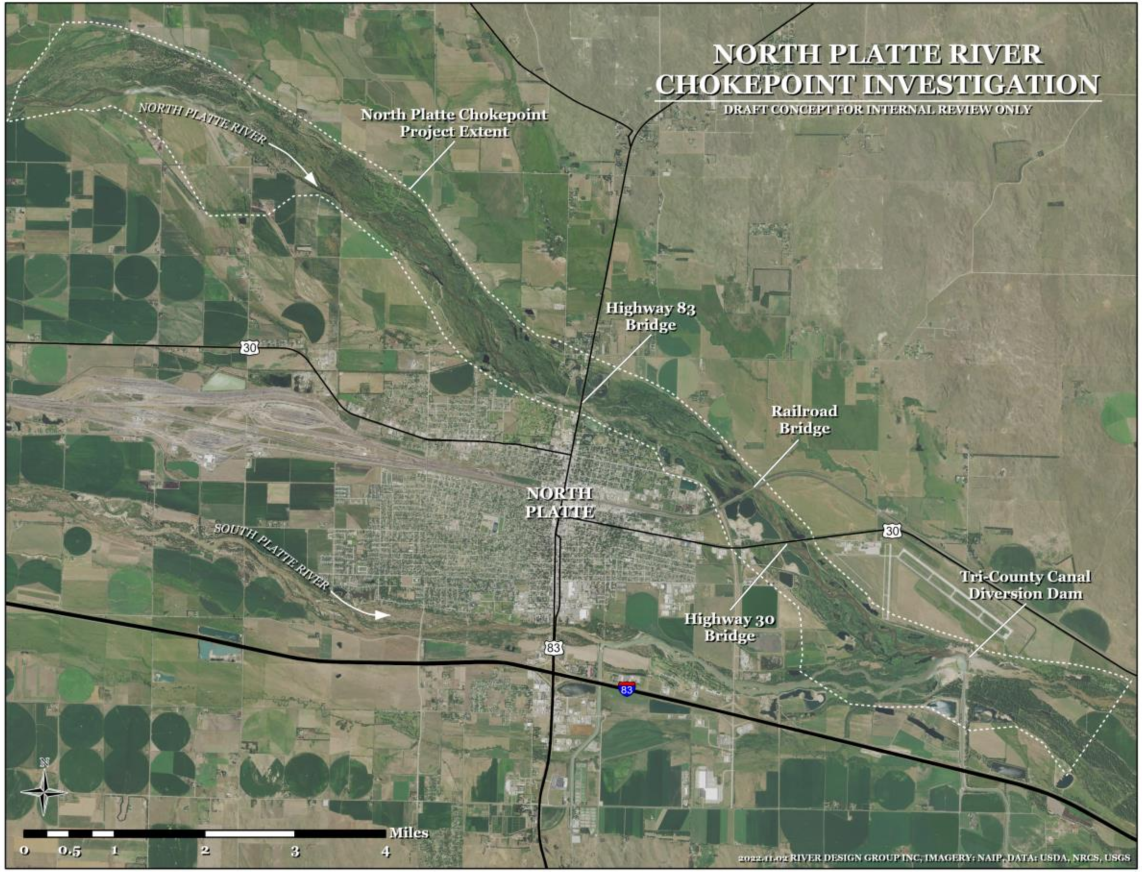
Funding & Timeline

Funded by VESPR participants

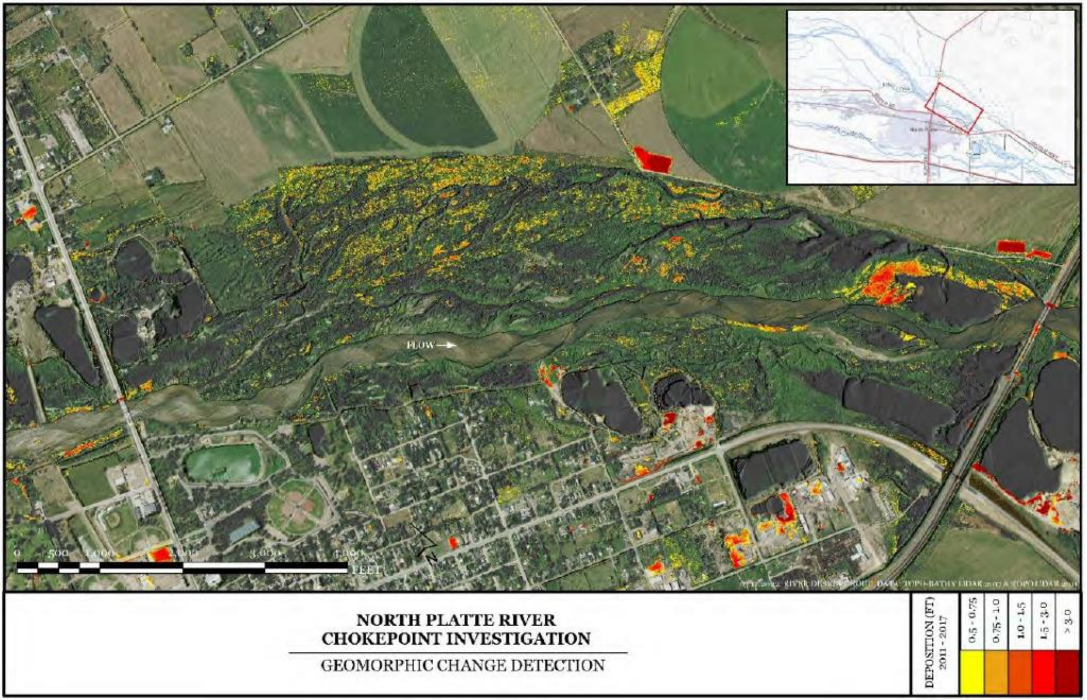
- The Crane Trust
- Nebraska Game & Parks Commission
- Audubon
- The Nature Conservancy
- Ducks Unlimited

Study Timeline

- RFP released January 2022
- Proposals submitted February 2022
- Consultants hired March 2022
- North Platte site visit June 2022
- RDG draft report October 2022
- Houston peer review December 2022
- Final report January 2023



Audubon



Key Questions in VESPR RFP

1. What are the major factors contributing to a loss of channel capacity at the North Platte Chokepoint Reach?
2. What is the flooding risk to the city of North Platte under various high flow conditions?
3. What is the projected future capacity at the North Platte Chokepoint under various management conditions?
4. What potential actions could increase capacity through the North Platte Chokepoint?

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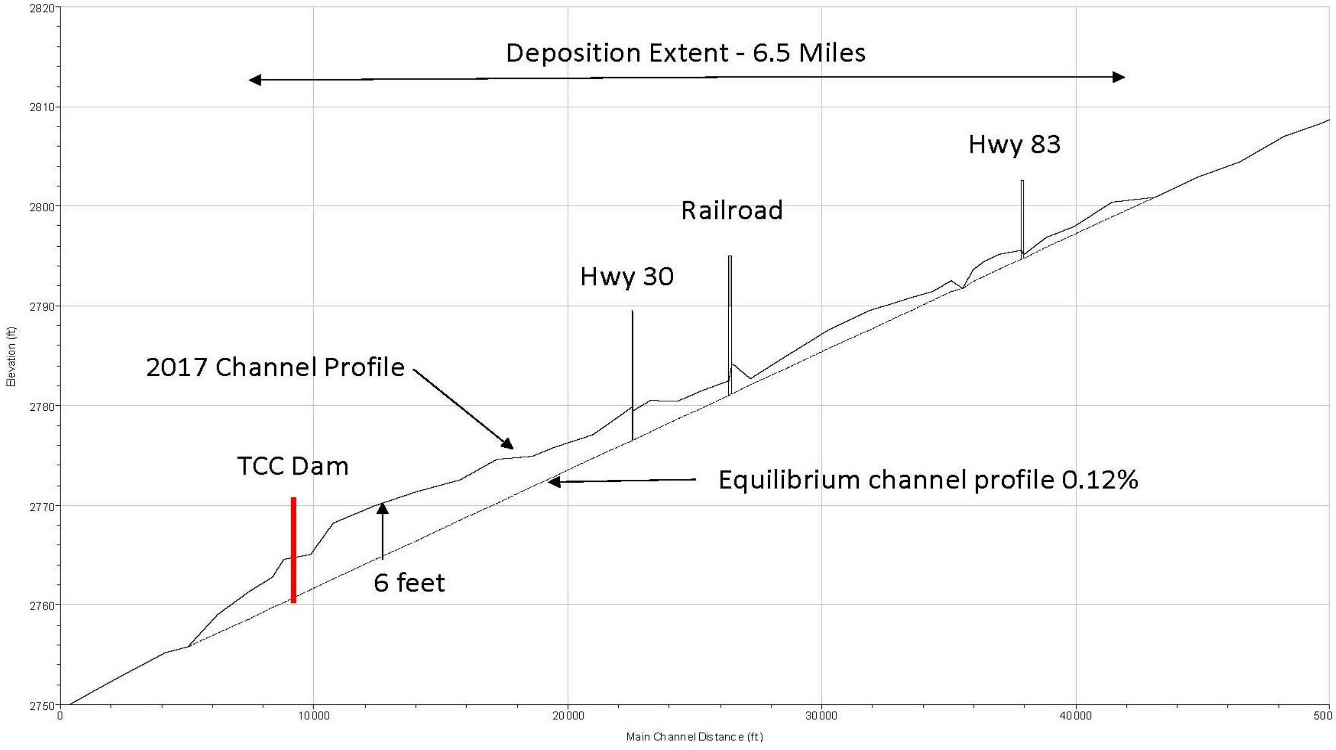
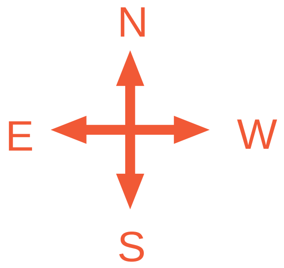
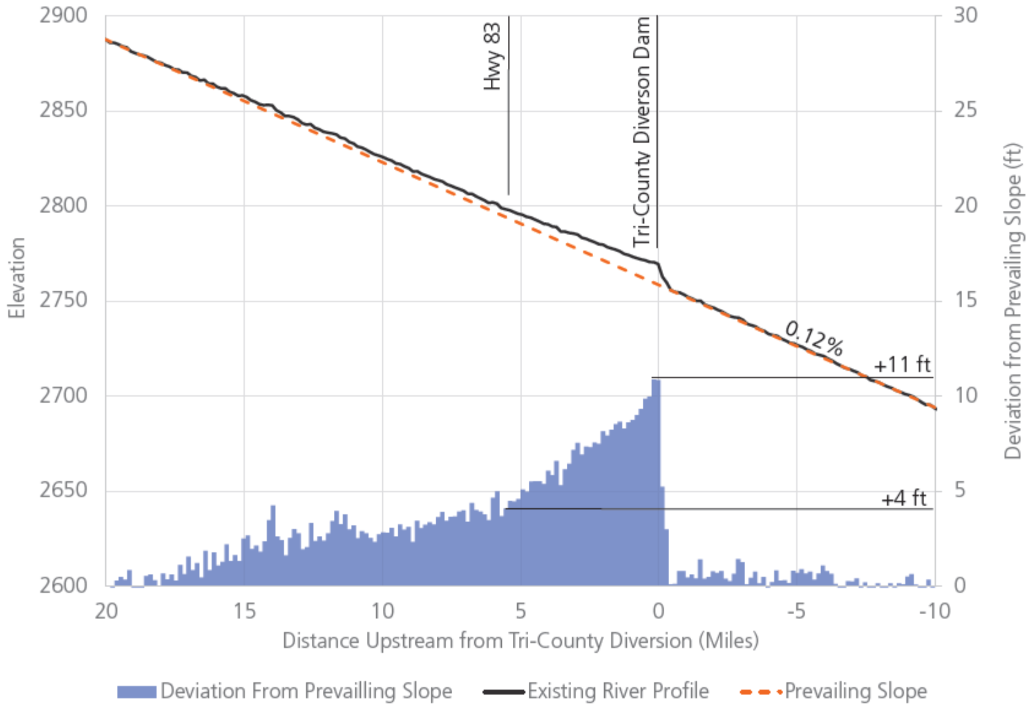
#1 – Contributing Factors



North Platte River Channel Profile

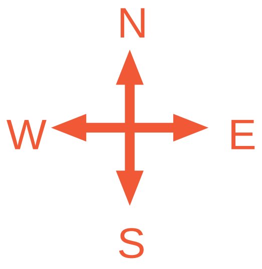


#1 – Contributing Factors



Profile of North Platte River bed elevation data through the chokepoint developed using publicly available data.

North Platte River Channel Profile



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Hydraulic Modeling Scenarios

10 modeling scenarios to evaluate sensitivity of channel capacity to key variables:

- Slope – TCCDD backwater
- Area - Sediment aggradation
- Area - bridge constrictions
- Roughness - vegetation

Table 3-3. Hydraulic modeling scenarios for the North Platte Chokepoint Investigation.

Scenario	Condition Modeled	Question Addressed
1	Existing conditions	Current channel capacity
2	Removal of bridge structure	Effect of bridge on capacity
3	Increase bridge openings to 500 ft	Effect of constrictions on capacity
4	Increase bridge openings to 1,000 ft	Effect of constrictions on capacity
5	Remove Tri-County Canal Diversion Dam	Effect of dam on capacity
6	Bypass dam and dredge 200-ft width through reach	Effect of aggradation on capacity
7	Bypass dam and dredge 500-ft width through reach	Effect of aggradation on capacity
8	Bypass dam and dredge 1000-ft width through reach	Effect of aggradation on capacity
9	Remove vegetation to 500-ft width	Effects of vegetation on capacity
10	Remove vegetation to 1000-ft width	Effects of vegetation on capacity

Modeling Results – Bridge Constrictions

Table 4-1. Increase in channel capacity at bridge locations for widening the openings to 1,000 feet.

Increase in capacity at Highway 83 (Existing width = 320 feet)	Increase in capacity at Union Pacific Railroad (Existing width = 250 feet)	Increase in capacity at Highway 30 (Existing width = 560 feet)
+ 96 (7%) at 1,334 cfs	+ 443 (30%) at 1,473 cfs	No increase
+ 551 (20%) at 2,773 cfs	+ 930 (33%) at 2,786 cfs	
+ 1,189 (24%) at 4,906 cfs	+ 1,886 (41%) at 4,626 cfs	
+ 2,042 (24%) at 8,362 cfs	+ 1,434 (18%) at 8,125 cfs	

- The bridges constrict the North Platte floodplain by as much as 85%.
- Modeling found that bridge constrictions contribute to ***localized*** effects on channel capacity and effects are relatively minor for moderate flows up to 3,000 cfs.
- Sedimentation effects from the TCCDD extend upstream through the three bridges.
- **Increasing the width of the bridge openings is not a sustainable solution without addressing TCCDD operations and reach-scale aggradation.**

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Modeling Results – Vegetation Encroachment

Table 4-2. Increase in channel capacity at bridge locations for vegetation removal within 1,000 feet of the active channel.

Increase in capacity at Highway 83	Increase in capacity at Union Pacific Railroad	Increase in capacity at Highway 30
+ 119 (10%) at 1,143 cfs	+ 106 (7%) at 1,473 cfs	+ 119 (10%) at 1,143 cfs
+ 153 (6%) at 2,576 cfs	+ 186 (7%) at 2,786 cfs	+ 153 (6%) at 2,576 cfs
+ 183 (4%) at 4,573 cfs	No increase	+ 183 (4%) at 4,573 cfs
+ 654 (9%) at 7,080 cfs	No increase	+ 654 (9%) at 7,080 cfs

- The current hydrologic regime supports vegetation establishment and vegetation encroachment in the channel, and contributes to reach-scale deposition.
- If vegetation was removed on a reach scale, channel capacity would increase by less than 10% for flows up to 7,000 cfs.
- Reach-scale vegetation removal may provide short-term benefits for habitat and capacity, but benefits would be temporary due to the lack of historic disturbance regimes such as floods and fires.
- **Vegetation removal is not a sustainable solution without addressing TCCDD operations, reach-scale aggradation, and Kingsley Dam operations.**

Modeling Results – Dredging Scenarios

Table 4-3. Modeled flood stage capacity at the Highway 83 Bridge for dredging scenarios.

Scenario	Flood Stage Capacity (cfs)	Dredge volume (cubic yards)
Existing Conditions	1,775	N/A
Dredge 200 feet wide	4,678	1,500,000
Dredge 500 feet wide	7,868	3,700,000
Dredge 1,000 feet wide	> 12,000	7,400,000

- Three dredging scenarios were simulated using the hydraulic model.
- Scenarios included dredging a channel seven miles through the Chokepoint Reach at the estimated equilibrium channel slope of 0.12% for widths of 200 feet, 500 feet and 1,000 feet.
- Dredging a channel 200 feet wide could increase flood stage capacity from approximately 1,500 cfs to 4,000 cfs and would require removal of ~1.5 million cubic yards of material.

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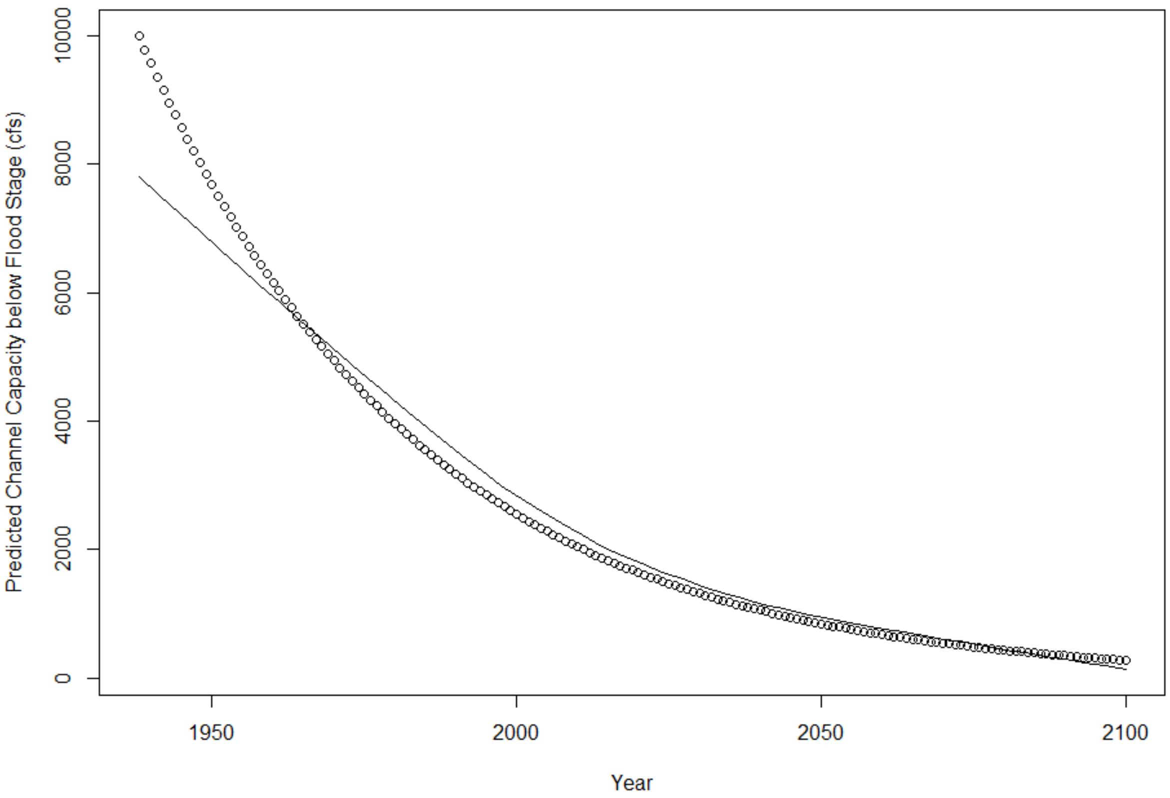
#2 - Flood Risk

A. What would be the spatial extent of flooding in the city of North Platte and adjacent communities considering a range of high flows including 3,000, 6,000, 9,000, and 12,000 cfs under current and projected future streamflow capacities?
B. In the absence of releases from Kingsley Dam, what is the probability that these flows will occur downstream of Lake McConaughey and upstream of the city of North Platte?
C. What level of rainfall needs to be observed locally for such flows to occur?
D. How do climate projections influence the probability of large rainfall events and therefore flooding risk from peak river flows?

#3 - Chokepoint Trends and Future Capacity

If nothing is done, at what rate will flow capacity in the North Platte River change?

- Loss of capacity ~85% in 80 years, or 2.2% per year (10,000 cfs to 1,800 cfs)
- Trend will continue with diminishing loss of capacity



Audubon

#4 - Potential Actions to Increase Capacity

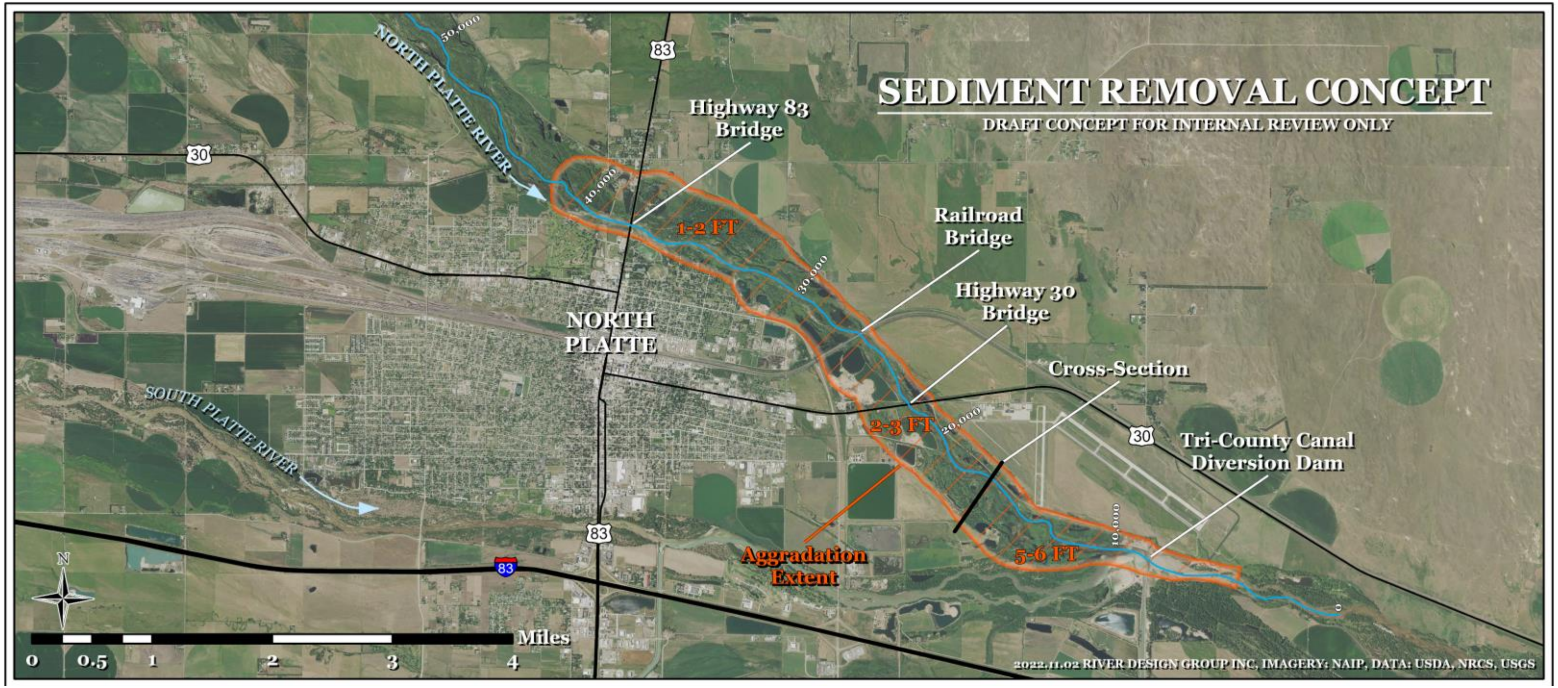
A. Is it essential to modify the Tri-County Canal diversion dam system to increase flow and sediment conveyance capacity locally? **Yes.**

B. Could widening bridges significantly increase discharge capacity and sediment transport? **No, benefits are local (within one half-mile of bridges) and temporary given reach-scale constraints.**

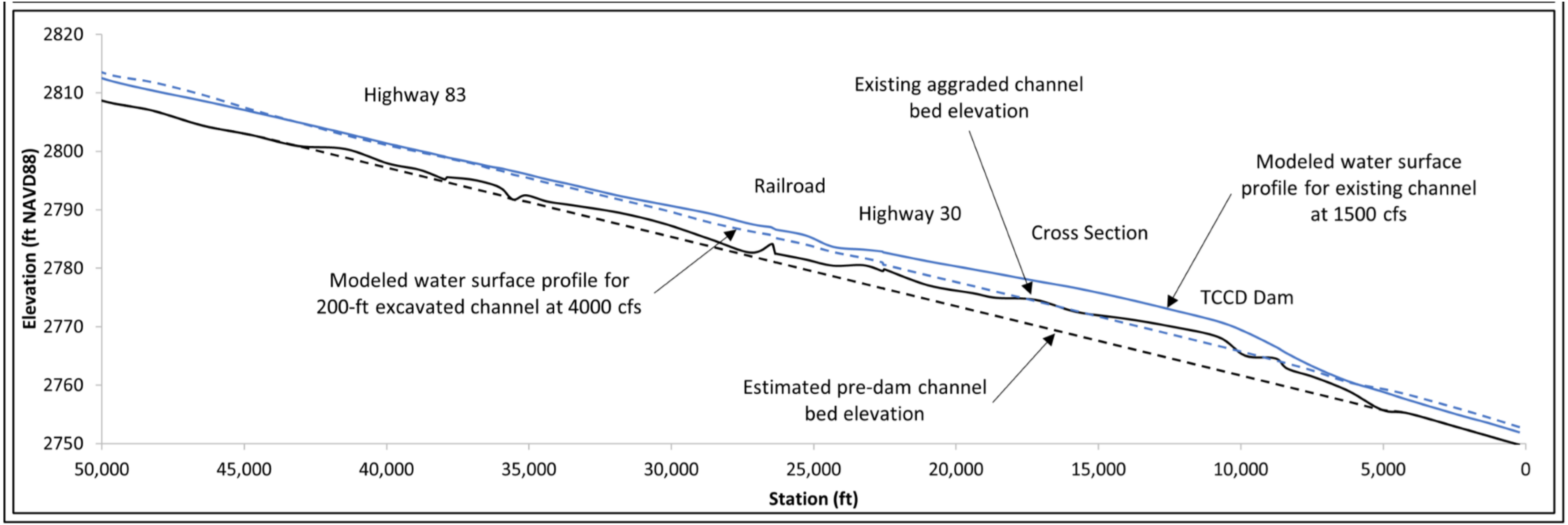
C. What impact could river disking and vegetation removal have on North Platte River flow conveyance capacity? **Extensive effort to achieve less than 10% gain in capacity and improvements would be temporary given constraints of current hydrologic and sediment regimes.**

D. Is it necessary to actively remove sediment from the channel bed to increase local flow conveyance? What methods could be used (e.g., dredging)? **Yes, a combination of active (dredging) and passive (river erosion) methods could be used. Modeling needed to confirm.**

Sediment Removal Concept



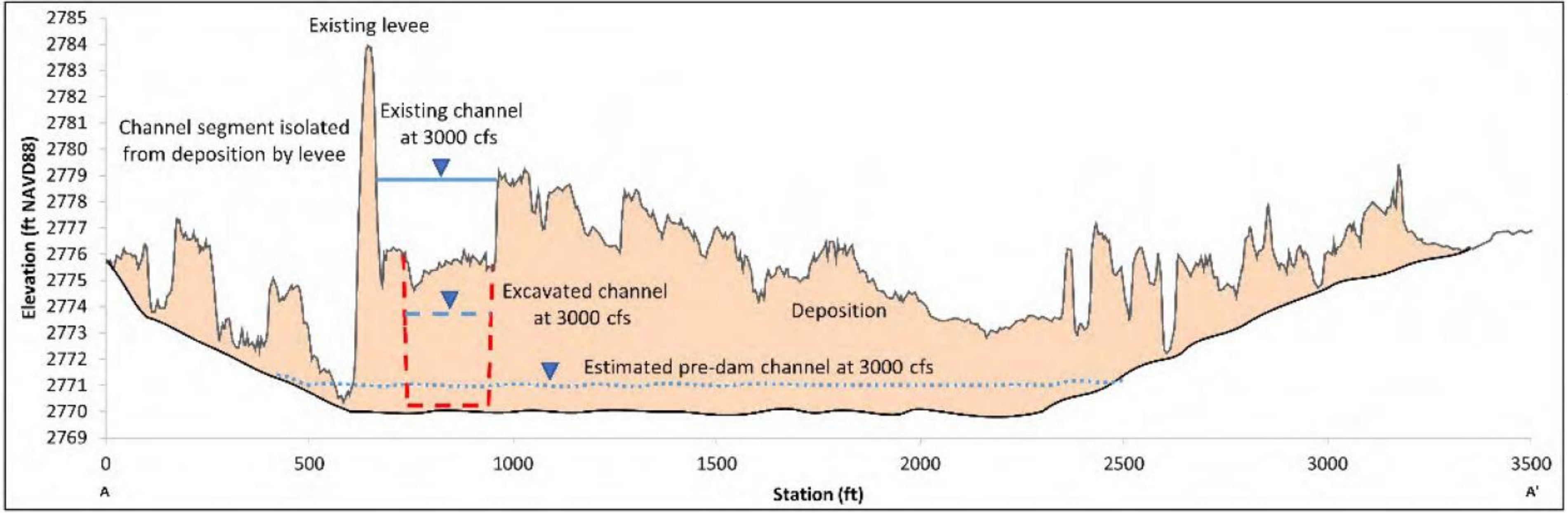
- Combination of dredging and modifications to TCCDD operations
- Pilot channel at estimated predam profile
- Allow river flows to perform additional sediment removal via lateral scour
- Energy for scour would depend on how much flow can pass the TCCDD
- A sediment transport model would be needed to evaluate potential combinations of dredging and flow releases that would be feasible



Benefits

- Addresses the primary cause of sedimentation by restoring equilibrium channel slope to the reach
- Increase in capacity from 1800 cfs to 4600 cfs at Highway 83
- Reduced flood risk
- Reduced dredging operations at TCCDD

- Lower water table limits vegetation establishment
- Continued channel erosion removes existing vegetation
- Sediment delivery to downstream reaches
- Formation of new sand bars creates habitat for focal species



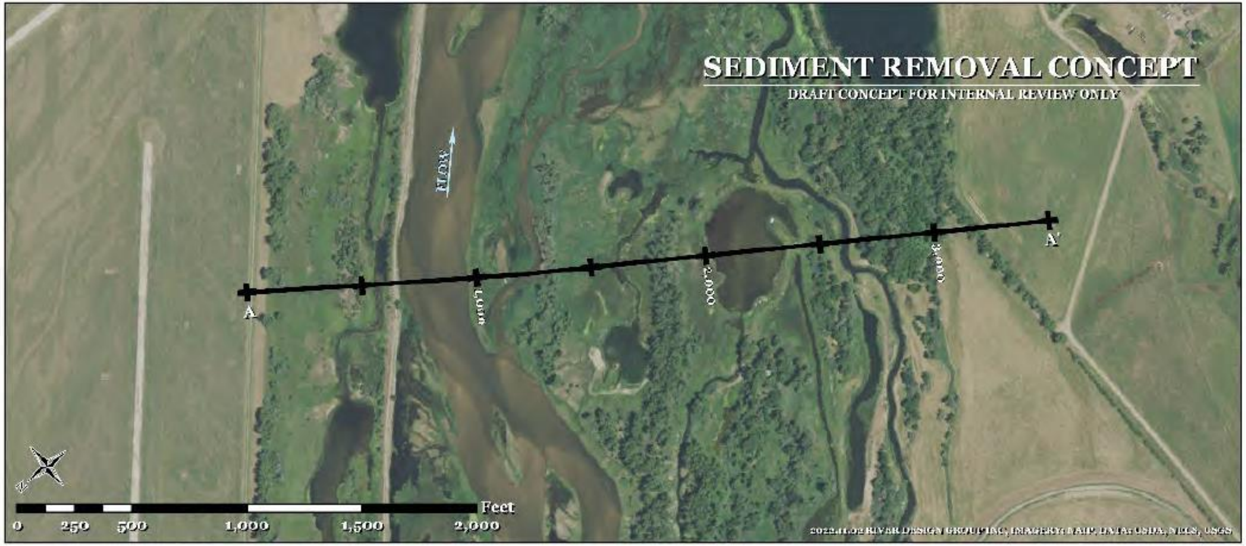
Feasibility Concerns

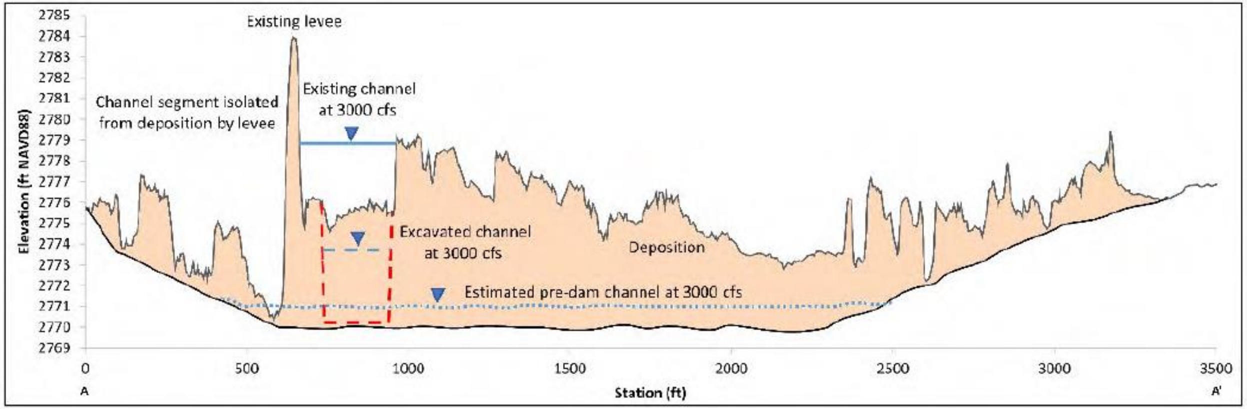
- Modifications to Tri-County Canal Dam and irrigation/hydropower operations
- Extent of channel erosion in response to dredging
- Impacts of channel erosion on private property and infrastructure
- Impacts of sediment delivery to downstream reaches
- Sustainability of dredged channel
- Ability to manage flows from Kingsley Dam to sustain channel capacity
- Vegetation re-establishment at lower elevations
- Permitting, outreach and coordination with stakeholders
- Cost

Sediment Transport Model

Develop sediment transport model to address questions:

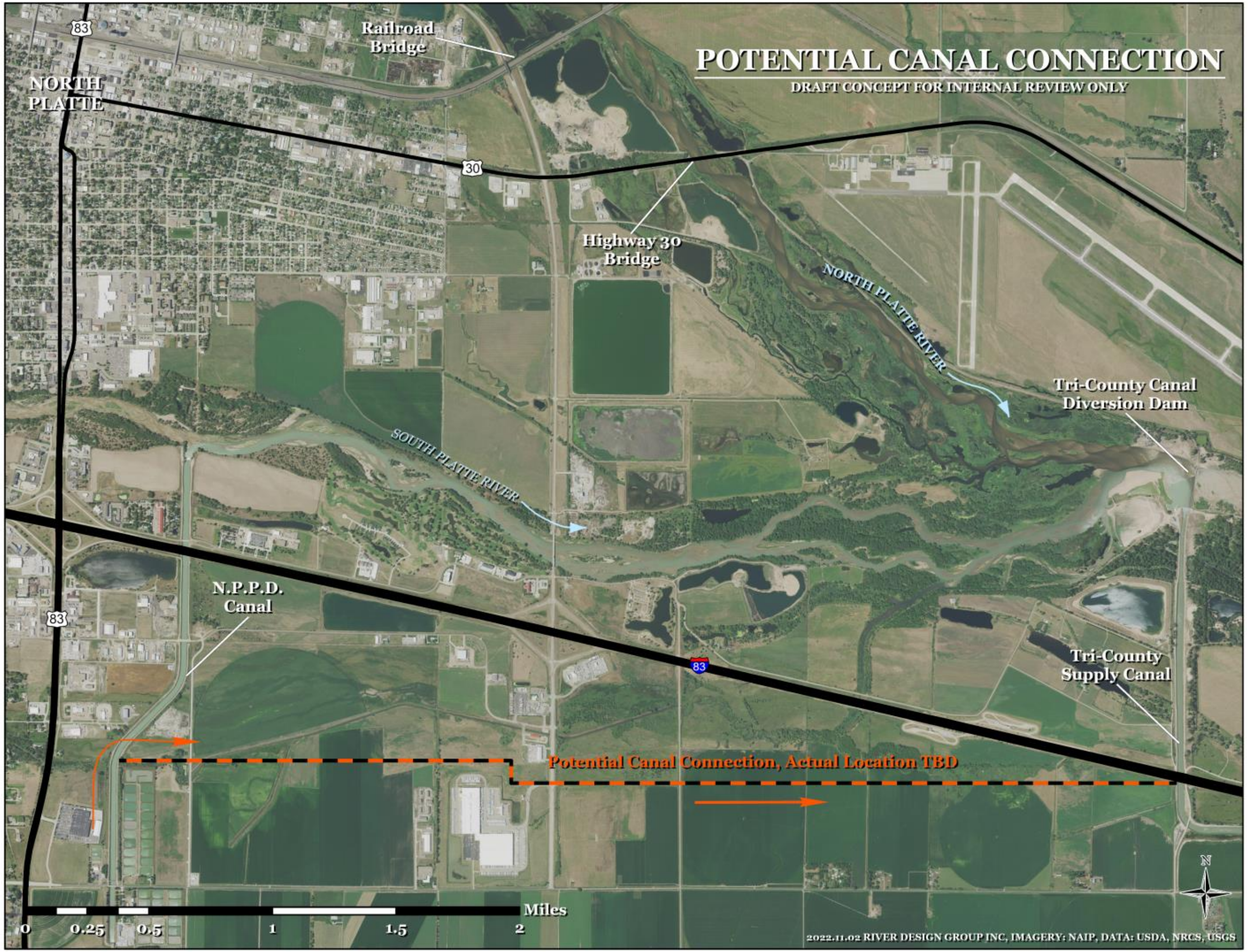
- How much dredging is required to allow the river to do the remaining work?
- What magnitude and duration of flows are needed?
- How much lateral erosion could occur?
- Which areas could be affected by erosion?
- How much flow and sediment can bypass the TCCDD via the existing spillway and radial gates?
- Where does the sediment go that bypasses the TCCDD?





Answers will inform how much active and passive removal can be accomplished

Canal Connection Concept



Canal Connection Concept

Benefits

- Reduces or eliminates need for Tri-County Canal Diversion Dam
- Dam modification could allow for passive sediment evacuation
- Addresses the primary cause of sedimentation by restoring equilibrium channel slope to the reach
- Increase in channel capacity
- Reduced flood risk
- Lower water table limits vegetation establishment
- Continued channel erosion removes existing vegetation
- Sediment delivery to downstream reaches
- Formation of new sand bars creates habitat for focal species

Feasibility Concerns

- Land acquisition for new canal
- Modifications to irrigation/hydropower operations
- Instream flow requirements for lower South Platte River
- Ecological, hydrologic and geomorphic impacts to the lower South Platte River
- Extent of channel erosion in response to passive sediment removal
- Impacts of channel erosion on private property and infrastructure
- Impacts of sediment delivery to downstream reaches
- Sustainability of new channel
- Permitting, outreach and coordination with stakeholders
- Cost

RDG Closing Thoughts

- North Platte River has many uses and recommendations must accommodate a broad audience to achieve solutions to the problem.
- VESPR provided criteria to guide the recommendations of this study including reduce flood risk, maintain irrigation canal operations, improve habitat for native species, decrease infrastructure maintenance, and promote opportunities for recreation.
- Removal of accumulated sediment from the Chokepoint Reach will require a combination of dredging and modifications to TCCDD operations to allow sediment to bypass the dam.
- Dredging could be employed to excavate a pilot channel down to the estimated pre-dam profile that would allow river flows to perform additional sediment removal via lateral erosion.
- The amount of energy available for flow to remove sediment would depend on how much flow can bypass the TCCDD.
- A sediment transport model would be needed to evaluate potential combinations of dredging and flow releases that would be feasible.