

EXPANDED RECAPTURE RECONNAISSANCE STUDY
PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
July 30, 2024

EXECUTIVE SUMMARY

The Expanded Recapture Reconnaissance Study's (Study) main goal is to help the Platte River Recovery Implementation Program (Program) and State of Nebraska Department of Natural Resources (NeDNR) determine how to more effectively control the timing and rate of surface and groundwater return flows to the Platte River to reduce deficits to target flows. The primary Study objectives were to evaluate the potential to install a gravity outlet from Elwood Reservoir to convey surface water to the Platte River through Plum Creek and to evaluate the net benefit of additional recapture wells, or a combination of the two proposed actions. With the goal of identifying the most cost-effective strategy for reducing deficits to target flows.

INTRODUCTION

Existing agreements between the Central Nebraska Public Power and Irrigation District (CNNPID) and the Program, Nebraska Department of Natural Resources (NeDNR), and Tri-Basin Natural Resources District (TBNRD) provide for the diversion of excess flows for groundwater recharge in Elwood Reservoir, Phelps County Canal, Cottonwood Ranch, and other facilities. The Study aims to create strategies for the Program and NeDNR to optimize excess flow diversions and recharge from Elwood Reservoir to maximize the Program's capacity to reduce deficits to U.S. Fish and Wildlife Service (USFWS) target flows for the Platte River near Grand Island (United States Geological Survey (USGS) stream gage (06770500)) and NeDNR's ability to reduce shortages on the Platte River below Overton.

The Project Area in general covers areas in which proposed new infrastructure projects would be located and can be described as Elwood Reservoir to the west, the Platte River to the north, Cottonwood Ranch on the east, and Highway 23 to the south (see Figure ES-1). The Project Area is located entirely within the boundaries of the TBNRD.

The Study answers the following key questions for the Program and NeDNR as presented below:

Program Questions:

1) What is the capability of Plum Creek to effectively convey flows to the Platte River?

Plum Creek appears to be capable of conveying augmented flows from Elwood Reservoir to the Platte River with minimal losses. Augmentation flows up to 50 cfs released through an Elwood Reservoir gravity outlet are consistent with the estimated ordinary high water line (OHWL) in Plum Creek and would pose minimal geomorphic risk when added to existing baseflow (12 cfs). Flow up to 100 cfs plus baseflow would likely require minor to

major bank repairs. Shorter-term duration, lower flow events will yield a lowest risk to geomorphic impacts.

2) If Plum Creek is used to convey flows, what impacts to the stream and existing infrastructure can be expected and what will it cost to mitigate those impacts?

If Plum Creek is used to convey flow, it will result in an increase in both minor and/or major geomorphic impacts depending on the magnitude and duration of augmented flow events. Minor erosion impacts can be expected at exposed unvegetated areas/banks located at or below OHWL. Major bank erosion impacts can be expected at exposed unvegetated areas where existing bank undercutting or bank sloughing is actively occurring adjacent to the channel above the OHWL. These areas are primarily located in the upper portion of the project area where exposed sand/gravel banks were observed.

Infrastructure improvements including replacement of existing culverts that are damaged or have insufficient capacity would be required for at least 11 agricultural crossings and two public road crossings at CR430 and CR437 at an estimated cost of \$450,000.

Erosion mitigation techniques such as shaping, revegetation, erosion control, bank grading, fabric encapsulated lifts, or armor would be likely options to mitigate damages. The geomorphic impacts vary based on flow magnitude and duration with estimated capital costs for mitigation ranging from \$1.2M to \$10M (including infrastructure improvements). An adaptive management approach should be used to mitigate geomorphic risk and impacts to Plum Creek from augmented flow.

3) What type of infrastructure would be associated with a gravity outlet from Elwood Reservoir, conceptually how would it be configured, what is a reasonable design capacity of the outlet, and how much does it cost?

The existing infrastructure, owned by CNPPID, could be utilized to release water from Elwood Reservoir using gravity flow. The lowest cost option is the use of CNPPID's evacuation pipeline located near the pump station into a new constructed open channel to convey water to Plum Creek. The second option would be the installation of a headgate and intake structure on the existing E65 canal directly east of Elwood Reservoir and south of Siphon 3 to convey releases from Elwood Reservoir through a buried pipeline. The conceptual capacity options for the outlet and conveyance infrastructure were assumed to be 50 and 100 cfs, based upon the results of the Plum Creek stream assessment.

Using the evacuation pipeline and open channel to pass water to the Highway 283 culvert has an estimated to capital cost between \$2.82M (50 cfs) and \$3.30M (100 cfs). Installation of a headgate south of Siphon 3 and a spillway on the east side of E65 would lead to a buried pipeline to the culvert under Highway 283. The range of capital costs for a 50 cfs pipeline is \$6.34M (PVC) to \$7.50M (steel) and the range of capital cost for a 100 cfs pipeline is \$7.14M (PVC) to \$9.47M (steel).

4) Can additional recapture wells operated by the Program improve the net benefit (score) to the river, and if so by how much, what is a practical size and location for an additional recapture wellfield, and how much does it cost?

For the Program, the 8 existing recapture wells in combination with an Elwood Reservoir gravity outlet appear to maximize the potential deficit reduction benefit to the river without the addition of new recapture wells.

If new recapture wells are added to the Program's existing recapture wells without an Elwood Reservoir gravity outlet, the net benefit (score) to the river can be improved by approximately 900 AF (150 AF/well) for areas close to the river (Recapture Zone 1) or by as much as 3,600 AF (600 AF/well) for areas located further from the river (Recapture Zone 3). The practical size of each well field would be based on available sites with adequate well spacing to accommodate between 3 to 6 wells, which can either be located together or separately as two well fields.

In general, wells located farther from the river can pump more and provide greater net benefit due to the smaller impact on recharge accretions to the stream. Therefore, to maximize their net benefit, recapture wells located in Recapture Zones 2-4 would require higher capacity wells and pipelines that result in higher costs. The total cost (over the assumed 50-yr project life cycle) for adding additional recapture wells ranges from \$17.11M (PVC) to \$18.02M (steel) for well fields/pipelines located close to the river (Recapture Zone 1) to \$25.57M (PVC) to \$30.28M (steel) for well fields/pipelines located further from the river (Recapture Zone 3).

5) How would a potential combination of a gravity outlet and recapture wells work in offsetting target flows?

The ability of recapture wells to pump intentionally-recharged groundwater from the aquifer is largely dependent on the volume of excess flows stored and managed in Elwood Reservoir because of the reservoir's capacity relative to other, smaller recharge projects. With a gravity outlet of 50 or 100 cfs, significantly less recharge would occur for the Program and it would be necessary to carefully manage operations of the Program's 8 existing recapture wells. The combination of a gravity outlet and existing recapture wells results in the highest scores of all alternatives evaluated, adding between 4,465 AF (50 cfs) to 5,009 AF (100 cfs) to the Program's established score of 6,800 AF.

6) What is the most cost-effective method for the Program to leverage excess flows through groundwater recharge and recapture and/or surface water releases from Elwood Reservoir to offset deficits to USFWS target flows at Grand Island, Nebraska?

The Cost Analysis shows that the most cost-effective scenario for the Program is the 50 cfs open channel alternative with existing recapture well at \$7.41M (\$33/AF) over the assumed 50-yr project life cycle. If the Program is considering additional recapture wells and no outlet from Elwood Reservoir the most cost-effective scenario is new recapture

wells in Recapture Zone 3 using a PVC pipeline at \$25.57M (\$141/AF) over the assumed 50-yr project life cycle.

NeDNR Questions:

- 7) If the NeDNR were to develop a recapture well program to aid in the retiming of available recharge from Elwood Reservoir, how much could recapture wells offset shortages to the river?**

If NeDNR were to develop a recapture well program, new recapture wells can offset shortages to the river by approximately 1,100 AF (183 AF/well) for areas close to the river (Recapture Zone 1) or by as much as 3,800 AF (633 AF/well) for areas located further from the river (Recapture Zone 3).

- 8) What is the most cost-effective method for NeDNR to maximize groundwater recharge and offset shortages in the Platte River below Overton, Nebraska?**

The Cost Analysis shows that the most cost effective scenario for NeDNR is to develop new recapture wells, specifically with well placement in Recapture Zone 3 using a PVC pipeline at \$24.65M (\$129/AF) over the assumed 50-yr project life cycle.

PLUM CREEK STREAM ASSESSMENT

To gather an understanding of the capability of Plum Creek to meet project objectives a complementary study was completed by Inter-Fluve, Inc. to inform the Program on the geomorphology, hydrology, hydraulics, and land use history of Plum Creek. The result was the Plum Creek Geomorphic Reconnaissance and Hydrologic Assessment (Assessment). A summary of the major Assessment efforts include:

- An existing review of stream gage data and reports,
- A field geomorphic and infrastructure assessment,
- Creation of a 1-D HEC-RAS hydraulic model,
- Completion of a geomorphic risk assessment for flows ranging from 25 to 1,400 cubic feet per second (cfs), and
- A planning level cost estimate.

The focus reach began at Highway 283 below Elwood Reservoir downstream to the confluence with the Platte River and included a total of four sub-reaches totaling 2.2 miles, or 7.7% of the total 28.4 miles, as shown in Figure ES-2. The team collected 43 topographic cross sections, visited ten public and two private crossings, obtained photographic documentation of channel conditions, measured stream velocity, documented agricultural crossings through desktop assessment, and recorded data on current stream conditions.

A watershed assessment was completed by LRE Water (LRE) to supplement findings of the stream assessment. One active stream gage (06767500 Plum Creek near Smithfield) is located on County Road (CR) 746 west of CR 434 and was used, along with other historic stream gage

data, to perform baseflow separation and frequency analyses which concluded a post-Elwood Reservoir average baseflow of 12 cfs.

A key flow threshold, the Ordinary High Water Line (OHWL) elevation, was determined to be 50 cfs. When considering channel erosion risk, it was determined that flow augmentation of 50 cfs, with a total flow of 63 cfs, is not likely to pose a significant geomorphic risk.

Release rates and volumes will vary annually based upon available storage in Elwood Reservoir and target flow deficits. Table ES-1 was created to show the range of flows assuming a constant release rates for short (50 days) and long (300 days) flow durations resulting in up to 13,500 acre-feet (AF). Values in the shaded area represent potential Elwood Reservoir outlet flow rates ("Release") in cubic-feet-per-second (cfs) including an assumed 12 cfs of baseflow. This table shows that higher flow rates for shorter duration have a higher geomorphic risk than lower flows for longer durations and that lower flow rates (≤ 50 cfs) can still result in a significant volume of release over an extended period.

Table ES-1: Risk Relative to Target Release Volumes Over-Time

Target Release (AF)	Duration of Release (Days)							Moderate Risk ↑ Plum Creek Flow (cfs) * ↓ Low Risk
	50	75	100	150	200	250	300	
13,500	148.1	102.7	80.1	57.4	46.0	39.2	34.7	Moderate Risk ↑ Plum Creek Flow (cfs) * ↓ Low Risk
12,000	133.0	92.7	72.5	52.3	42.2	36.2	32.2	
10,000	112.8	79.2	62.4	45.6	37.2	32.2	28.8	
8,000	92.7	65.8	52.3	38.9	32.2	28.1	25.4	
6,000	72.5	52.3	42.2	32.2	27.1	24.1	22.1	
4,000	52.3	38.9	32.2	25.4	22.1	20.1	18.7	
2,000	32.2	25.4	22.1	18.7	17.0	16.0	15.4	
1,000	22.1	18.7	17.0	15.4	14.5	14.0	13.7	
500	17.0	15.4	14.5	13.7	13.3	13.0	12.8	

*Plum Creek Flow includes an assumed 12 cfs of baseflow.

Mitigation cost information for the assessed sub-reaches were extrapolated to the full stream segment to develop total estimated planning level mitigation cost ranges for the 50 cfs and 100 cfs scenarios as shown in Table ES-2. For the purposes of this study, the estimated mitigation costs are treated as capital improvements that likely would be completed during project development and construction.

Table ES-2: Estimated Plum Creek Mitigation Cost at 50 and 100 cfs Augmented Flow

Item	50 cfs Scenario		100cfs Scenario	
	Lower	Upper	Lower	Upper
Plum Creek Mitigation* Costs	\$0	\$1,230,662	\$971,575	\$7,513,516
Culverts & Stream Crossings	\$449,000	\$449,000	\$449,000	\$449,000
Total	\$449,000	\$1,679,662	\$1,420,575	\$7,962,516
30% Contingency	\$134,700	\$503,899	\$426,173	\$2,388,755
Total w/ contingency	\$583,700	\$2,183,561	\$1,846,748	\$10,351,271

**Cost estimates for assessment reaches (1-4) were utilized to estimate potential mitigation costs for the entire 28.4 miles. Mitigation costs include erosion mitigation techniques such as shaping, revegetation, erosion control, bank grading, fabric encapsulated lifts, and/or channel armoring.*

GRAVITY OUTLET ASSESSMENT

The gravity outlet assessment included a feasibility-level concept and cost analysis by RJH Consultants, Inc. (RJH) as documented within the Concept and Cost Opinions for Conveyance Facilities to Plum Creek memo. After a site visit and consultation with CNPPID, the owners of Elwood Reservoir and the E65 system, the Study focus was primarily on the east side of Elwood Reservoir and the E65 canal and south of E65 Siphon 3. The goal was to develop feasibility-level concepts and cost estimates for infrastructure that would control releases and convey Program water from Elwood Reservoir to Plum Creek. This evaluation assumed the new E65 inlet would be in place, and that flow would not be available from the existing E65 siphon.

Initially four alternatives, assuming 100 cfs, were presented, three utilizing flows from Elwood Reservoir into the existing E65 infrastructure and one utilizing the existing evacuation pipeline near the pump station from Elwood Reservoir.

After presentation, the Program elected to evaluate two primary alignments, each assumed to convey 50 and 100 cfs, referred to as Alternative A: Open Channel and Alternative B: Buried Pipeline. The alignment of the two alternatives carried forward can be found in Figure ES-3 and are described below.

- Alternative A: A 5-foot wide, riprap lined open channel, conveying either 50 or 100 cfs, from the outlet of the Elwood Reservoir evacuation pipeline to the culvert below U.S. Highway 283.
- Alternative B: A new diversion/intake 2,250 feet north of the existing E65 canal pump station and a new canal headgate just south of Siphon 3 outlet. A 4,500 linear feet welded steel or PVC (Alt B1 or Alt B2) pipeline through the valley of an ephemeral drainage to the U.S. Highway 283 culvert. The pipe diameter would be 30 inches for 50 cfs and 36 inches for 100 cfs. A final determination on pipe material would be determined as part of the preliminary design phase.

The Opinion of Probable Project cost is shown in Table ES-3.

Table ES-3 – Elwood Reservoir Outlet Capital Cost (OPPC) Summary

Concept	OPPC ¹ (\$)
Alt A1: Open Channel, 100 cfs	3,300,000
Alt A2: Open Channel, 50 cfs	2,820,000
Alt B1: Steel Pipeline, 100 cfs	9,470,000
Alt B2: Steel Pipeline, 50 cfs	7,500,000
Alt B1: PVC Pipeline, 100 cfs	7,144,000
Alt B2: PVC, Pipeline, 50 cfs	6,340,000

Prior to pursuing the conceptual design of a 50 cfs and 100 cfs Elwood Reservoir outlets, LRE completed modeling assessments to determine the incremental benefits (i.e., score increases) from the gravity outlet alone and in combination with additional recapture wells. This is addressed in Trade Off analysis described below.

RECAPTURE WELL ASSESSMENT

Recapture wells add a controllable element to recharge projects that otherwise generate return flows to the Platte River over which the Program has no control of timing, magnitude, or location. Recapture wells currently play an important role in maximizing the benefit of the Program's existing recharge projects by discharging groundwater directly to the Platte River specifically during periods with deficits to target flows at Grand Island. Similarly, the use of recapture wells by NeDNR could help to maximize the net benefit to the Platte River during times of shortage. The purpose of the recapture well assessment is to determine the feasibility of adding new recapture wells and net benefit to the Platte River for both the Program and NeDNR. Evaluating a range of conceptual wellfields to understand infrastructure requirements, costs, and net benefits (score) to support a comparative Trade Off analysis.

As a part of the recapture well assessment the following key tasks were completed by LRE:

Hydrogeologic Cross-Sections: The analysis started with the completion of two hydrogeologic cross-sections stretching from Elwood Reservoir following Plum Creek, and south of the Platte River from west to east. Registered well logs from the NeDNR Groundwater Well Database were used to characterize both the alluvial and Ogallala aquifers. Areas of greater saturated thickness were identified, and the similar groundwater elevations of both aquifers indicated that they are in hydrogeologic connection with each other. Almost all of the wells in the Project Area were

¹ OPPC does not include the cost to replace or enlarge the culvert under U.S. Route 283 or land acquisition.

completed in either the alluvial aquifer, the Ogallala aquifer, or both. Well depths, pumping yields, screening intervals, and hydraulic heads (static water levels) were used to inform the selection of new recapture areas.

Natural Conveyance: A review of natural conveyances and drains in the Project Area determined the most effective method to deliver recapture water was through an underground pipeline. Most natural drainages were dry, thus adding new water would create challenges with erosion, phragmites, beavers, seepage, erosion, and losses from evapotranspiration.

Recapture Well Zones and Areas: Utilizing Stream Depletion Factors (SDF) from the Platte River Cooperative Hydrology Study (COHYST), the Platte River, and Phelps County Canal three primary groundwater areas, or Recapture Zones, for analyzing recharge well options were established. Each Zone represents a range of SDFs at varying distances from the Platte River, both north and south of the Phelps County Canal (see Figure ES-4).

- **Recapture Zone 1** - A proposed land area relatively close (0 to 2 miles) from the Platte River or Plum Creek and generally within a SDF Zone > 80 and with existing conveyance (stream or drain) that is able to convey flows naturally to the Platte River. In general, the area can be described as north of Phelps County Canal to the Platte River and is similar to the Program's recapture well network.
- **Recapture Zone 2** - Proposed recapture sites are located between 2 to 5 miles south of the Platte River and south of Phelps County Canal, in a range of SDF Recapture Zone between 60 and 80. Conveyance of recapture water from a wellfield located in Zone 2 would require a pipeline, including a crossing of Phelps County Canal, to reach the Platte River. The Zone 2 area is irregularly shaped and bound in general to the north by the Phelps County Canal, south by County Rd 745 and 747, and to the east at K Rd.
- **Recapture Zone 3** - The Zone 3 area covers a SDF zone ranging from 30 to 60. Proposed recapture sites are located more than 3 to 5 miles from the Platte River and south of Phelps County Canal and require constructed conveyance infrastructure.
- **Zone 4** – Beyond 5 miles from the Platte River, requiring extensive conveyance infrastructure.

Seven conceptual well sites (Recapture Areas) within the established Recapture Zones were then identified with the assistance of Program staff, based on proximity to natural conveyance/drains and power, land use, well spacing, and competing water sources (co-mingled, surface water, groundwater only). Each conceptual well site includes the siting of three wells with connecting pipelines. Conceptual well designs and estimated costs were established for each Recapture Area based on well logs information from nearby alluvial wells including estimated well yield, well depth, screen interval, and static water level necessary for estimated well costs. Total pipeline lengths were also calculated to support conveyance pipeline costs estimates.

- Recapture Well Performance: Key to the recapture well assessment and to the management and use of recapture wells is the performance and accounting of each recapture well's net benefit in terms of reducing target flow deficits. Analyses show that recapture wells located closer to the river provide less net benefit to the river because pumping has a larger near term depletive effect on recharge accretions to the stream. Essentially, recapture wells located in close proximity to the river provide the benefit of pumping during periods of shortage but much of the pumped water would have reached the river in a similar time frame anyway. Conversely, recapture wells farther from the river provide greater net benefits because pumping has a lesser near term effect on recharge accretions to the stream. This dynamic is important as recapture wells close to the stream can outpace recharge accretions if not carefully managed, ultimately increasing target flow deficits, while recapture wells farther from the stream can pump substantially more with smaller impacts to recharge accretions. To represent this dynamic an aquifer balance model was developed using GoldSim (described below) to optimize the well capacity and number of wells required in each recapture scenario based upon available recharge and whether existing recapture wells are operating. Table ES-4 below summarizes the well requirements for each recapture area for the Program and NeDNR. Program well requirements are based on available recharge from Elwood Reservoir and Phelps County Canal assuming 8 existing recapture wells are operating. NeDNR well requirements are only based on available recharge from Elwood Reservoir.

Table ES-4 - Program and NeDNR Recapture Area Well Requirements

Recapture Zone	Recapture Area	COHYST SDF	Average Well Yields* (gpm)	Average Well Depth* (ft)	Average Screen Length* (ft)	Program Well			NeDNR Well		
						Well Field Capacity (gpm)	Well Count	Well Capacity (gpm)	Well Field Capacity (gpm)	Well Count	Well Capacity (gpm)
1	1	94.2	913	48	28	1,800	3	600	2,700	3	900
	2	87.2	814	51	26	1,800	3	600	2,700	3	900
2	3	71.7	767	360	22	1,500	3	500	2,100	3	700
	4	64.8	665	242	45	1,500	3	500	2,100	3	700
3	5	45.7	1085	287	60	3,000	3	1,000	2,700	3	900
	6	33.7	1058	215	80	3,000	3	1,000	2,700	3	900

*Average well yields, well depths, and screen intervals based on averages from nearby wells from the NeDNR well database.

- Recapture Well Costs: To estimate the cost of developing Recapture Zones 1-3 a comprehensive cost tool was created. Unit cost for wells and conveyance were developed based on Program costs associated with the recent development of Cottonwood Ranch wells from 2019 and updated with 2024 pipe costs. Well counts and conveyance infrastructure cost estimates for each zone are limited based on remaining recharge (after existing recapture wells) with a max of 36 wells per Recapture Zone. Costs represent well capacities ranging from 500 gpm to 1,000 gpm, well depths from 48 to 360 feet, and conveyance pipelines from 2.53 to 4.68 miles depending on the performance requirements for each Recapture Zone. Table ES-5 summarizes well, conveyance pipeline (PVC & steel), and total capital cost estimates for each Recapture Zone.

Table ES-5 – Well and Conveyance Pipeline Capital Cost Summary
Program Well and Pipeline Requirements and Capital Cost for Additional Recapture Wells

Requirement	Recapture Zone 1 (Recapture Area 1 & 2)		Recapture Zone 2 (Recapture Area 3 & 4)		Recapture Zone 3 (Recapture Area 5 & 6)	
Well Count	6		6		6	
Well Capacity (gpm/well)	600		500		1000	
Well Cost (\$)*	\$475,474		\$653,862		\$709,038	
Conveyance Pipeline (Miles)	2.53 miles ¹		5.61 miles ²		4.68 miles ³	
Pipeline Cost (\$)*	PVC	Steel	PVC	Steel	PVC	Steel
	\$1,727,220	\$2,630,343	\$4,180,477	\$6,555,857	\$7,401,977	\$12,108,169
OPPC (\$)*	\$2,202,694	\$3,105,817	\$4,834,340	\$7,209,720	\$8,111,015	\$12,817,207

*Costs include a 30% design and construction contingency

1. Recapture Zone 1 includes the following estimated pipe capacities: 10" = 0.63 mi, 12" = 0.19 mi, 14" = 1.72 mi

2. Recapture Zone 2 includes the following estimated pipe capacities: 8" = 0.57 mi, 12" = 3.11 mi, 18" = 1.93 mi

3. Recapture Zone 3 includes the following estimated pipe capacities: 12" = 0.38 mi, 16" = 0.38 mi, 18" = 1.46 mi, 24" = 2.46 mi

NeDNR Well and Pipeline Requirements and Capital Cost for New Recapture Wells

Requirement	Recapture Zone 1 (Recapture Area 1 & 2)		Recapture Zone 2 (Recapture Area 3 & 4)		Recapture Zone 3 (Recapture Area 5 & 6)	
Well Count	6		6		6	
Well Capacity (gpm/well)	900		700		900	
Well Cost (\$)*	\$521,365		\$684,457		\$693,741	
Conveyance Pipeline (Miles)	2.53 miles ¹		5.60 miles ²		4.68 miles ³	
Pipeline Cost (\$)*	PVC	Steel	PVC	Steel	PVC	Steel
	\$2,642,526	\$4,155,853	\$5,756,970	\$9,287,854	\$7,301,429	\$11,940,589
OPPC (\$)*	\$3,163,891	\$4,677,218	\$6,441,427	\$9,972,311	\$7,995,170	\$12,634,330

*Costs include a 30% design and construction contingency

1. Recapture Zone 1 includes the following estimated pipe capacities: 10" = 0.63 mi, 14" = 0.19 mi, 18" = 1.72 mi

2. Recapture Zone 2 includes the following estimated pipe capacities: 10" = 0.57 mi, 12" = 0.19 mi, 16" = 2.92 mi, 20" = 1.93 mi

3. Recapture Zone 3 includes the following estimated pipe capacities: 10" = 0.38 mi, 14" = 0.38 mi, 18" = 1.46 mi, 24" = 2.46 mi

TRADE OFF ANALYSIS

The Trade Off analysis was completed by LRE to evaluate the range of possible project configurations, costs, and the scores of project portfolios to meet target flows deficits. This was done using a custom GoldSim model developed for this project and designed to replicate the existing Elwood Reservoir Score Model as modified by the Program's Executive Director's Office to incorporate the reservoir outlet concept and both existing and new recapture wells. The GoldSim model ("the Model") incorporates three primary components, which include:

- 1) The Elwood Reservoir storage balance, which includes separate accounting of excess flow diversions (inflows) and reservoir seepage (recharge outflows) for both the Program and NeDNR, as wells as a gravity outlet option for the Program;
- 2) The Aquifer Storage Balance, which includes groundwater recharge from Elwood Reservoir and Phelps County Canal, accretions to the Platte River from recharge, and recapture well pumping and associated depletive effects and;
- 3) The Scoring Model, which routes net river returns from accretions, recapture pumping, and releases to Grand Island to determine beneficial reductions to target flow deficits.

With the three components combined in the Model, it represented inflows available from excess flows; management and accounting of flows in and through Elwood Reservoir; outflows in the form of seepage into the aquifer as recharge or releases directly to the Platte River (via Plum Creek) from Elwood Reservoir; aquifer accounting of recharge to limit available pumping (based on lagged accretions and depletions); and the net benefit (score) of each project to reduce target flow deficits at Grand Island. The Model provides the Program a systematic and robust solution needed to evaluate the range of possible project portfolios.

Prior to completing the Trade Off analysis the model was calibrated and validated to the established scores of each existing project (1947-1994). Once validated the model was run in a baseline condition representing actual excess flow diversions, Elwood Reservoir accounting, recharge, pumping, and net benefits to the Platte River based on the Program's operations accounting records (2015-2023). This baseline condition represents the antecedent or starting conditions of Elwood Reservoir and the alluvial aquifer including the current timing of lagged accretions and depletions. With the starting conditions established the model was then executed in the forward mode from 1947 to 2023 for a total of ten scenarios representing the range of possible project configurations and scores of project portfolios. Note that the forward mode of the model was run continuously reflecting lagged accretions and depletive effects of pumping from the earlier historical period (1947-1994) in the latter recent period (1995-2023).

Scores were compiled based on averages for the historical period (1947-1994) and the recent period (1995-2023) and compared to and the Program's established score for existing projects of 6,800 AF or the NeDNR estimated score of 3,400 AF (based on scenario 4) to determine the incremental score value of each project. Table ES-6 below summarizes the ten scenarios evaluated and the incremental scores of each. The following scenarios are included based on the identified project objectives: For the Program, Scenario 1 represents the Program baseline and is comparable to the Program's established score of 6,800 AF for Elwood recharge, Phelps recharge, and the 8 existing recapture wells. Scenarios 1.1 to 1.3 evaluate the use of additional recapture wells in zones 1-3, and Scenarios 2 and 3 evaluate the use of a 50 cfs or 100 cfs gravity outlet from Elwood Reservoir. For NeDNR, Scenario 4 represents the NeDNR baseline and the basis of the NeDNR established score of 3,400 AF (based on accretions to the Platte River from Elwood recharge at or above Overton, with no routing to Grand Island), and Scenarios 4.1 to 4.3 evaluate the use of new recapture wells in Zones 1-3.

The results of the Trade Off analysis (1947-1994) show that the Program's use of a 100 cfs outlet structure with no additional recapture wells results in the highest net benefit (score) to the Platte River, adding 5,009 AF to the Program's established score of 6,800 AF. The Trade Off analysis also shows that without an outlet structure the addition of new recapture wells in Recapture Zone 1 (north of Phelps County Canal) results in the lowest score adding 887 AF (148 AF/well) while Recapture Zone 3 results in the highest score of adding 3,635 AF (606 AF/well). Alternatively, if NeDNR develops new recapture wells based on only available recharge from Elwood Reservoir, Recapture Zone 3 results in the highest score adding 3,809 AF (635 AF/well) to the NeDNR's estimated score of 3,400 AF. It is important to note that the results of the Trade Off analysis for the 1995-2023 period are uniformly less than the 1947-1994 period, likely reflecting reduced excess flows availability during the recent hydrologic period. Cost considerations associated with each of the ten scenarios are presented in the section below.

Table ES-6 – Scenario and Score Summary

Scenario	Scenario Description	Elwood Outlet Capacity (cfs)	Existing Recapture Well Count	New Recapture Well Count	New Well Yield (gpm)	New Well Yield Per Well for 6 wells (gpm)	Established Score (1947-1994)	Score (1947-1994)	Incremental Gain from Established Score (1947-1994)	Score (1995-2023)	Incremental Gain from Established Score (1995-2023)
1.0	No Elwood Outlet, 8 Existing Recapture Wells, No New Recapture Wells (Program Baseline)	0	8	0	-	-	6,800 ¹	7,089	289	6,377	-423
1.1	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 1)	0	8	6	3600	600		7,687	887	6,853	53
1.2	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 2)	0	8	6	3000	500		8,055	1,255	7,078	278
1.3	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 3)	0	8	6	6000	1000		10,435	3,635	8,864	2,064
2.0	50 cfs Elwood Outlet, 7 Existing Recapture Wells, No New Recapture Wells	50	7	0	-	-		11,265	4,465	10,391	3,591
3.0	100 cfs Elwood Outlet, 6 Existing Recapture Wells, No New Recapture Wells	100	6	0	-	-		11,809	5,009	11,122	4,322
4.0	Elwood Reservoir Recharge Only (NeDNR Baseline)	0	0	0	-	-	3,400 ²	3,422	22	3,545	145
4.1	Elwood Reservoir Recharge and New Recapture Wells (Zone 1)	0	0	6	5400	900		4,526	1,126	4,424	1,024
4.2	Elwood Reservoir Recharge and New Recapture Wells (Zone 2)	0	0	6	4200	700		5,111	1,711	4,820	1,420
4.3	Elwood Reservoir Recharge and New Recapture Wells (Zone 3)	0	0	6	5400	900		7,209	3,809	6,487	3,087

1. Established Score: Program established score based on the aggregate score for Elwood Reservoir (2,800 AF), Phelps County Canal (2,700 AF), and an estimated 1,300 AF for the 8 existing recapture wells (based on an approved score of 160 AF for the Cook well). Does not include Cottonwood BSR.

2. NeDNR established score above Overton based on the approximate modeled results of Elwood Reservoir Recharge Only (Scenario 4.0). Does not include WMC Losses to Grand Island.

COST ANALYSIS

Total capital costs were compiled for each project scenario described above based on the capital costs compiled from the assessments of Plum Creek (Table ES-2), the Elwood gravity outlet (Table ES-3), and recapture wells (Table ES-5). Total capital costs were then combined with the estimated O&M over an assumed 50-yr project life cycle to calculate total project costs. O&M over an assumed 50-yr project life cycle include O&M for recapture wells (including pump replacements), O&M for the gravity outlet, Plum Creek O&M (inclusive of wood debris removal and beaver/phragmites mitigation), easements, SCADA, HP/electric, and Tri-Basin NRD staff time assuming a 3% annual rate of escalation. Table ES-7 summarizes the total capital costs (\$), O&M (\$), total costs (\$), and unit costs (\$/AF) for each scenario based on the scores summarized in Table ES-6 above. Note that unit costs presented are based on total costs divided by total score over the assumed 50-yr project life cycle.

The results of the Cost Analysis shows that although the use of a 100 cfs outlet structure with six existing recapture wells results in the highest (score) it is the most expensive gravity outlet alternative with a total cost ranging between \$20.58M (\$82/AF) for the open channel outlet alternative to \$26.75M (\$107/AF) for a steel pipeline outlet. The Cost Analysis shows that the most cost-effective scenario for the Program (highest score (AF)/lowest cost) is the 50 cfs open channel alternative at \$7.41M (\$33/AF). If the Program is considering additional recapture wells the most cost-effective scenario is the new recapture wells in Recapture Zone 3 using a PVC pipeline at \$25.57M (\$141/AF). Similarly, if NeDNR were to develop new recapture wells, Recapture Zone 3 is the most cost-effective alternative using a PVC pipeline at \$24.65M (\$129/AF).

Table ES-7 – Scenario Cost Summary

Scenario	Cost Scenario	Scenario Name	Elwood Reservoir Outlet Costs ¹	Plum Creek Mitigation & Infrastructure Costs ²	Recapture Well Costs ³	Conveyance Pipeline Costs ⁴	Total Capital Cost ⁵	O&M (50-Yr Project Life) ⁶	Total Costs (50-Yr Project Life) ⁷	Score (AF/Yr) (1947-1994) ⁸	Total Score (AF) (50-yr Project Life) ⁹	Unit Cost (\$/AF) (1947-1994) ¹⁰	Score (AF/Yr) (1995-2023) ¹¹	Total Score (AF) (50-yr Project Life) ¹²	Unit Cost (\$/AF) (1995-2023) ¹³
1	1.0	No Elwood Outlet, 8 Existing Recapture Wells, No New Recapture Wells (Program Baseline)	\$0	\$0	\$0	\$0	\$0	\$0	\$0	289	14,449	\$0	-423	-21,172	\$0
1.1	1.1A	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 1) (PVC)	\$0	\$0	\$475,474	\$1,727,220	\$2,202,694	\$14,885,546	\$17,113,239	887	44,351	\$386	53	2,645	\$6,470
	1.1B	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 1) (Steel)	\$0	\$0	\$475,474	\$2,630,343	\$3,105,817	\$14,885,546	\$18,016,362	887	44,351	\$406	53	2,645	\$6,811
1.2	1.2A	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 2) (PVC)	\$0	\$0	\$653,862	\$4,180,477	\$4,834,340	\$13,724,629	\$18,583,968	1,255	62,741	\$296	278	13,885	\$1,338
	1.2B	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 2) (Steel)	\$0	\$0	\$653,862	\$6,555,857	\$7,209,720	\$13,724,629	\$20,959,348	1,255	62,741	\$334	278	13,885	\$1,510
1.3	1.3A	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 3) (PVC)	\$0	\$0	\$709,038	\$7,401,977	\$8,111,015	\$17,437,959	\$25,573,974	3,635	181,762	\$141	2,064	103,214	\$248
	1.3B	No Elwood Outlet, 8 Existing Recapture Wells, New Recapture Wells (Zone 3) (Steel)	\$0	\$0	\$709,038	\$12,108,169	\$12,817,207	\$17,437,959	\$30,280,166	3,635	181,762	\$167	2,064	103,214	\$293
2	2.0	50 cfs Elwood Outlet (Open Channel), 7 Existing Recapture Wells	\$2,816,104	\$1,383,630	\$0	\$0	\$4,199,734	\$3,107,831	\$7,407,565	4,465	223,257	\$33	3,591	179,557	\$41
	2A	50 cfs Elwood Outlet (PVC), 7 Existing Recapture Wells	\$6,339,920	\$1,383,630	\$0	\$0	\$7,723,550	\$3,107,831	\$10,931,381	4,465	223,257	\$49	3,591	179,557	\$61
	2B	50 cfs Elwood Outlet (Steel), 7 Existing Recapture Wells	\$7,502,720	\$1,383,630	\$0	\$0	\$8,886,350	\$3,107,831	\$12,094,181	4,465	223,257	\$54	3,591	179,557	\$67
3	3	100 cfs Elwood Outlet (Open Channel), 6 Existing Recapture Wells	\$3,290,192	\$6,099,009	\$0	\$0	\$9,389,201	\$11,086,030	\$20,575,231	5,009	250,446	\$82	4,322	216,102	\$95
	3A	100 cfs Elwood Outlet (PVC), 6 Existing Recapture Wells	\$7,144,000	\$6,099,009	\$0	\$0	\$13,243,009	\$11,086,030	\$24,429,039	5,009	250,446	\$98	4,322	216,102	\$113
	3B	100 cfs Elwood Outlet (Steel), 6 Existing Recapture Wells	\$9,469,600	\$6,099,009	\$0	\$0	\$15,568,609	\$11,086,030	\$26,754,639	5,009	250,446	\$107	4,322	216,102	\$124
4	4.0	Elwood Recharge Only (No New Infrastructure) - NeDNR Baseline	\$0	\$0	\$0	\$0	\$0	\$0	\$0	22	1,091	\$0	145	7,234	\$0
4.1	4.1A	New Recapture Wells Only (Zone 1) (PVC)	\$0	\$0	\$521,365	\$2,642,526	\$3,163,891	\$17,322,669	\$20,511,560	1,126	56,320	\$364	1,024	51,210	\$401
	4.1B	New Recapture Wells Only (Zone 1) (Steel)	\$0	\$0	\$521,365	\$4,155,853	\$4,677,218	\$17,322,669	\$22,024,887	1,126	56,320	\$391	1,024	51,210	\$430
4.2	4.2A	New Recapture Wells Only (Zone 2) (PVC)	\$0	\$0	\$684,457	\$5,756,970	\$6,441,427	\$15,349,378	\$21,815,805	1,711	85,535	\$255	1,420	71,022	\$307
	4.2B	New Recapture Wells Only (Zone 2) (Steel)	\$0	\$0	\$684,457	\$9,287,854	\$9,972,311	\$15,349,378	\$25,346,689	1,711	85,535	\$296	1,420	71,022	\$357
4.3	4.3A	New Recapture Wells Only (Zone 3) (PVC)	\$0	\$0	\$693,741	\$7,301,429	\$7,995,170	\$16,625,584	\$24,645,754	3,809	190,440	\$129	3,087	154,341	\$160
	4.3B	New Recapture Wells Only (Zone 3) (Steel)	\$0	\$0	\$693,741	\$11,940,589	\$12,634,330	\$16,625,584	\$29,284,914	3,809	190,440	\$154	3,087	154,341	\$190

1. Elwood Reservoir Outlet Costs (\$) from Tabel ES-3.

2. Plum Creek Mitigation and Infrastructure Costs (\$) assume an average of the cost range provided in Table ES-2 for 50 cfs and 100 cfs flow augmentation scenarios.

3. Recapture Well Costs (\$) from Table ES-5.

4. Conveyance Pipeline Costs (\$) from Table ES-5.

5. Total Capital Costs (\$) = Sum of Elwood Reservoir Outlet Costs, Plum Crk Mitigation & Infrastructure Costs, Recapture Well Costs, and Conveyance Pipeline Costs.

6. O&M (50-Yr Project Life) (\$) includes costs for O&M for recapture wells (including pump replacements), O&M for the gravity outlet, Plum Creek O&M (inclusive of wood debris removal and beaver/phragmites mitigation), easements, SCADA, HP/electric, and Tri-Basin NRD staff time. The total

7. Total Costs (\$) (50-Yr Project Life) plus \$25,000 for permitting of recapture wells scenarios or \$100,000 for permitting of Elwood Reservoir outlet scenarios.

8. Scores (AF) (1947-1994) from Table ES-6.

9. Total Score (AF) (50-yr Project Life)= Scores (1947-1994) X 50

10. Unit Cost (\$/AF) (1947-1994) = Total Costs (\$) (50-Yr Project Life)/Total Score (AF) (50-yr Project Life), for the 1947-1994 period.

11. Scores (AF) (1995-2023) from Table ES-6.

12. Total Score (AF) (50-yr Project Life)= Scores (1995-2023) X 50

13. Unit Cost (\$/AF) (1995-2023) = Total Costs (\$) (50-Yr Project Life)/Total Score (AF) (50-yr Project Life), for the 1995-2023 period.

PERMITTING

Based on a desktop review of the National Hydrography Dataset (NHD) and National Wetland Inventory (NWI), the 6,000 feet of waterway flowing to the Highway 283 culvert from Central's evacuation pipeline is classified as an intermittent stream with significant areas of wetland (greater than 2-acres) evident. If the open channel alternative is pursued, and assuming the U.S Army Corp of Engineers (USACE) declares this reach as a jurisdictional Waters of the United States (WOTUS), it is likely a Section 404 Individual Permit would be required along with stream and wetland mitigation. The gravity outlet pipeline option would likely have temporary impacts, or very minor permanent impacts on the waterway and adjacent wetlands, and is likely permissible through a Nationwide Permit (NWP). Any work on the existing E65 canal is assumed to be exempt from Section 404 permitting because the existing infrastructure was created for irrigation uses. The same applies to agricultural crossings, where exemptions are available if the work does not alter the flow path. Minor repairs on Plum Creek, or impacts from construction of recapture wells or associated pipelines, are likely permissible under a NWP.

Other potential permits include well permits from TBNRD and a consideration of a variance for the spacing of new recapture wells, Gosper County floodplain and right-of-way permits, and authorization from the Nebraska Department of Transportation (NDOT) for any modifications to the existing Highway 283 culvert or work in the right-of-way to build a drop structure.

Construction does not appear to have significant impacts to Threatened and Endangered species and cultural resources. These potential impacts would be reviewed during the Section 404 permitting process.

CONSIDERATIONS FOR NEXT STEPS

Below is a summary of considerations for next steps beyond the Expanded Recapture Reconnaissance Study:

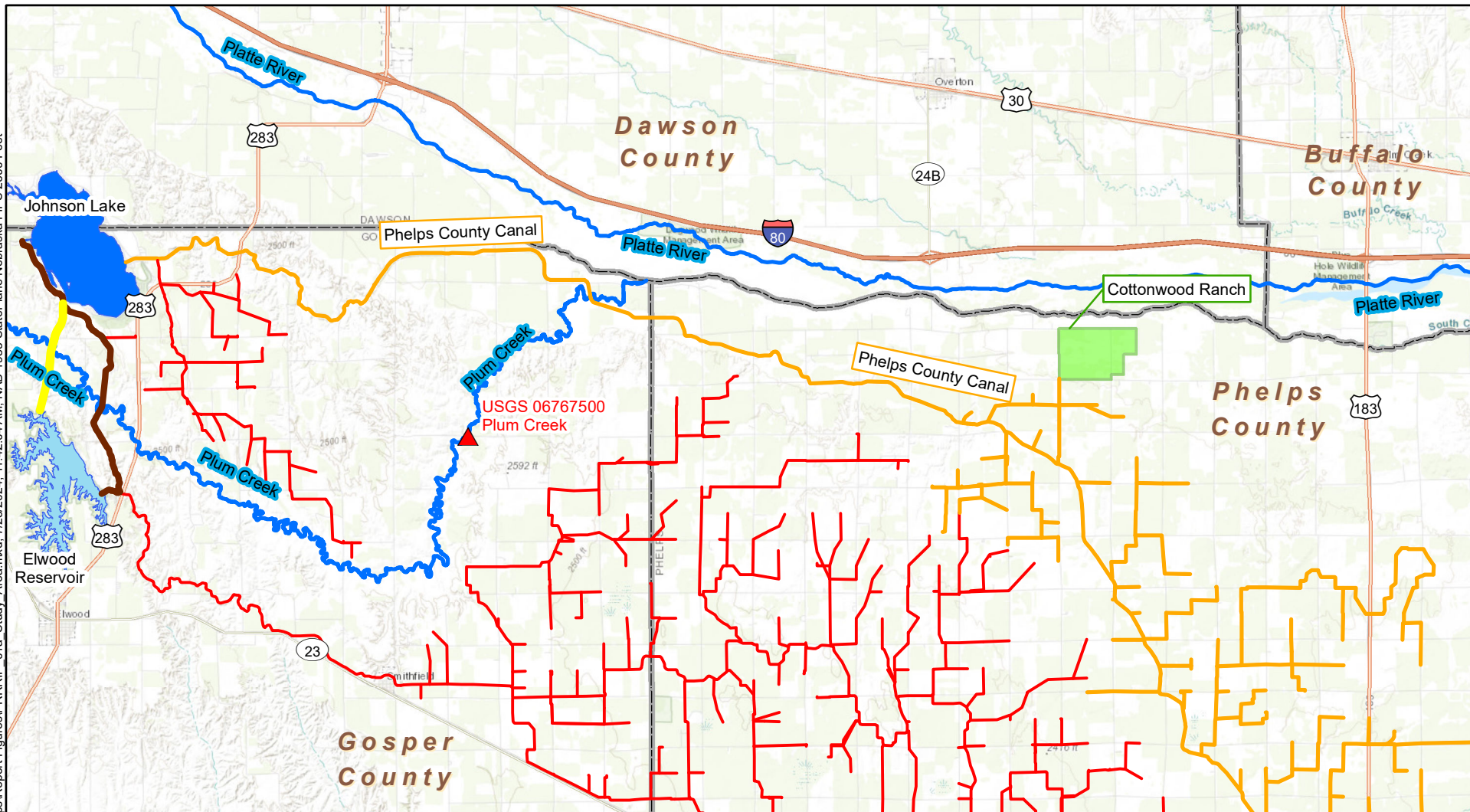
- **Well Yields** – Sustainable alluvial well yields in the area vary significantly (between 300 to 1,000 gpm). Site specific evaluation of hydrogeology and aquifer conditions are necessary to accurately determine prospective well yields.
- **Elwood Reservoir Operations** – The modeling of Elwood Reservoir assumes the required pumping into and release from Elwood Reservoir are coordinated around CNPPID's current operation of the reservoir for irrigation. This will likely change if CNPPID proceeds to construct a new E65 Canal and siphons and a gravity inlet to Elwood Reservoir. Model refinements will be necessary to better represent CNPPID's planned future operations once they become known.
- **Recapture Well Operations** – Modeled recapture well pumping operations were limited to a monthly volumetric rate based on the estimated capacity of each well and seasonally with pumping only allowed from March through November. For all gravity outlet scenarios, recapture wells were pumped to reduce deficits remaining after outlet releases. Additional

investigation supporting the use and optimization of recapture wells in combination with a gravity outlet is warranted.

- Alluvial Saturated Sand – The primary conduit for conveying aquifer recharge from existing recharge projects back to the Platte River is alluvial saturated sand not the Ogallala aquifer. Wells logs indicate wells located further from the Platte River in Recapture Zones 2 and 3 are primarily screened in the Ogallala aquifer. If pumping is only allowed from alluvial saturated sand, well yields farther from the river may not be sustainable or result in well interference concerns. Preliminary feedback from NeDNR suggests this may not be a significant issue for the state. However, the Program may have issues of policy and/or perception related to water recharged vs water recaptured that warrant further consideration.
- Real-time vs Annual Hydrologic Conditions – Annual hydrologic conditions from the 1947 to 1994 period are used as the basis for assigning target flows to determine excesses/shortages and transit losses (WMC transit loss factors). In the more recent period (1995 to 2023) real-time hydrologic conditions are used as the basis for assigning target flows and transit losses. A preliminary comparative analysis completed by EDO staff indicates the use of real-time hydrologic conditions for the more recent period 1995-2023 results in a slightly lower overall estimate of shortages and slightly higher excess flow compared to the annual hydrologic condition. However, a closer look at the analysis on a monthly timestep suggests little meaningful difference when considering the magnitude of augmentation flows that the Program could contribute to the Platte River compared to the typical magnitude of shortages. Scores can be further impacted by the assignment of transit losses based on annual or real-time monthly hydrologic conditions. Additional investigation, sensitivity testing, and/or model refinements are warranted.
- Aquifer Accounting – The Program would benefit from the establishment of an operations and management plan for existing recapture wells to ensure that pumping practices are sustainable. Under several scenarios aggressive pumping or over use of recapture wells can result in negative accretions to the Platte River that actually increase target flow deficits. Aquifer accounting and management should include both short-term and long-term impacts to the river, ensuring pumping today will not detrimentally impact the river long-term.
- Aquifer Timing - The timing of aquifer accretions and depletions in this analysis utilize multiple sources for Unit Response Functions (URFs). Program URFs associated with Phelps County Canal, Elwood Reservoir, and the Cook Well are site specific project URFs generated from the Program's groundwater model(s) or Integrated Decision Support Alluvial Water Accounting System (IDS AWAS). URFs utilized for recapture wells are based on SDFs from COHYST. This difference is important to the timing of the aquifer accretions and pumping impacts to the stream. It is recommended that the GoldSIM model be refined to use a consistent set of URF's based upon a single representative groundwater model.

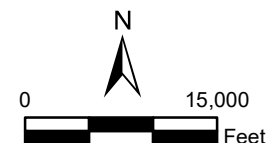
- Scoring - Historically, all Program projects have been individually scored. This exercise highlights the benefits of collectively scoring inter-dependent Water Action Plan projects to better understand the aggregate net benefit to the river.
- Cost – Costs included in the Study were established at a reconnaissance level resulting in conservative estimates to support the Model and to provide resources for decision makers. These costs are intended to serve as a foundation for future planning efforts for comparative purposes and include a 30% contingency. A detailed cost analysis should be refined in subsequent Phases of this project supporting actual costs of the selected alternatives.

ATTACHMENT A – FIGURES



- ▲ Plum Creek Gage (USGS 06767500)
- Cottonwood Ranch Project Boundary
- New E65 Siphon
- Existing E65 Siphon
- Phelps County Canal
- CNPID Canals
- County Boundary

Sources: Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



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PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM EXPANDED RECAPTURE RECONNAISSANCE STUDY GOSPER/PHELPS COUNTY

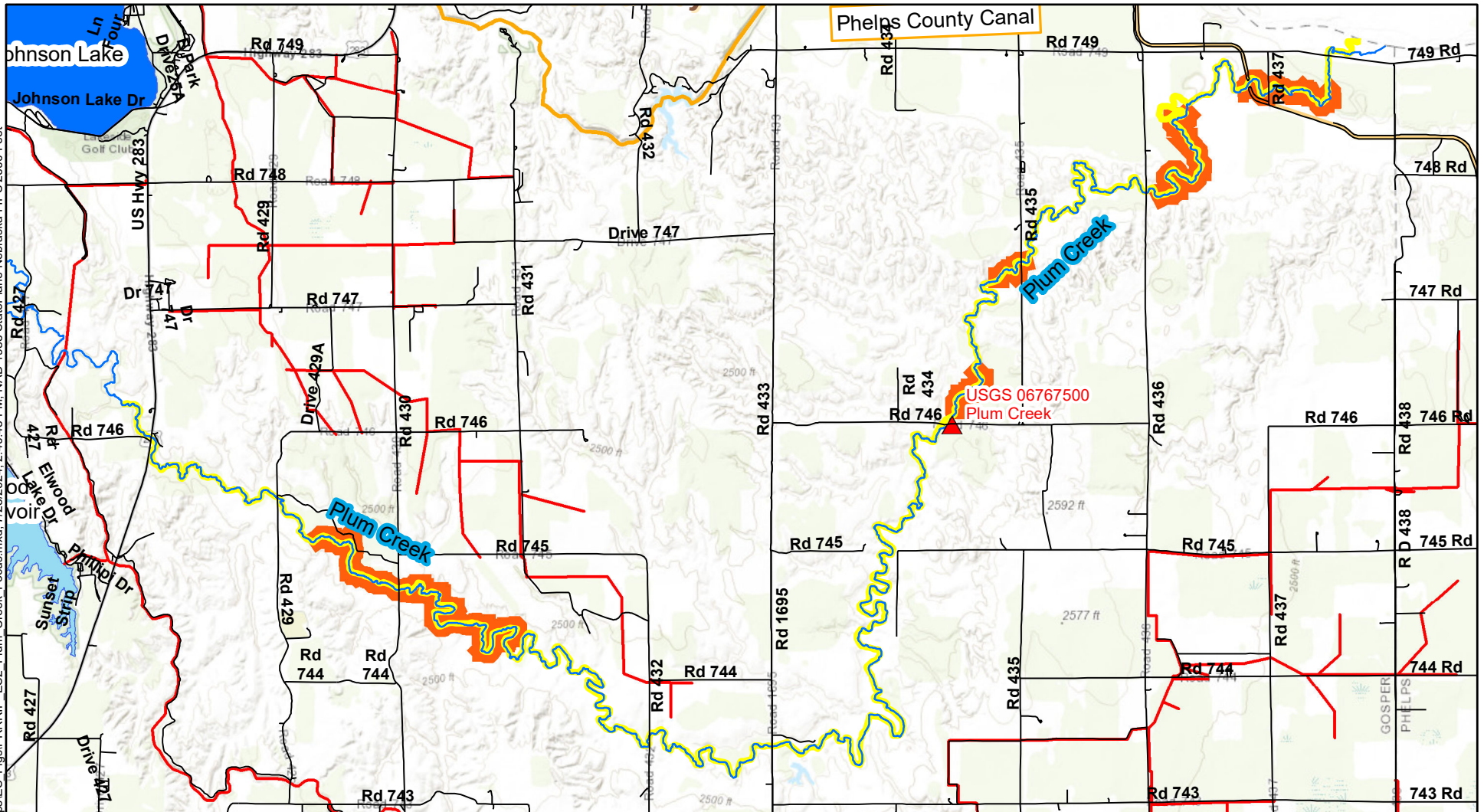
PRRIP EXPANDED RECAPTURE PROJECT AREA

FILE: PRRIP_01a_Study_Area.MXD

DATE: 6/21/2024

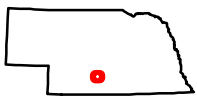
FIGURE: ES-1

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- ▲ Plum Creek Gage (USGS 06767500)
- Sub-reaches
- Plum Creek Focus Area
- Phelps County Canal
- CNPPID Canals

Sources: Service Layer Credits: Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community



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PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
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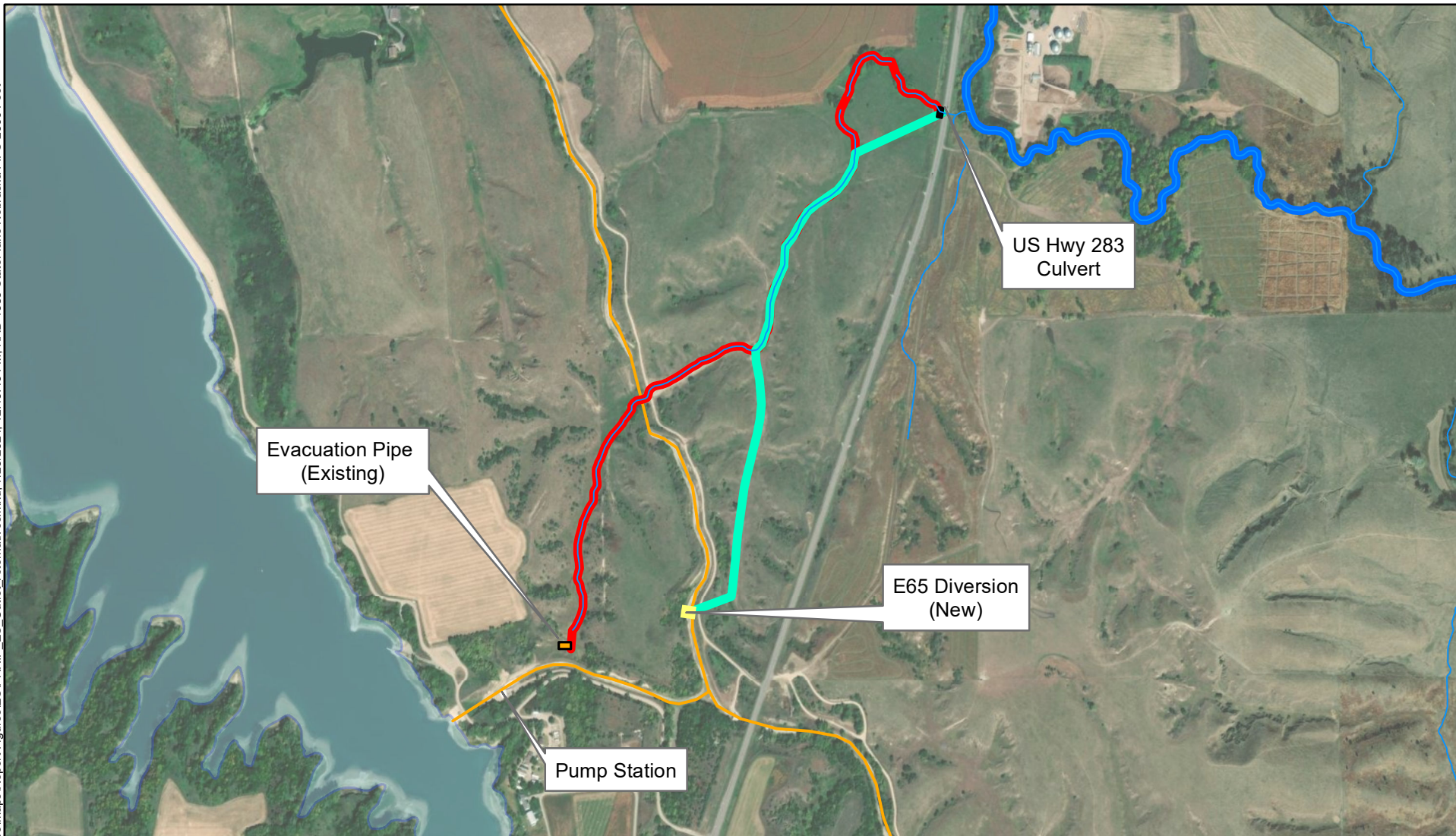
PLUM CREEK FOCUS AREA

FILE: PRRIP_ES2_Plum_Creek_Focus.MXD

DATE: 7/23/2024

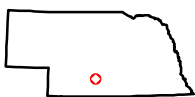
FIGURE: ES-2

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- Flowline (NHD)
CNPPID Canals
- Outlet Alternatives**
Alt. A - Open Channel
Alt. B - Pipeline

Sources: Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community
Nebraska DNR Groundwater Well Database



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PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
EXPANDED RECAPTURE RECONNAISSANCE STUDY
GOSPER/PHELPS COUNTY

GRAVITY OUTLET ALTERNATIVES A & B

FILE: PRRIP_ES_Outlet_Alternatives.MXD

DATE: 7/23/2024

FIGURE: ES-3



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Legend

- Conceptual Recapture Well Placement
- Closest Power Location
- Plum Creek
- NHD Streams
- CNPPID Canal/Lateral
- Conceptual Conveyance
- COHYST Cell
- Recapture Zone

COHYST Stream Depletion Factor (%)

0.21 - 10.0
10.01 - 20.0
20.01 - 30.0
30.01 - 40.0
40.01 - 50.0
50.01 - 60.0
60.01 - 70.0
70.01 - 80.0
80.01 - 90.0
90.01 - 100.0

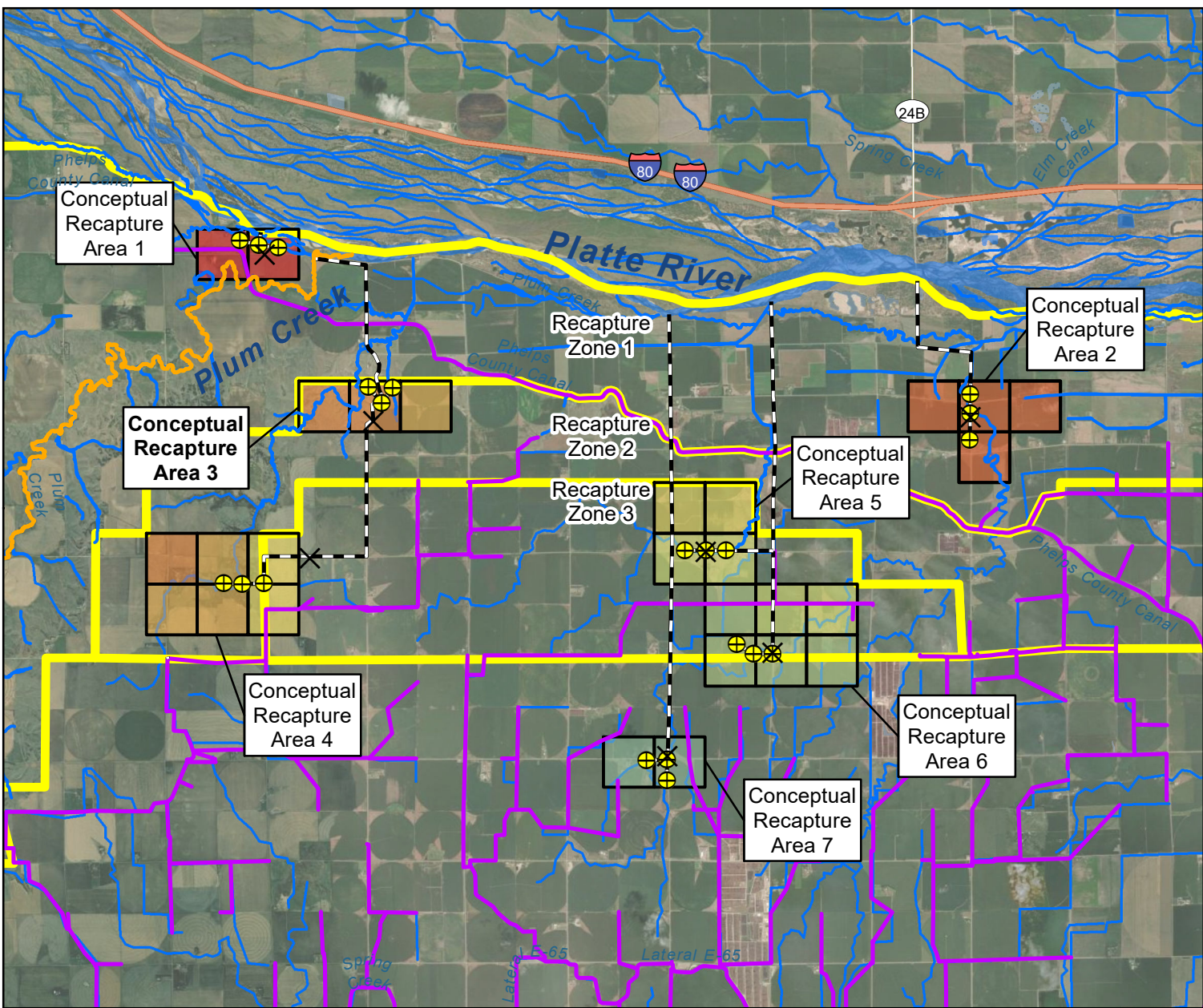
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Sources:

Service Layer Credits: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community COHYST data from Nebraska Department of Natural Resources.



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CONNECTING WATER TO LIFE

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PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM
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GOSPER/HELPS COUNTY

ALL PRRP CONCEPTUAL RECAPTURE WELL
AREAS WITH COHYST STREAM DEPLETION FACTOR (SDF)

FILE: 6011PRRP01_01m_Ali_SDF.MXD | DATE: 7/23/2024 | FIGURE: ES-4