Lower Platte River Basin Coalition

Basin Water Management Plan - Second Increment (2022-2026) of Plan Implementation

APRIL
2022

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HDR

THE FLATWATER GROUP INC.

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Contents

1.0 Background Information

The Lower Platte River Basin (Basin) is one of the state's most valuable resources and is integral to the state's development and sustainability - from an agricultural, social, industrial, and municipal perspective. The Basin is geographically large and diverse in its geology, hydrology, land use, ground and surface water supplies, and water uses. The water resources of the Basin are managed by the Nebraska Department of Natural Resources (NeDNR) and seven Natural Resources Districts (NRDs), including:

- Lower Platte South NRD
- Lower Platte North NRD
- Papio-Missouri River NRD
- Lower Loup NRD
- Lower Elkhorn NRD
- Upper Elkhorn NRD
- Upper Loup NRD

Together with the NeDNR, the seven NRDs entered into an Interlocal Cooperative Agreement in April 2013 to form the Lower Platte River Basin Water Management Plan Coalition (Coalition). The Nebraska Association of Resource Districts (NARD) serves as the coordinator on behalf of the members of the Coalition. The Coalition recognizes the interrelation of water resources inherent within the basin and has embarked on a critical mission to protect and sustain the long-term balance between the water uses and water supplies throughout the Basin within the seven represented NRDs. The first action taken by the Coalition was the development of a voluntary Basin Water Management Plan (Plan). The intent of the Plan was to inform and provide consistency of the individual NRD Integrated Management Plans (IMPs). The original plan was completed and adopted by Coalition members in 2017.

The Plan identified 3 primary goals:

1. Develop and maintain a water supply and use inventory based on the best available data and analysis
2. Collectively develop a water management plan that maintains a balance between current and future water supplies and demands
3. Develop and implement water use policies and practices that contribute to the protection of existing surface and groundwater uses, while allowing for future water development.

These goals were supported by identified Objectives and Action Items for Plan implementation. The plan also contained several key recommendations:

- Defined a first increment for plan implementation with a duration of five years that extended through 2021
- Track and account for uses using the Basin-Wide Accounting methodology developed as part of the planning process
- Conduct an annual meeting to discuss water management activities, coordinate NeDNR and NRD activities, and monitor progress towards goals and objectives of the plan
- The cumulative allowable development within the hydrologically connected areas of the Basin during the first five-year increment to be less than 10% of the 25 year (1988-2012) average annual excess during the peak season, defined as June through August[1].
- Cumulative allowable development to be based upon peak season depletions. Full consumptive use of new development to also be tracked and reported.

[1] For more information on the Basin-Wide Accounting methodology and the development of the cumulative allowable development, please refer to the original Plan document for a full description.

The cumulative allowable development for the Basin was apportioned by sub-basin, and ultimately by NRD, based on contributions to the total water supply of the Lower Platte Basin. Table 1 summarizes the allowable cumulative development by NRD for the first increment from the original Plan document.

TABLE 1. FIRST 5-YEAR INCREMENT ALLOWABLE NEW DEVELOPMENT

NRD	Sub-Basin	First 5-year Increment Allowable New Development (Depletions) – Peak Season	
		% Sub-Basin Supply	AF
Upper Loup NRD	Loup River	32%	2,768
Lower Loup NRD		68%	5,883
Upper Elkhorn NRD	Elkhorn River	25%	1,504
Lower Elkhorn NRD		75%	4,514
Papio-Missouri River NRD	Lower Platte River	21%	869
Lower Platte South NRD		24%	993
Lower Platte North NRD		55%	2,276

During the first increment of the Plan implementation, each Coalition member has tracked and reported the portions of their allowable depletions that have been allocated each year. Table 2 summarizes the new development by NRD that has been allocated during the first increment of Plan implementation.

TABLE2. SUMMARY OF FIRST 5-YEAR INCREMENT NEW DEVELOPMENT ALLOCATED AND REMAINING ALLOWABLE NEW USE

NRD	First 5-year Increment		
	Allowable New Use (AF)	Allocated New Use (AF)	Remaining Allowable New Use (AF)
Upper Loup NRD	2,768	703	2,065
Lower Loup NRD	5,883	1,133	4,750
Upper Elkhorn NRD	1,504	370	1,134
Lower Elkhorn NRD	4,514	1,661	2,853
Papio-Missouri River NRD	869	101	768
Lower Platte South NRD	993	103	890
Lower Platte North NRD	2,276	1,310	966
Total	**18,807**	**5,380**	**13,427**

2.0 Second Increment of Plan Implementation

The Plan document calls for a review by Coalition members at the end of the first increment and development of a second increment for Plan implementation. The Coalition initiated the development of the second increment in 2021 with a focus on the following elements:

- Update the analysis of Basin supplies and uses using the basin-wide accounting methodology
- Complete the allowable new depletions analysis and determine allowable new depletions by NRD for the second increment (including carryover from the first increment)
- Review of Plan's goals, objectives, and action items and update as necessary
- Consideration of the appropriateness of the five-year increment duration

Basin Supplies and Uses Update

The analysis conducted during the development of the original Plan utilized data from the 1988-2012 period as the best and most current dataset available. For development of the second increment of the Plan, water supply and use data was available through 2020. Using the basin-wide accounting methodology, the analysis was updated utilizing the available data through 2020. Two options were considered for evaluating the peak season excess flow within the Basin:

1. Extension of the period of analysis from the first increment through 2020 (1988-2020, a total of 33 years of data)
2. Extension of the period of analysis from the first increment through 2020 and truncating the data to the most recent 25 years of data – the same duration of analysis period used for the first increment (1996-2020, a total of 25 years of data)

An auto-correlation statistical analysis was conducted on each dataset, and both met the unbiased criteria. The Technical and Management Committees reviewed the analyses and ultimately recommended the use of the most recent 25 years of data for evaluating the peak season excess flow within the Basin. Rationale for this recommendation included:

- Consistency with the first increment analysis
- 25 years is an adequate duration to be statistically representative of conditions
- The most recent data includes the most accurate information (well meter data, land use data, etc.) and therefore is more representative of conditions today
- The most recent data better reflects current farm and tillage practices that have continued to evolve since the 1980's and 1990's

Second Increment Allowable New Depletions Analysis

Using the analysis of supplies and uses from the 1996-2020 period, the allowable new development for the second increment of Plan implementation was developed utilizing the same methodology as the first increment, namely:

1. The average annual excess flow during the peak season (June through August) for the analysis period was determined. The annual excess is defined as the total basin supply less the total basin demand, measured at the Louisville gage on the Platte River.
2. The cumulative allowable new development within the Basin during the second 5-year increment is limited to 10% of the 25-year (1996-2020) average annual excess flow during the peak season, adjusted by the unused first increment allowable development.
3. Apportion the second increment allowable new development to each NRD area using that areas contribution to total Basin supply using the same percentages as the first increment.
4. Add the first increment carryover of allowable new development of each NRD to the calculated second increment amounts.

Appendix A describes the analysis of Basin supplies and uses, and the calculations of the average annual excess flow during the peak season for the second increment. The average annual excess flow during the peak season for the 1996-2020 period was determined to be 242,319 acre-feet. Adjusting this value for the 13,427 acre-feet of carryover allowable new development from the first increment, yields 22,889 acre-feet of allowable new development for the second increment to be apportioned to the individual NRD areas ((242,319 AF – 13,427 AF) x 10%). Table 3 summarizes the total allowable new development by NRD for the second increment.

TABLE 3. TOTAL ALLOWABLE NEW DEVELOPMENT BY NRD FOR THE SECOND INCREMENT

NRD	Allowable Depletions by NRD		
	New 2nd Increment	Carryover from 1st Increment	Total
Upper Loup NRD	3,369	2,065	**5,435**
Lower Loup NRD	7,160	4,750	**11,910**
Upper Elkhorn NRD	1,831	1,134	**2,965**
Lower Elkhorn NRD	5,493	2,853	**8,346**
Papio-Missouri River NRD	1,058	768	**1,826**
Lower Platte South NRD	1,209	890	**2,098**
Lower Platte North NRD	2,770	966	**3,736**
Total	**22,889**	**13,427**	**36,316**

Currently the Plan does not limit the ultimate allowable new development within the Basin, rather the Plan calls for an evaluation to occur at the end of each increment to determine the average annual excess flow within the Basin during the peak season. This evaluation considers and accounts for the cumulative new development that has occurred within the previous increments and serves as a basis for determining the allowable new development for the next increment.

During this planning effort it was discussed and recognized by Coalition members that pending the findings of drought effects within the Basin (new objective discussed in next section), consideration may be given to developing an ultimate allowable new development limit within the Basin for the third and any subsequent increments.

Review of Plan Goals, Objectives, and Action Items

In the course of the development of the second increment of the Plan, the Technical Committee reviewed the goals, objectives, and action items of the Plan and found them to be applicable and appropriate for the second increment. During their review, Coalition members discussed potential drought impacts on water supplies, the effects of shortages on existing and new uses, and the need to consider drought conditions. Based on this discussion, an additional objective was added to consider drought conditions and its effects on the Lower Platte Basin. The specific objective - "Evaluate impacts of new development during drought conditions" – was added under Goal #2, with four action items identified to support this objective. Sections 2.0 and 3.0 from the original plan document, with the new objective and action items incorporated, is included in Appendix B.

Coalition members also considered the alternative durations of the second increment, including extending the duration to ten years. Other factors may include availability of new models or data, changes in precipitation patterns, and occurrences of drought. Ultimately Coalition members agreed to keep the five-year duration for the second increment of Plan implementation, but recognize there is some flexibility for the Coalition to adjust the duration during the implementation period.

3.0 Summary

Consistent with the original Plan document, Coalition members have reviewed the first increment of Plan implementation and have developed a second five-year increment Plan. The primary elements/additions of this Plan development included:

1. Evaluation of Basin supplies and uses, and annual average peak season excess flow, using the 1996-2020 period of record (Appendix A)
2. Development of allowable new depletions by NRD for the second increment, including first increment carryover (Table 3)
3. Added one objective and four action items to the Plan Goals, Objectives, and Action Items to address drought effects in the Basin (Appendix B)

Appendices

Appendix A -
Evaluation of Basin Supplies and Uses

MEMORANDUM

To: Lower Platte River Basin Coalition
From: The Flatwater Group, Inc.
Date: March 15, 2022

Subject: Updated INSIGHT Analysis

Overview

The Flatwater Group was tasked with providing the updated INSIGHT analysis for the Lower Platte River Basin Water Management Plan. The original analysis was done by HDR using the Nebraska Department of Natural Resources (NeDNR) INSIGHT data, as described in LPRBC_BWMP_AppendixC_TM_Basin_Accounting_20170911.pdf[1]. The DNR INSIGHT methods document was also used[2]. The goal of the updated analysis was to utilize the same methodology as the original analysis, including using the demand scenario that would maintain 40% of the average streamflow at Louisville (without hydropower considered) to calculate the water supplies available within the Lower Platte River Basin.

The original analysis used a period of 1988-2012 to estimate basin supply. The updated analysis added the years 2013-2020. The final updated spreadsheet was uploaded to DNR's Sharepoint on 11/9/2021[3].

The following sections will highlight the major points of the analysis and the differences between the original and updated analysis methodologies (which are minor).

[1] https://lprbc.nebraska.gov/MtgMaterials/LPRBC_BWMP_AppendixC_TM_Basin_Accounting_20170911.pdf
[2] https://dnr.nebraska.gov/sites/dnr.nebraska.gov/files/doc/water-planning/INSIGHT/2015INSIGHTMethods.pdf
[3] Spreadsheet titled 2017Mar24_LPBasin_Supply_and_Demands_Updateto2020_20211104.xlsm

Basin Water Supply

Streamflow

Daily stream gage values were compiled from the USGS and NeDNR for the water years 1988-2020. For each subbasin analyzed, the streamflow gain in each subbasin was calculated as was done in the original analysis[1].

The Loup River at Columbus gage was filled from 1988-2008 in the same manner as was done in the original analysis. Data from 2008-2020 is from NeDNR.

In the original analysis, the streamflow values in each subbasin were capped at the 5% exceedance value for 1988-2012 because those higher flow events often cannot be captured or used. To keep the 1988-2012 values consistent in the updated analysis, the same 5% exceedance value for 1988-2012 was used to cap the 2013-2020 data as well[4].

Surface Water Consumptive Use

Surface water consumptive use (SWCU) was split into four categories: irrigation, municipal, industrial, and evaporation from large reservoirs.

Irrigation:

Irrigation SWCU was calculated using the available data, in the same manner as the original analysis. Mirdan Canal, Fullerton Canal, and Farwell Main, Central, and South canals had diversion, delivery, and return information available (Type 1). Sargent Canal, Burwell-Sumter Canal, Ord-North Loup Canal, Taylor-Ord Canal, and Middle Loup Canals 1, 2, 3, and 4 had only diversion data available (Type 4). The rest of the surface water irrigated lands (mostly small pumpers) had no diversion records available (Type 5) so the SWCU for these lands was determined by calculating a surface water demand for those surface water irrigated acres. That demand was then adjusted by NeDNR administration records if there were shortages to junior surface water users. The calculation methods for each type are detailed in the DNR Methods documentation[2].

Note: any commingled irrigated acres were treated as surface water only so as not to double count any irrigation demands on these acres. For reference, Figure 1 displays the location of the irrigated acres in the CNEB model while the next two figures display the surface water only irrigated acres (Figure 2) and the commingled irrigated acres (Figure 3) for 2012-2020 in the CNEB model area[5].

[4] The capped streamflow values by basin can be found in the final spreadsheet[3] on the FinalBasinData_20160314 tab in columns P:R

[5] The graphics come from a NeDNR presentation at a LPRBC meeting on 11/16/2021

Figure 1: Lower Platte Basin 2020 Irrigated Acres within the CNEB Model Domain

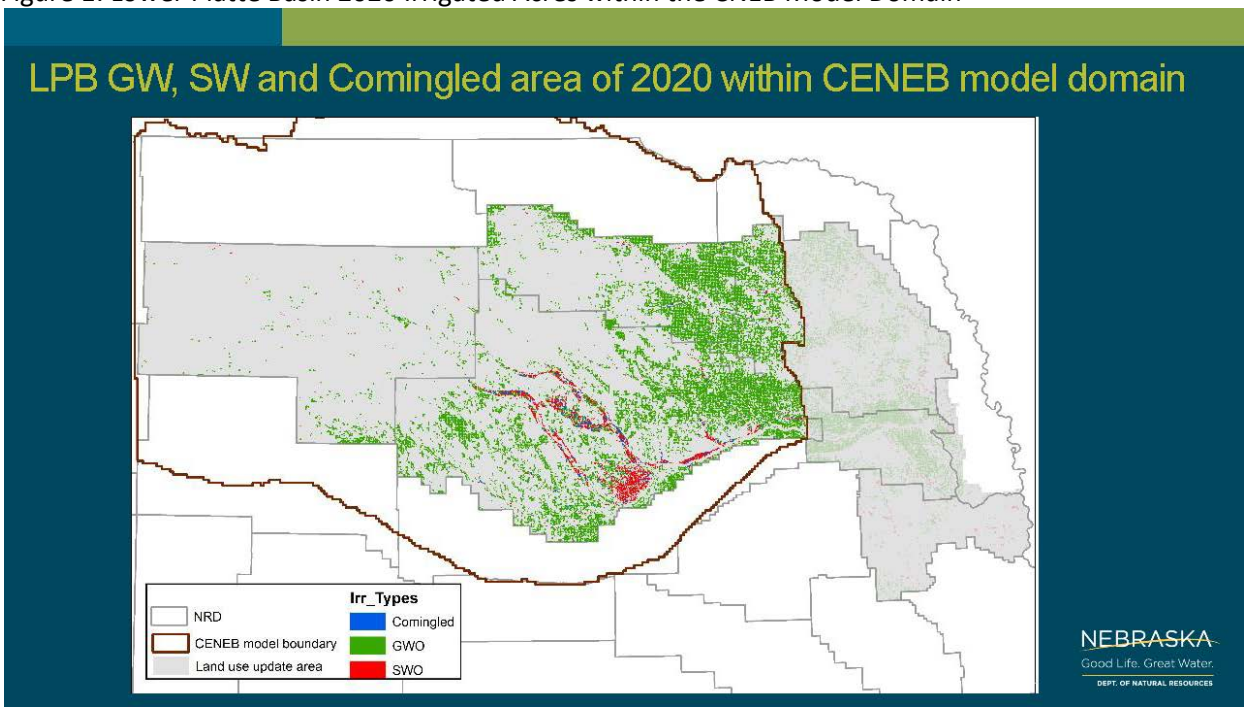
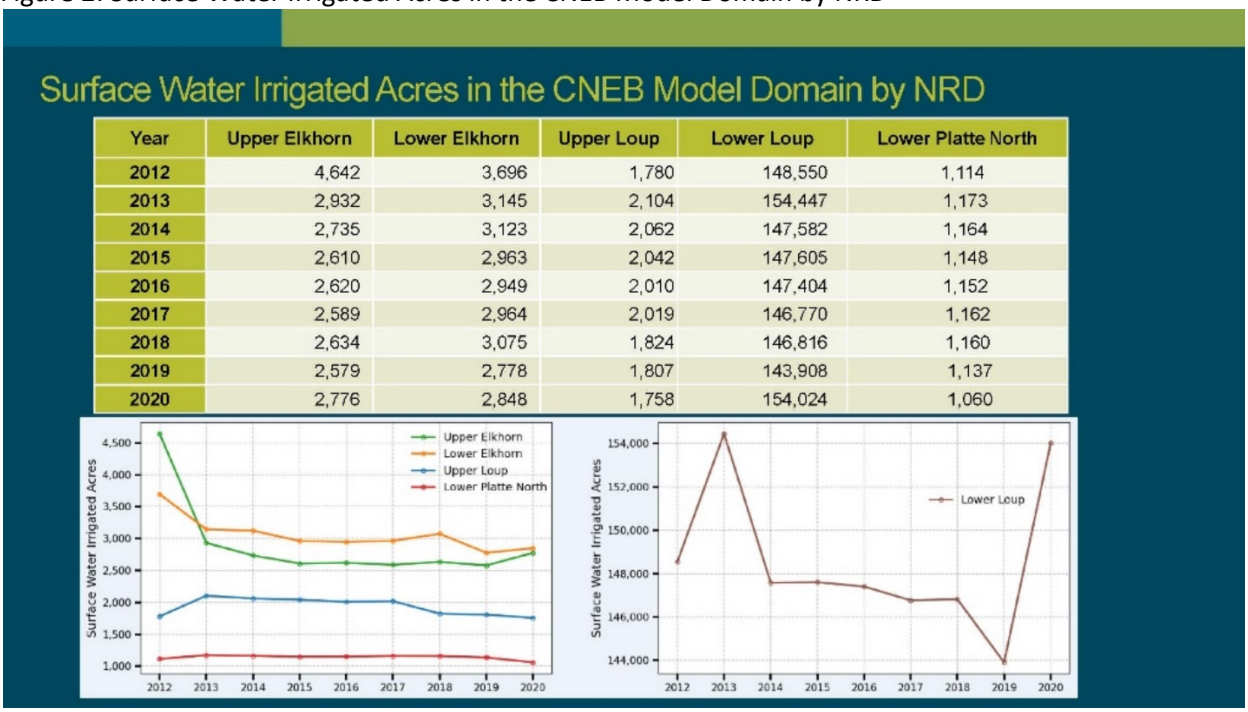
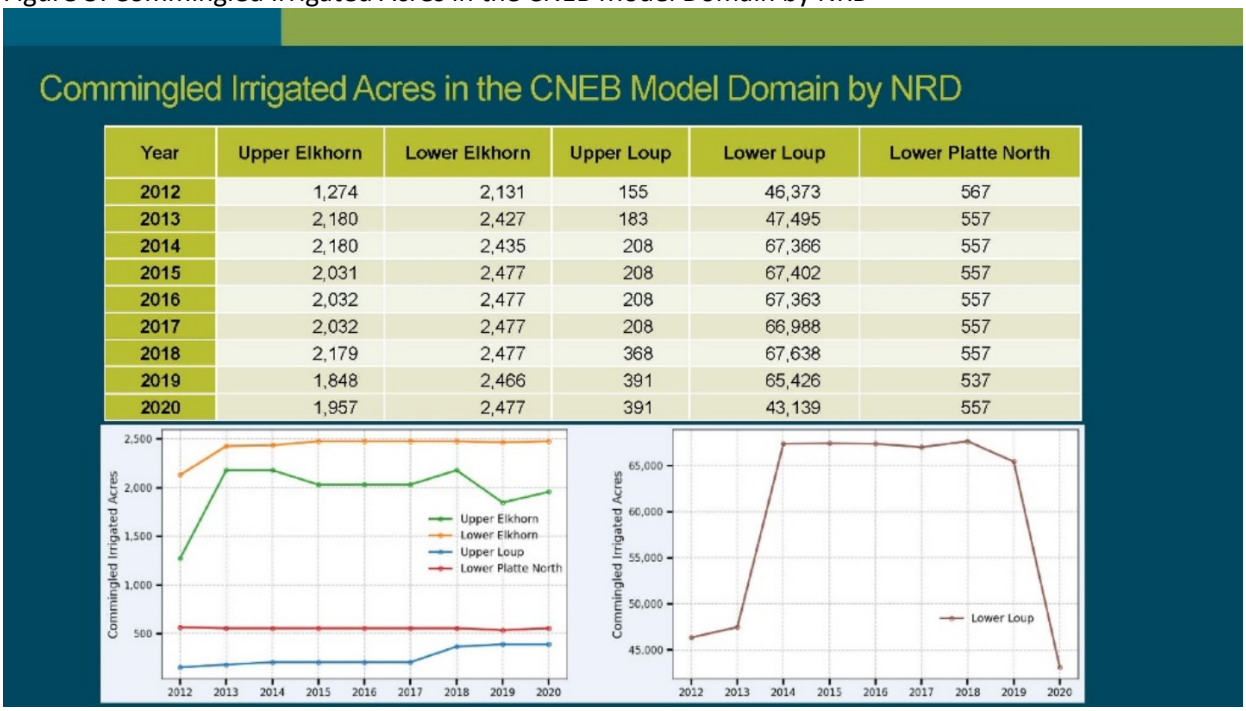


Figure 2: Surface Water Irrigated Acres in the CNEB Model Domain by NRD



Year	Upper Elkhorn	Lower Elkhorn	Upper Loup	Lower Loup	Lower Platte North
2012	4,642	3,696	1,780	148,550	1,114
2013	2,932	3,145	2,104	154,447	1,173
2014	2,735	3,123	2,062	147,582	1,164
2015	2,610	2,963	2,042	147,605	1,148
2016	2,620	2,949	2,010	147,404	1,152
2017	2,589	2,964	2,019	146,770	1,162
2018	2,634	3,075	1,824	146,816	1,160
2019	2,579	2,778	1,807	143,908	1,137
2020	2,776	2,848	1,758	154,024	1,060

Figure 3: Commingled Irrigated Acres in the CNEB Model Domain by NRD



Year	Upper Elkhorn	Lower Elkhorn	Upper Loup	Lower Loup	Lower Platte North
2012	1,274	2,131	155	46,373	567
2013	2,180	2,427	183	47,495	557
2014	2,180	2,435	208	67,366	557
2015	2,031	2,477	208	67,402	557
2016	2,032	2,477	208	67,363	557
2017	2,032	2,477	208	66,988	557
2018	2,179	2,477	368	67,638	557
2019	1,848	2,466	391	65,426	537
2020	1,957	2,477	391	43,139	557

Municipal:

As in the original analysis, consumptive uses from the Lincoln and Omaha well fields were calculated by NeDNR and included in the surface water consumptive use category.

Industrial:

As was done in the original analysis, no industrial surface water consumptive uses were included in this analysis.

Evaporation:

As in the original analysis, net evaporation for the large reservoirs with available data was calculated using the formula below:

Net Evaporation = ((Pan Evaporation * 0.7) – Precipitation) * Surface Area

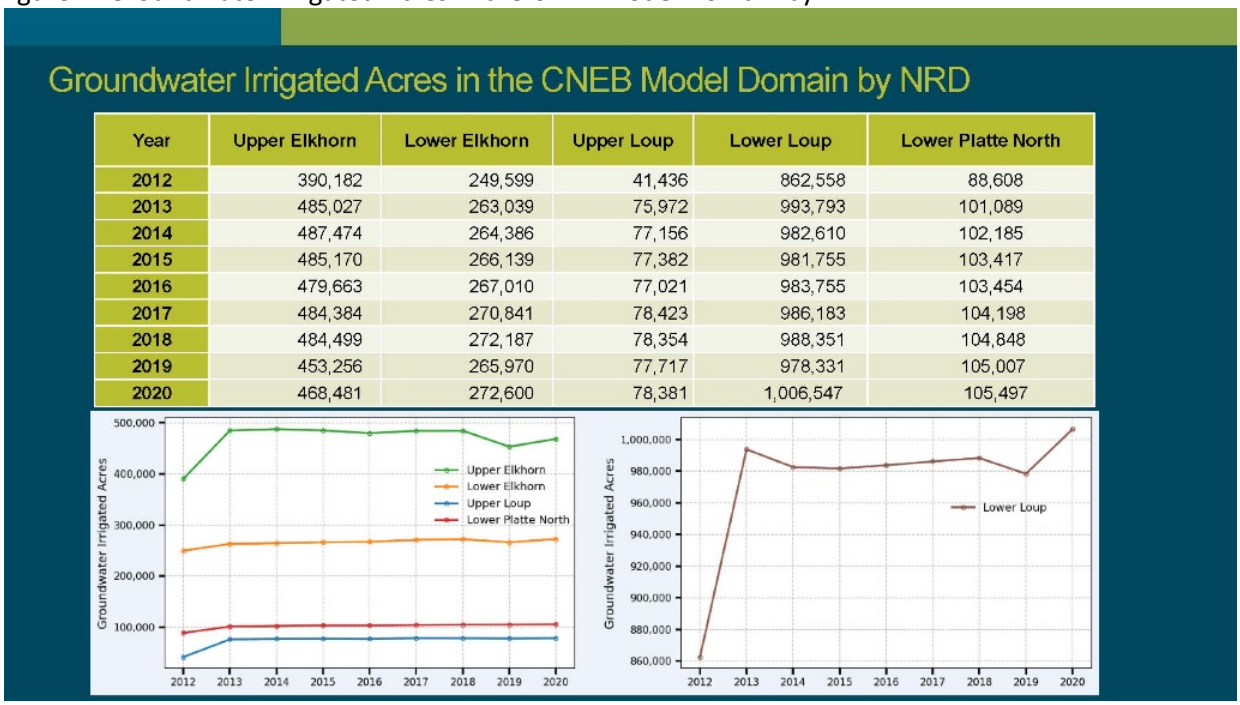
Groundwater Depletion

As in the original analysis, the groundwater depletion analysis was done in two parts because of the groundwater models available. The Central Nebraska (CNEB) model was used for the portions of the Elkhorn, Loup, and Lower Platte River Basins shown in the red boundary in figure 1, while an analytical

depletions model was used for portions of the Lower Elkhorn and Lower Platte River Basins outside the CNEB model domain.

Note: any commingled irrigated acres were treated as surface water only so as not to double count any irrigation demands on these acres. Figure 4 displays the groundwater only irrigated acres for 2012-2020 in the CNEB model area[5].

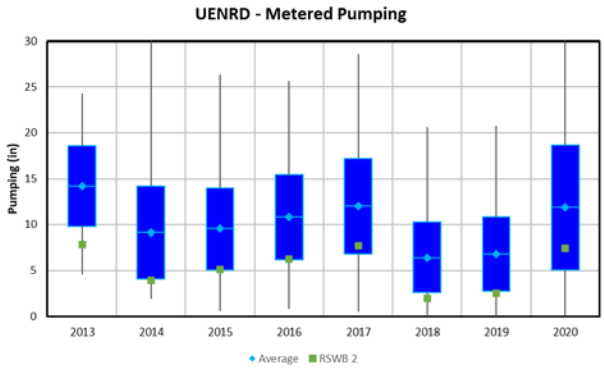
Figure 4: Groundwater Irrigated Acres in the CNEB Model Domain by NRD



The following five graphics (Figures 5 – 9) show how the modeled (identified as RSWB 2 on the graphics) groundwater pumping values compare to available metered pumping information and the corresponding groundwater irrigated acres by NRD, all within the CNEB model domain. The metered pumping graphics provide a summary of metered values displayed as annual bar and whisker plots (presenting the minimum and maximum recorded values as the extent of the whiskers and values between the 25th and 75th quartile in the highlighted section of the plot) with the average of the recorded values shown as a blue diamond. The average modeled value is shown as a green square.

The acreage plots provide a comparison between the total number of ground water irrigated acres in area (shown by the green bars) compared to the number of acres represented by the metering information (shown by the blue bars). At the top of each bar stack are the number of meter readings available for use in developing the previously discussed whisker plots.

Figure 5: Upper Elkhorn NRD Metered (Blue) and Modeled (Green) Pumping and Groundwater Irrigated Acres in the CNEB Model Domain



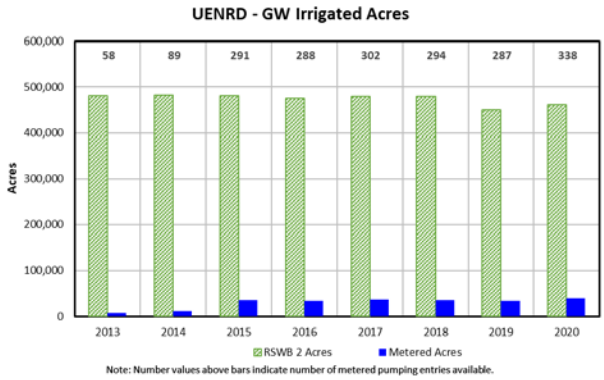
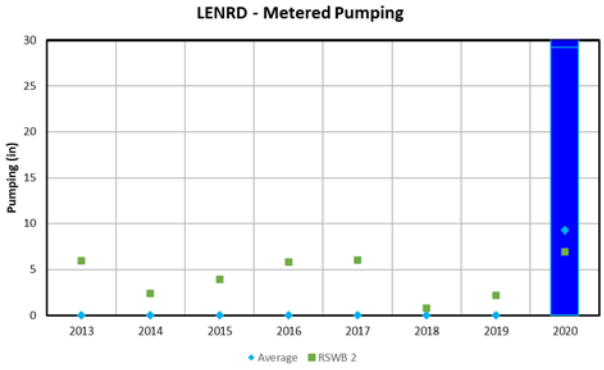


Figure 6: Lower Elkhorn NRD Metered (Blue) and Modeled (Green) Pumping and Groundwater Irrigated Acres in the CNEB Model Domain



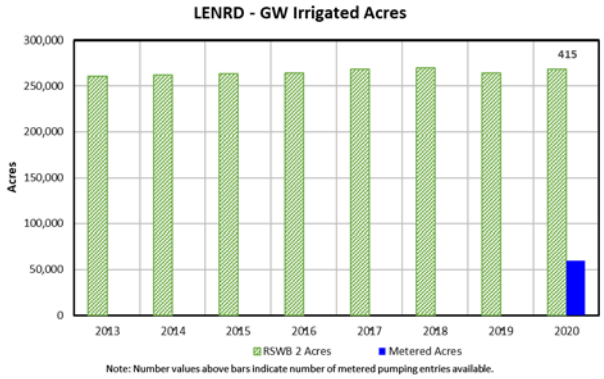
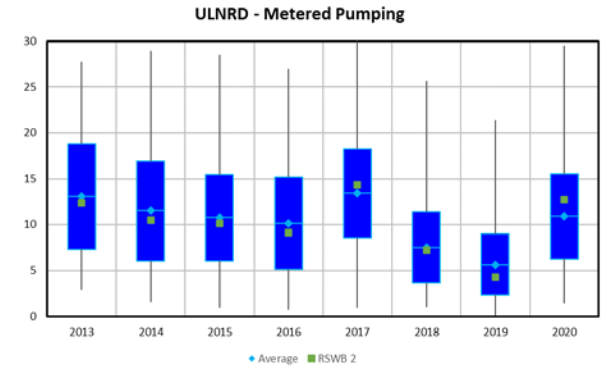


Figure 7: Upper Loup NRD Metered (Blue) and Modeled (Green) Pumping and Groundwater Irrigated Acres in the CNEB Model Domain



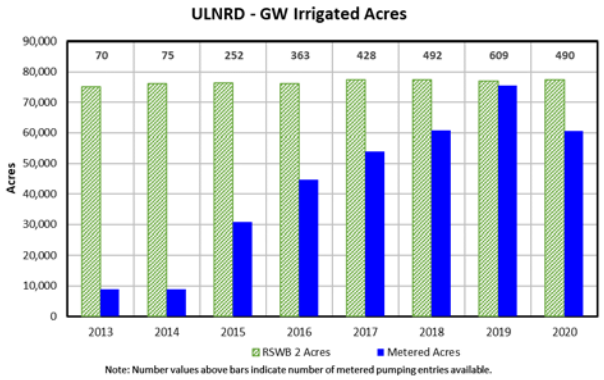


Figure 8: Lower Loup NRD Metered (Blue) and Modeled (Green) Pumping and Groundwater Irrigated Acres in the CNEB Model Domain

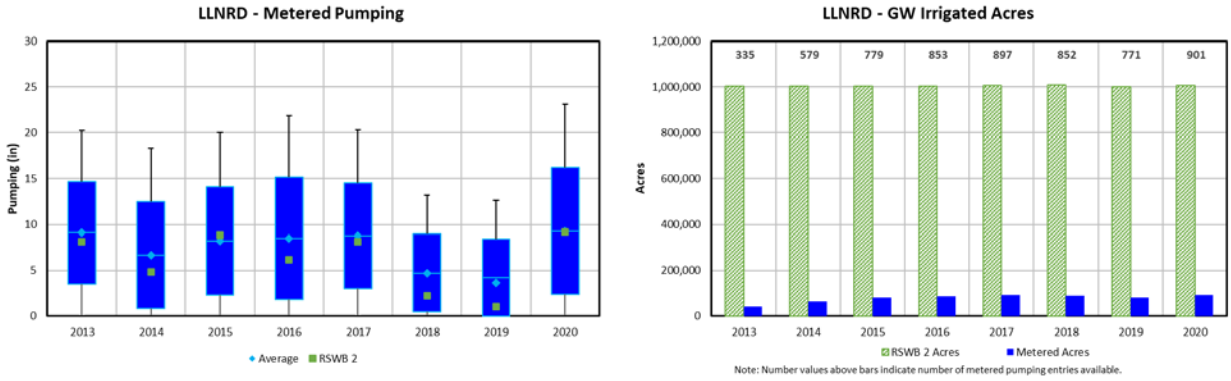
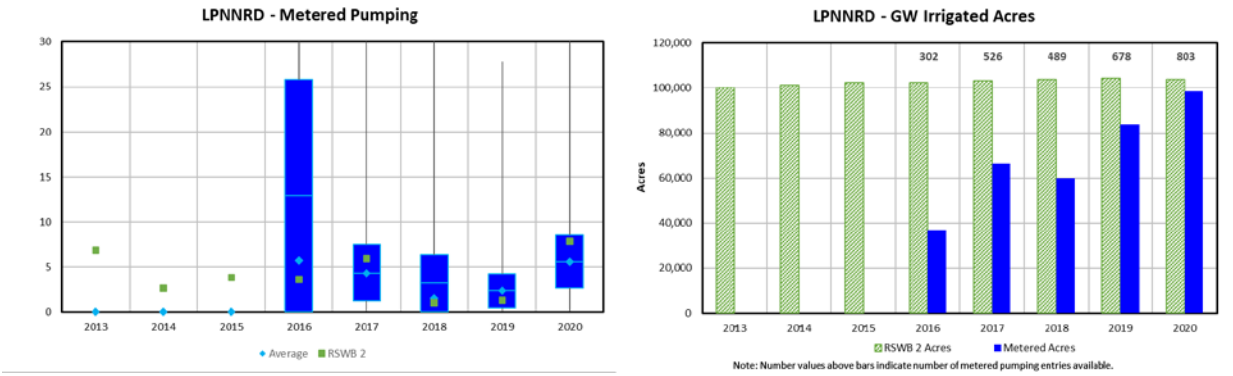


Figure 9: Lower Platte North NRD Metered (Blue) and Modeled (Green) Pumping and Groundwater Irrigated Acres in the CNEB Model Domain



Required Inflow

The required inflow term is used to recognize the historic contribution of the basin water supply from an upstream basin. It represents the portion of demand within a basin or subbasin that is reliant upon upstream sources for part of the water supply. The methodology used in the original analysis was used in the updated analysis and can be found in the original documentation[2].

Basin Water Demand

Surface Water Demand

As in the original analysis, surface water demand was calculated the same way as the surface water consumptive use except that no administrative adjustments were done so that the full demand was used even if junior water users were curtailed at certain times during the year. The other two differences are that surface water consumptive use is redistributed from the peak season to the non-peak season when the storage reservoirs could provide a portion of the supply, and that the full Lincoln and Omaha permitted extraction rates are used for the municipal surface water demand.

Groundwater Demand

As in the original analysis, groundwater demand was calculated using the same information that was used to calculate groundwater depletions for the supply calculation.

Groundwater withdrawal volumes were summed on an annual basis and then distributed 70 percent to the non-peak season and 30 percent to the peak season to match the observed seasonal pattern of groundwater depletions.

Non-Consumptive Use Demands

Non-consumptive use demands are demands on the water supply that are available to meet other demands as well. Examples of these demands include hydropower demands, instream flow, induced groundwater recharge, or downstream demands for consumptive uses. As these water demands can be for the "same" water, only the largest of the non-consumptive uses is considered. This is the same approach used in the original analysis.

In the updated 2013-2020 analysis, the largest non-consumptive use was the demand of 40% of the Louisville flows.

Net Surface Water Loss

As in the original analysis, net surface water loss is the water determined to be necessary to deliver streamflows to meet consumptive demands for surface water irrigation districts. This serves as an additional demand.

Net surface water loss = Canal diversion – SWCU

Net surface water loss is calculated for irrigation districts in the Middle Loup and North Loup River Basins.

Final Balances

The final balances are calculated by taking the difference between the basin water supply and the basin water demand.

The original 25 year analysis final peak season balances are displayed below:

Table 1: Original 25 year (1988-2012) Peak Season Balances

Original 25Yr Avg	Peak BWS						Peak Total Long Term Demand					Peak Balance	
	SWCU	GW Depl.	Streamflow	intrinsic supply	Req. Inflow	Total	SW demand	GWCU	NonCU	Net SW Loss	Total		
Loup	152,576	29,072	380,027	561,677	-	561,677	109,733	128,051	223,704	42,898	504,386	57,291	
Beaver Creek	2,777	7,266	(490)	9,555	2,686	12,241	2,999	30,199	5,393	-	38,591	(26,350)	
Elkhorn	16,849	59,246	357,354	433,450	-	433,450	17,476	98,209	180,260	-	295,945	137,506	
Lower Platte	32,073	54,184	238,210	324,468	408,454	732,922	116,646	56,713	539,934	-	713,293	19,630	
Total Lower Platte				1,329,150							1,552,215		
				BWS%	accounting for rounding in master spreadsheet and Beaver Creek not in Lower Platte						total	188,077	10%
			Loup	0.4226	0.44								
			Beaver Creek	0.0072	0.02						Loup Plus Beaver	86,515	8,652
			Elkhorn	0.3261	0.32						Elkhorn	60,185	6,018
			Lower Platte	0.2441	0.22						Lower Platte	41,377	4,138

The next two tables show the updated 25 year analysis (moving the dates from 1988-2012 to 1996-2020) and an updated 33 year analysis (1988-2020).

Table 2: Updated 25 year (1996-2020) Peak Season Balances

Updated 25Yr Avg	Peak BWS						Peak Total Long Term Demand					Peak Balance	
	SWCU	GW Depl.	Streamflow	intrinsic supply	Req. Inflow	Total	SW demand	GWCU	NonCU	Net SW Loss	Total		
Loup	154,173	35,631	402,685	592,490	-	592,490	110,841	131,971	242,273	40,810	525,896	66,595	
Beaver Creek	2,535	8,791	3,287	14,614	2,244	16,858	2,705	30,490	7,144	-	40,339	(23,481)	
Elkhorn	15,147	55,945	400,350	471,443	-	471,443	15,467	100,125	199,731	-	315,324	156,120	
Lower Platte	34,530	52,252	281,360	368,143	448,624	816,767	116,549	54,260	602,873	-	773,682	43,086	
Total Lower Platte				1,446,690							1,655,240	103,025	
				BWS%	accounting for rounding in master spreadsheet and Beaver Creek not in Lower Platte						total	242,319	10%
			Loup	0.4095	0.44								
			Beaver Creek	0.0101	0.02						Loup Plus Beaver	111,467	11,147
			Elkhorn	0.3259	0.32						Elkhorn	77,542	7,754
			Lower Platte	0.2545	0.22						Lower Platte	53,310	5,331

Table 3: Updated 33 year (1988-2020) Peak Season Balances

Updated 33Yr Avg	Peak BWS						Peak Total Long Term Demand					Peak Balance	
	SWCU	GW Depl.	Streamflow	intrinsic supply	Req. Inflow	Total	SW demand	GWCU	NonCU	Net SW Loss	Total		
Loup	147,907	32,596	398,135	578,639	-	578,639	107,935	125,818	237,609	40,851	512,213	66,425	
Beaver Creek	2,549	8,110	5,096	15,756	2,303	18,058	2,716	29,084	6,881	-	38,682	(20,623)	
Elkhorn	15,558	55,111	380,933	451,603	-	451,603	16,033	95,369	192,253	-	303,655	147,949	
Lower Platte	33,328	51,339	269,198	353,865	436,140	790,005	116,351	52,874	585,986	-	755,211	34,796	
Total Lower Platte				1,399,863							1,609,760		
				BWS%	accounting for rounding in master spreadsheet and Beaver Creek not in Lower Platte						total	228,547	10%
			Loup	0.4134	0.44								
			Beaver Creek	0.0113	0.02						Loup Plus Beaver	105,131	10,513
			Elkhorn	0.3226	0.32						Elkhorn	73,135	7,313
			Lower Platte	0.2528	0.22						Lower Platte	50,280	5,028

Appendix B –
Second Increment Goals, Objectives, and Action Items

2.0 Goals and Objectives

The Coalition Board initially developed draft Goals and Objectives for the Plan in April, 2013. These goals and objectives were refined and finalized through the collaborative planning process. The three final goals that were developed include:

1. Develop and maintain a water supply and use inventory based on the best available data and analysis.

2. Implement a water management plan for the Basin that maintains a balance between current and future water supplies and demands.

3. Develop and implement water use policies and practices that contribute to the protection of existing surface and groundwater uses while allowing for future water development.

These goals, as well as objectives for each, are presented in detail in Table 2.1. Specific action Items to support these goals and objectives are presented in Section 3.0.

TABLE 2.1. GOALS AND OBJECTIVES

Goal 1. Develop and maintain a water supply and use inventory based on the best available data and analysis.	
OBJECTIVES OF GOAL 1	1. Develop a comprehensive inventory of the location and source of the Basin's current and future water supplies, water uses and outflows. Maintain and update on a schedule that is coincident with the 5-year update of the INSIGHT database.
	1.1 Develop a better understanding of basinwide inflows/outflows to enable development of a more comprehensive water inventory.
	1.2 Project changes to water inventory due to changes in urban and rural population and land use.
	1.3 Evaluate potential effects on water inventory of coordination, innovation and technology.
	1.4 Refine the extent of hydrologically connected ground and surface waters in the Lower Platte River Basin.
	1.5 Evaluate variations in water inventory due to climate cycles.
	2. Monitor current and future water demands in the Basin. Provide report at the annual Basin meeting that will be used for NeDNR's FAB analysis.
Goal 2. Implement a water management plan for the Lower Platte River Basin that maintains a balance between current and future water supplies and demands.	
OBJECTIVES OF GOAL 2	1. Collaborate with state and local governments to identify a minimum of three (3) opportunities to augment water supplies within the Lower Platte River Basin and, if necessary, identify opportunities to supplement with imported water from outside the Lower Platte River Basin.
	2. Monitor the instream flow needs in the Lower Platte River Basin to foster an understanding of the existing appropriation priorities and locations, and provide a basis for evaluating impacts of existing and future uses. Provide report at the annual Basin meeting that will be used for NeDNR's FAB analysis.
	3. Evaluate options for Basin water banking methodologies.
	4. Evaluate impacts of new development during drought conditions.
Goal 3. Develop and implement water use policies and practices that contribute to the protection of existing surface and groundwater uses while allowing for future water development.	
OBJECTIVES OF GOAL 3	1. Identify available water storage opportunities throughout the Lower Platte River Basin.
	2. Evaluate, understand, and develop policies to address impacts on stream flows of uses outside of management control.
	3. Expand public education programs on general awareness of water supplies and to encourage water conservation measures. Provide annual reporting and press release that includes, at a minimum, activities from previous year, supporting data, education statements and on-going work.

3.0 Action Items

Action items to support implementation of the plan were developed through collaboration with Coalition members. The action items are tasks directly linked to the specific objectives, and ultimately the overarching goals they help to accomplish.

GOAL 1: Develop and maintain a water supply and use inventory based on the best available data and analysis.

OBJECTIVES

1. Develop and maintain a comprehensive inventory of the location and source of the Basin's current and future water supplies, water uses and outflows.

1.1 Develop a better understanding of basinwide inflows/outflows to enable development of a more comprehensive water inventory.

1.2 Project changes to water inventory due to changes in urban and rural population and land use.

1.3 Evaluate potential effects on water inventory of coordination, innovation and technology.

1.4 Refine the extent of hydrologically connected ground and surface waters in the Lower Platte River Basin.

1.5 Evaluate variations in water inventory due to climate cycles.

ACTION ITEMS

- A. Compile a tabular summary of basinwide inflows and outflows using existing gage measurements where available, and estimates or calculated components where unavailable.
- B. Evaluate and prioritize estimated components based on uncertainty and relative impact of water inventory.
- C. Identify locations where additional gaging data or further study/modeling would reduce uncertainty in the basinwide water inventory.

- A. Develop projected municipal and industrial growth estimates, incorporating current city growth plans if available.
- B. Develop projected agricultural land use trends to estimate future change in inventory.
- C. Utilize existing tools to evaluate the impacts on water inventory due to changes in both urban and rural land use scenarios.

- A. Evaluate impacts of soil and water conservation practices on the water inventory.
- B. Review scientific studies that quantify consumptive water use reductions that result from applying water saving conservation practices.
- C. Evaluate potential new supply due to new or improved technology (deep aquifer recover, horizontal wells, etc.).

- A. Utilize best available data and tools to develop refined extents of the hydrologically connected ground and surface waters in the Lower Platte River Basin.

- A. Work with other state and federal agencies to develop a baseline climate scenario as well as a set of projected climate scenarios.
- B. Utilize available tools to test and evaluate resiliency of water inventory under baseline and projected climate scenarios. Evaluation to consider delta between baseline and projected climate scenarios and consider both elements of use and supply.

2. Monitor current and future water demands in the Basin.

ACTION ITEMS

- A. Develop a standard data collection and reporting system for all NRDs in Lower Platte River Basin for documenting water uses in Basin.
- B. Identify significant unmeasured demands and develop and maintain a standard methodology for estimating. Unmeasured demands may include unmetered groundwater irrigation pumping, livestock use, riparian ET, unmeasured municipal and industrial use, environmental remediation.

GOAL 2: Implement a water management plan for the Lower Platte River Basin that maintains a balance between current and future water supplies and demands.

OBJECTIVES

1. Collaborate with state and local governments to identify opportunities to augment water supplies within the Lower Platte River Basin and, if necessary, identify opportunities to supplement with imported water from outside the Lower Platte River Basin.

ACTION ITEMS

- A. Utilize information from the water inventory to determine need, quantities, and locations of water shortages to define water augmentation needs and goals of augmentation projects.
- B. Identify potential excess surface water sources within the basin and determine locations, timing, quantities, and reliability of excess surface water sources.
- C. Identify potential groundwater sources within the basin and determine locations, timing, quantities, and reliability of groundwater sources.
- D. Based on potential supplies and goals, identify potential partners, develop and prioritize augmentation plans.
- E. Identify potential partners and collaborate to develop opportunities for imported water supplies, as necessary.

2. Monitor the instream flow needs in the Lower Platte River Basin to foster an understanding of the existing appropriation priorities and locations, and provide a basis for evaluating impacts of existing and future uses.

ACTION ITEMS

- A. Assess USGS and NeDNR gage flows as well as NeDNR administrative records and actions to identify change of use or location of existing appropriations, new appropriation applications, and priority calls within the basin.

3. Evaluate options for Basin water banking methodologies.

ACTION ITEMS

- A. Identify potential water banking methods that have applicability in the Lower Platte River Basin relative to current physical, administrative, legal and legislative framework.
- B. Establish uniform and consistent accounting methodology (depletions, offsets, etc.) for use in developing and maintaining a water bank.
- C. Develop an administrative framework (agreements, rules, etc.) for establishing a water bank in the Lower Platte River Basin.

4. Evaluate impacts of new development during drought condition.

ACTION ITEMS

- A. Evaluate the balance of water supplies and uses during droughts and the potential impacts of new uses on this balance.
- B. Evaluate the hydrologic impacts of drought planning activities in the basin (NRD drought plans and mitigation strategies and other plans).
- C. Evaluate the hydrologic impacts of surface water administration activities through examination of closing notices issued by NeDNR.
- D. Evaluate other management tools that may be available to mitigate impacts from new water uses during droughts.

GOAL 3: Develop and implement water use policies and practices that contribute to the protection of existing surface and groundwater uses while allowing for future water development.

OBJECTIVES

1. Identify available water storage opportunities throughout the Lower Platte River Basin.

ACTION ITEMS

A. Inventory past project studies (US Bureau of Reclamation, US Army Corps of Engineers, Natural Resource Conservation Service, individual NRDs) to assess if any opportunities exist to utilize those analyses, whole or in part, as potential projects for purposes of this Plan.

B. Inventory existing infrastructure to assess potential for rehabilitation/expanding/modifying physical or operational components for purposes identified in this Plan.

C. Identify potential new opportunities for water storage in consideration of proximity to available water, return flow options, physical site characteristics, etc.

2. Evaluate, understand, and develop policies to address impacts on stream flows of uses outside of management control.

ACTION ITEMS

A. Inventory and review existing studies/reports on uses outside management control (conservation measures , riparian uses, etc.) and determine impacts on water inventory.

3. Expand public education programs on general awareness of water supplies and to encourage water conservation measures .

ACTION ITEMS

A. Support and coordinate research, training, and incentive programs concerning invasive plant species in the Platte River system, and assist with information and education efforts to distribute research results.

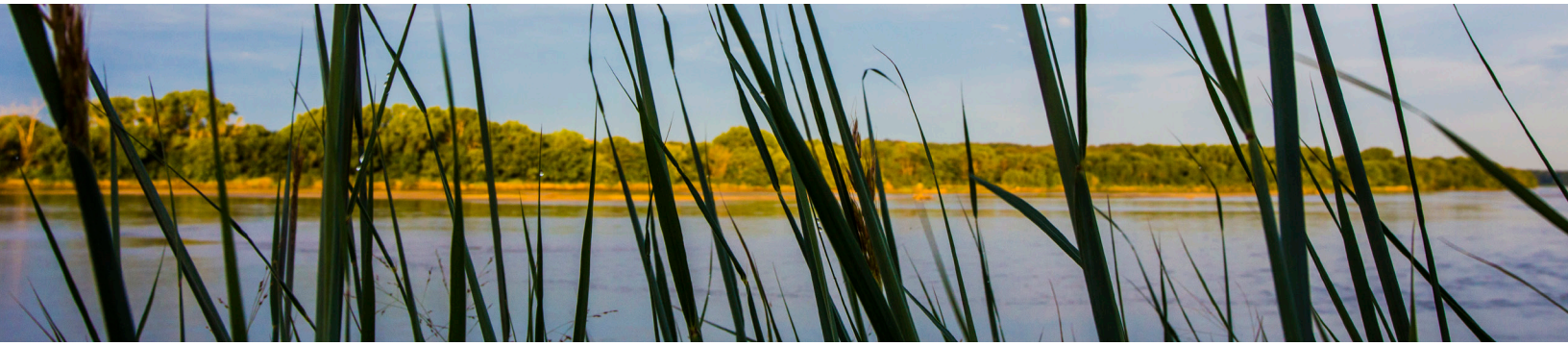
B. Coordinate with public water systems to develop or expand educational materials and programs on water supplies, water quality, and best conservation practices.

C. Coordinate with cities, counties, and others to encourage water education and conservation.

D. Promote water use education that addresses both rural and urban water conservation efforts.

E. Support school environmental education programs focused on water.

F. Impose mandatory educational requirements designed to stabilize or reduce the incidence of groundwater depletion, or conflict between users and appropriators.



3.1 Action Items Completed During Plan Development

Several action items in support of objectives have been completed, wholly or in part, as part of the Plan development and are summarized below. Supporting documentation of these efforts can be found in the Plan appendices, as noted.

Evaluation and Application of NeDNR INSIGHT Methodology (Appendix C). Data and methodology used in the NeDNR's INSIGHT database was evaluated, modified as noted in Section 1.2, and applied to the Lower Platte River Basin as a whole, and to sub- basins where applicable. The sensitivity of water supply and use terms on the overall balance was evaluated. – Action items 1.1.11 (A) & 2.3 (B)

Development of a Basinwide Accounting Methodology (Appendix C). The NeDNR INSIGHT databases and methodology were also evaluated for appropriateness as a basin-wide accounting tool.

During the course of the project, the technical committee requested that alternative demand scenarios be investigated that are more conservative than the demands considered by the draft NeDNR methodology.[1] After considering the various demand scenarios and assessing the benefits and constraints on the individual subbasins, the management committee agreed to utilize the demand scenario that would maintain 40% of the 25-year average streamflow at Louisville (without hydropower considered) to calculate the volume of water within the Lower Platte River Basin that exceeds the long term demand.[2]

An additional variance between the INSIGHT methodology and the basin-wide accounting methodology, is the Above North Bend sub-basin was divided above and below Columbus to break out the Beaver Creek basin for inclusion in the Loup River Basin, consistent with basin topography.– Action items 1.1.1 (A) & 2.3 (B)

Summary of Existing Surface and Groundwater Controls (Appendix D). Existing ground and surface water control measures currently employed by each Coalition member, as well as control measures used in other portions of Nebraska and other states were summarized. – Supports Action Item 2.3 (C).

Data Collection Efforts (Appendix E). Existing available datasets for relevant water budget terms and on-going data collection efforts were summarized. On-going and completed study efforts within the basin were also compiled. Recommendations for additional data collection efforts were included. – Supports Action Item 1.1.1 (C).

[1] Section 2.4.5 and 3.0 of Appendix C describe these alternative demand scenarios in more detail.

[2] For reference, the draft NeDNR INSIGHT methodology considers the maximum of either the induced groundwater recharge demand or the adjusted instream flow demand in the North Bend to Louisville sub-basin. This adjusted instream flow demand corresponds to maintaining approximately 20% of the 25-year average streamflow in the Platte River at Louisville.

Evaluation of Potential Conjunctive Management and Water Banking Opportunities (Appendix F). A sampling of potential conjunctive management and water banking opportunities in the Basin were evaluated. Fundamental to this effort was development of a consistent water accounting methodology (Appendix C) for assessment, tracking, and accounting of accretions and depletions to the hydrologically connected streams and rivers within the Basin. – Supports Action Items 2.3 (A) and 3.1 (B) and 3.1 (C)

- ***Conjunctive Management Opportunities.*** Conceptual examples of several types of conjunctive management projects within the Basin were developed. These examples identified water sources, necessary infrastructure, functional operations and potential benefits of each conceptual example.
- ***Water Banking.*** Existing water banking systems and pertinent statutory and regulatory authorities available to establish a water banking system were summarized. Example water banking instruments from Nebraska and other states were identified and administrative and operational function summarized.

3.2 Plan Implementation Activities

The first increment implementation of the Plan will occur over a 5-year period. The Plan activities consist of identifying goals and objectives for implementation over the first 5-yr planning increment and include the following:

GOAL 1: DEVELOP AND MAINTAIN A WATER SUPPLY AND USE INVENTORY BASED ON THE BEST AVAILABLE DATA AND ANALYSIS.

OBJECTIVE 1: DEVELOP AND MAINTAIN A COMPREHENSIVE INVENTORY OF THE LOCATION AND SOURCE OF THE BASIN'S CURRENT AND FUTURE WATER SUPPLIES, WATER USES, AND OUTFLOWS.

During the planning effort, the NeDNR INSIGHT database was evaluated and verified at the basin and sub-basin level as an appropriate tool to quantify basin water supplies and uses. The Coalition has approved the use of the INSIGHT database and methodologies, as modified for development of this Plan, for inventorying of water supplies and uses in the basin and for basin- wide tracking and accounting of supplies and uses.

During the first planning increment, Coalition members will update the uses within the Basin as part of their annual reporting. Basinwide supplies will be updated approximately every 5 years, with the first update coincident with the end of the first planning increment.

Action items to enhance or supplement the basin-wide inventory of supplies and uses are planned during the first increment. These action items can loosely be grouped into three categories: 1) Supplemental information or refinements; 2) Forecasts and projections; and 3) Data collection efforts to fill data gaps. The individual Coalition members will implement action items.

1. **Supplemental information and refinements**
    a. Update basin-wide accounting with updated numerical modeling tools (ELM Phase III, CENEB, and Lower Platte and Missouri River Tributaries groundwater models) as they become available to refine the extent of the hydrologically connected ground and surface water in the Basin.

b. Develop and incorporate supplemental information to INSIGHT database as they become available. These include unmeasured uses such as riparian ET, unmetered M&I use, livestock use, and environmental remediation.

c. Refine the spatial extent of supplies and uses to better correspond to NRD boundaries.

2. **Forecasts and projections**

a. Project future municipal and industrial demands.

b. Project future land use and irrigation requirements, including innovations in technology.

c. Project variations in water supply and demand due to climate variability.

d. Project uses using both current depletive levels and the ultimate full consumptive use of current uses.

3. **Data collection**

To better align with NRD boundaries (and thus refine the estimate of demands and supplies within each NRD), it may be beneficial to include additional stream gage locations in the basin accounting to break the current INSIGHT sub-basins along NRD boundaries. Currently, approximations have been utilized to assign supplies and demands between multiple NRDs within a single sub-basin.

Suggestions for utilizing additional stream gage locations in the inventory and analyses or potential new stream gage locations include:

a. Existing USGS Station 0677500: Middle Loup River at Dunning, Nebraska or an additional gage on the mainstem Middle Loup above the Sargent Canal diversion to divide the Middle Loup sub-basin between the Upper Loup NRD and the Lower Loup NRD.

b. Existing USGS Station 06781600: South Loup River at Arnold, Nebraska to divide the South Loup sub-basin between the Upper Loup NRD and the Lower Loup NRD.

c. Existing USGS Station 06785500: North Loup River at Brewster, Nebraska or an additional gage on he mainstem North Loup River below this gage on the NRD boundary to divide the North Loup sub-basin between the Upper Loup NRD and the Lower Loup NRD.

d. A new gage on the Calamus River at the Upper Loup NRD/Lower Loup NRD boundary.

e. NeDNR gage Elkhorn River near Tilden better aligns with Upper Elkhorn NRD/Lower Elkhorn NRD boundary.

f. New gage at the confluence of the Platte River and Clear Creek to better match the divide between the Lower Loup NRD and the Lower Platte North NRD.

g. A new gage at the confluence of Wahoo Creek and the Platte River to better match the boundary between the Lower Platte South NRD and the Lower Platte North NRD.

h. A new gage at the confluence of the Elkhorn River and Maple Creek to better match the boundary of the Lower Elkhorn NRD and the Papio-Missouri River NRD.

i. A new gage at the confluence of the Elkhorn River and the Platte River to better isolate the reach of Elkhorn River in the Papio-Missouri River NRD.

OBJECTIVE 2: MONITOR CURRENT AND FUTURE WATER DEMANDS IN THE BASIN.

Coalition members will collaborate on consistent methods to be used in reporting annual uses. Estimates of uses will utilize the best available information and tools. Standard methodologies for estimating unmeasured uses of significance (unmetered pumping, riparian ET, livestock use, etc.) will be developed by the Coalition. This coordination of collecting and reporting uses will provide consistency within the basin as well as with INSIGHT database.

GOAL 2: IMPLEMENT A WATER MANAGEMENT PLAN FOR THE LOWER PLATTE RIVER BASIN THAT MAINTAINS A BALANCE BETWEEN CURRENT AND FUTURE WATER SUPPLIES AND DEMANDS.

OBJECTIVE 1: COLLABORATE WITH STATE AND LOCAL GOVERNMENTS TO IDENTIFY OPPORTUNITIES TO AUGMENT WATER SUPPLIES WITHIN THE LOWER PLATTE RIVER BASIN AND, IF NECESSARY, IDENTIFY OPPORTUNITIES TO SUPPLEMENT WITH IMPORTED WATER FROM OUTSIDE THE LOWER PLATTE RIVER BASIN.

During the planning effort, extensive evaluation of the balance of supplies and uses at the basin and sub-basin level were completed, primarily focused on surface water supplies. These evaluations identified timing, location, and relative frequency of surpluses and deficits in streamflow. The results generally indicate that shortages are likely to occur during the peak season (June, July, and August) and are amplified during drought conditions within the basin. Surpluses are likely to occur during the non-peak season and occasionally during the peak season during normal or wetter than normal conditions. Several types of conjunctive management projects aimed at retiming flows (from times of surplus to times of deficit) were identified throughout the basin and potential water supply benefits of each identified.

During the first increment, Coalition members will continue to investigate and pursue conjunctive management opportunities and potential partners to augment streamflows during times of shortage, with the intent of implementing at least one conjunctive management project in each of the three primary river basins.

OBJECTIVE 2: MONITOR THE INSTREAM FLOW NEEDS IN THE LOWER PLATTE RIVER BASIN TO FOSTER AN UNDERSTANDING OF THE EXISTING APPROPRIATION PRIORITIES AND LOCATIONS, AND PROVIDE A BASIS FOR EVALUATING IMPACTS OF EXISTING AND FUTURE USES.

As part of the annual meeting reporting, NeDNR will report changes to existing surface water appropriations or new appropriation applications. In addition, NeDNR will summarize a report on the streamflow conditions throughout the basin, shortages, and administrative calls during the previous year.

OBJECTIVE 3: EVALUATE OPTIONS FOR BASINWIDE WATER BANKING METHODOLOGIES.

During the planning effort, several examples of water banking instruments currently in operation in Nebraska and throughout the western United States were summarized with respect to administration, operation, and function. In addition, pertinent legislation and authorities from State statutes related to the formation of water banks in Nebraska were summarized. Finally, a basinwide accounting tool based on the NeDNR INSIGHT database was developed. This accounting system is needed to be able to fairly and consistently track water supplies and uses within the Coalition area, and to allow for water banking or transfer actions between different NRDs. The basinwide accounting system is designed to serve as the administrative backbone for future water management actions by the Coalition, and can be adapted to account for any form of water banking and conjunctive management projects that may be chosen by individual NRDs, or groups of NRDs.

As work on the water banking efforts commenced, it quickly became apparent that Coalition managers, and other stakeholders in the basin, were strongly against a "one-size-fits-all" approach, and that the goals and priorities of individual NRDs should be respected, and emphasized, as part of the water banking efforts. The geography, hydrology, and infrastructure within each NRD are clearly different, and suggest that multiple types of water banking projects would be more effective than attempting to force a single implementation strategy on all Coalition members. In addition, areas such as the Lower Loup NRD already have water-banking operations in place, and the need in that area appears to be not for a new implementation strategy, but instead for a way to ensure that banking operations conducted by the NRD are acknowledged, and protected, into the future.

As the Coalition moves forward and begins to consider setting up a collaborative or individual water bank, two useful sources should be consulted: a water banking "guidebook"[1] developed by Dr. Bonnie Colby at the University of Arizona in 2010, and an "Analysis of Water Banks in the Western States"[2] prepared by the Washington Department of Ecology and WestWater Research in 2004. In addition, Appendix F provides "checklist" summaries of several existing water banks and the administrative, operational, and financial characteristics of each.

[1] http://ag.arizona.edu/arec/sites/cals.arizona.edu.arec/files/publications/ewsr-Banks-final-5-12-10.pdf

[2] https://fortress.wa.gov/ecy/publications/publications/0411011.pdf

OBJECTIVE 4: EVALUATE IMPACTS OF NEW DEVELOPMENT DURING DROUGHT CONDITIONS

During the planning effort, evaluations of the balance of supplies and uses have been used to establish allowable levels of development. This allowable level of development has been based on limiting the total depletive effect of new surface water and groundwater uses to 10% of the average annual basinwide excess during the peak season (June, July, August). While this approach places limits on new depletions it also allows the Coalition to manage the growth of new uses while still providing a level of protection to current uses.

The Coalition also recognizes that these protections may become limited in times of drought when water supplies may not be in balance. Therefore, the Coalition members will continue to investigate the impacts of drought and use this information to inform future planning increments. The activities that will be evaluated during the second increment include:

- The balance of water supplies and uses during droughts and the potential impacts of new uses on this balance
- The hydrologic impacts of NRD drought plans and mitigation strategies
- The hydrologic impacts of surface water administration activities through examination of closing notices issued by NeDNR
- The hydrologic impacts of other drought planning activities in the basin
- Other management tools that may be available to mitigate impacts from new water uses during droughts

Evaluation of these activities will be used to inform subsequent increments of the plan and establish allowable depletion limits that work in conjunction with other mitigation strategies to protect existing users and mitigate the effects of drought.

GOAL 3: DEVELOP AND IMPLEMENT WATER USE POLICIES AND PRACTICES THAT CONTRIBUTE TO THE PROTECTION OF EXISTING SURFACE AND GROUNDWATER USES WHILE ALLOWING FOR FUTURE WATER DEVELOPMENT.

OBJECTIVE 1: IDENTIFY AVAILABLE WATER STORAGE OPPORTUNITIES THROUGHOUT THE LOWER PLATTE RIVER BASIN.

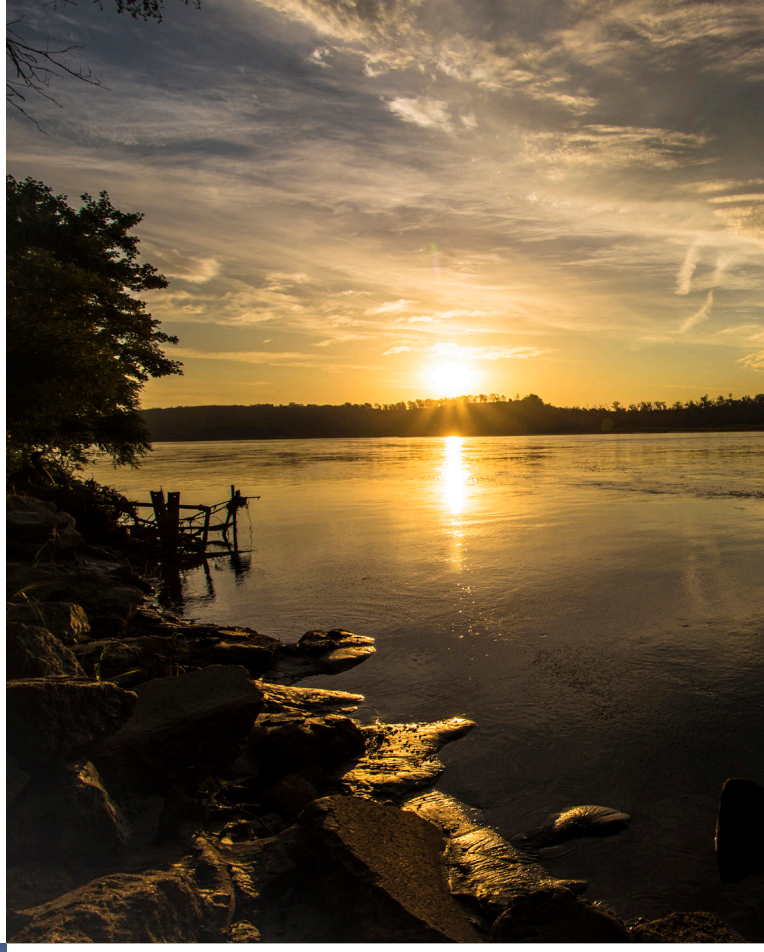
Previous planning efforts undertaken by the member NRDs, USACE, USBR, and NRCS had identified sites throughout the basin including Sherman Reservoir in the Loup Basin, Battle Creek in the Elkhorn Basin, and Skull Creek Reservoir in the Lower Platte Sub-basin. During the planning effort, water storage opportunities in each of the three primary basins were investigated and the most feasibly opportunities identified. These opportunities include new structures as well as the re-purposing of storage within existing structures. Available water for storage and operational characteristics were identified, and ultimately the impacts on streamflows were estimated. During the first increment, Coalition members will continue to investigate and pursue new storage as a conjunctive management opportunity to augment (both active and passive management) water supplies during times of shortage.

OBJECTIVE 2: EVALUATE, UNDERSTAND, AND DEVELOP POLICIES TO ADDRESS IMPACTS ON STREAM FLOW OUTSIDE OF MANAGEMENT CONTROL.

During the first increment, Coalition members will conduct a literature review of previous studies that estimate or quantify the impacts of significant uses outside of Coalition member jurisdictional control, including riparian uses and the effects of conservation measures. Using the findings of this literature review, Coalition members will apply the results in a consistent manner across the Basin to estimate impacts on the basin water inventory.

OBJECTIVE 3: EXPAND PUBLIC EDUCATION PROGRAMS ON GENERAL AWARENESS OF WATER SUPPLIES AND TO ENCOURAGE WATER CONSERVATION MEASURES.

During the first increment, the individual Coalition members will coordinate with public water systems, cities, counties, and others as appropriate to develop outreach and education materials that focus on water supply, water quality, and water conservation practices. The Coalition members will also coordinate with others, such as the Invasive Species Task Force, to support and coordinate research and incorporate results of the research into the outreach and education materials.



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