TO: PRRIP WATER ADVISORY COMMITTEE
FROM: PRRIP EXECUTIVE DIRECTOR'S OFFICE
SUBJECT: 2018 PRRIP WATER PROJECTS ACCOUNTING
DATE: AUGUST 27, 2019

I. EXECUTIVE SUMMARY

The First Increment Water Objective for the Platte River Recovery Implementation Program (PRRIP or Program) is to reduce deficits to U.S. Fish and Wildlife Service (USFWS) target flows at Grand Island, Nebraska, by an average of 130,000 to 150,000 acre-feet per year (AFY). Initial water projects developed by the three states that are party to the Program (Colorado, Nebraska, and Wyoming) were credited with providing 80,000 AFY towards this objective. The Program is charged with meeting the remaining 50,000 to 70,000 AFY of deficit reductions through implementation of the Water Action Plan (WAP).

By the end of 2018 (Year 12 of the Program's First Increment), the Program had agreements with stakeholder entities for the operation of eight unique[1] WAP projects, which are generally one of two types: (1) projects that divert available excess flows for retiming through groundwater recharge, and (2) projects in which surface water is leased or otherwise made available to be credited to the Lake McConaughy Environmental Account (EA) and later released to meet downstream flow needs.

Although it was anticipated by the Program Document[2], this memo is the first to provide both all-inclusive reporting for a single calendar year (2018) of Program water projects operations (both state projects and WAP projects) and comprehensive accounting[3] of water projects operations since the start of the First Increment in 2007. The EDO plans to update this memo annually, and the content will be adjusted as needed when new WAP projects are added to the Program's water portfolio (or, potentially, when water projects are terminated).

For groundwater recharge projects, the operations accounting is generally a process that begins with measured diversions of excess flows from the Platte River. Groundwater models or response functions are used to simulate the processes of seepage and migration of water through the alluvial aquifer. Once the timing and volume of river return flows (accretions) is estimated, transit loss factors are used to route water from the point or reach of return to Grand Island, Nebraska. The resulting volumes of Program project water reaching Grand Island are then compared to target flow deficits to determine the amount of shortage reduction credit or operational yield for the project.

[1] The Cook Recapture Well is effectively a part of the Phelps County Canal Groundwater Recharge Project and is only factored into the assessment of accretions and shortage reduction credits for that project.
[2] See Milestone Steps 4.6 and 4.7 (Program Document, Attachment 2) and item #7 in Appendix B of the Water Plan Reference Material (Program Document, Attachment 5, Section 11).
[3] An initial attempt at comprehensive accounting was presented as part of the PRRIP Governance Committee Water Workshop in March 2018, but that was not compiled into a formal accounting memo.

The volumes of water credited to the Lake McConaughy EA from individual Program water projects are confirmed through data or documentation from the Nebraska Department of Natural Resources (NDNR), after which the water loses the distinct identity of its origin. Collective release volumes from the Lake McConaughy EA and routing from Kingsley Dam to Grand Island are also derived from measurements or model results generated by NDNR. Volumes of Lake McConaughy EA water reaching Grand Island are likewise compared to target flow deficits to determine the amount shortage reduction credits.

Table ES-1 summarizes groundwater recharge diversions and accretions in calendar year 2018. Cells that are blacked out in the table indicate data that is not readily available to the EDO at this time. For some projects (e.g., Tamarack I and CPNRD canal recharge diversions), this is a matter of how reporting or invoicing is done for the project. In other cases (e.g., CPNRD and NPPD canal recharge accretions and routing), the EDO has not yet developed the tools necessary to complete the analyses; it is anticipated that those tools will be available for the next iteration of this memo.

Table ES-1. PRRIP Groundwater Recharge Diversions and Accretions, 2018

Project	Project Type	Diversions [AF]	Recharge[1] [AF]	Total Accretions at Point of Return[2] [AF]	Total Accretions Reaching Grand Island [AF]	Shortage Reduction Credits at Grand Island [AF]
Tamarack I	State (CO)	27,610		23,250		10,350
Phelps County Canal Groundwater Recharge	WAP	3,258	3,700	3,200	2,800	1,800
Elwood Reservoir Recharge	WAP	14,916	8,500	2,000	1,700	1,000
CPNRD Canal Recharge	WAP			1,866		
NPPD Canal Recharge	WAP	3,346	2,701			

[1] The recharge volume may include seepage from diversions during the previous calendar year, such as diversions into Elwood Reservoir in December 2017, as well as diversions made during the current year.
[2] Tamarack I point of return is assumed to be the Colorado-Nebraska state line for reporting purposes. Accretions from all other recharge projects are assumed to return at or upstream of Overton, Nebraska.

Table ES-2 summarizes Lake McConaughy EA accruals and releases in calendar year 2018. The "upstream releases" column is only applicable to the two projects with water originating from Pathfinder Modification Project accounts.

Table ES-2. Lake McConaughy EA Accruals and Releases, 2018.

Project	Project Type	Upstream Releases [AF]	Credits to EA [AF]	Total EA Releases [AF]	Total EA Releases Reaching Grand Island [AF]	Shortage Reduction Credits at Grand Island [AF]
Lake McConaughy EA – Storable Natural Inflows (SNI)	State (NE)	N/A	47,198	89,332	74,600	73,300
Pathfinder EA	State (WY)	20,469	17,545			
No-Cost NCCW	WAP	N/A	314			
Pathfinder Municipal Account Lease	WAP	8,100	6,943			
CNPPID Irrigator Lease	WAP	N/A	1,541			
CPNRD Pilot Exchange Project	WAP	N/A	14,251			
TOTAL =		28,569	87,792			

To the extent that the EDO was able to complete the full calculations, the comprehensive accounting of Program water projects includes estimates of average annual credits for shortage reduction at Grand Island. Where the comparison can be made, these operational yields are compared to approved or recommended project scores; in general, the operational yields are less than scores at this point in the Program's First Increment. The EDO identified two key reasons for the differences:

(1) Time.

a. Project scores are based on simulated operations averaged over 48 years. At most, projects that were operational from the start of the First Increment have only 12 years of data to evaluate, and most WAP projects have even less. Consequently, it is not yet feasible to draw any conclusions about the long-term performance of Program water projects.

b. In addition, the nature of groundwater recharge projects is such that accretions lag behind the time of diversion and recharge by months to years. It may take decades for all water recharged in a given year to return to the Platte River, but these accretions will provide the long-term benefit of increased river baseflows. WAP recharge projects have operations histories ranging from 4 years (Elwood Reservoir, NPPD canals) to 8 years (Phelps County Canal). Accretions from these projects are still on an upward trajectory that will continue for many years before leveling off at a sort of steady state, assuming consistent operations well beyond the end of the Program's First Increment. Elwood Reservoir, located about 8 miles from the Platte River, is the most extreme example, with accretions that are increasing each year but totaling less than 10 percent of recharge diversions through the early years of operations.

(2) Reduced availability of excess flows. In a white paper developed by the EDO in 2016, it was shown that there was less availability of divertible excess flows through the first 9 years of the First Increment (2007-2015) than during the historical period corresponding to the OPSTUDY hydrology used for WAP project scoring (1947-1994). The differences were most significant in the months of January through May, all of which had First Increment average monthly excess flows well below the historical averages (ranging from 125 cfs to 426 cfs less). Reduced excess flows in January and February affect the Phelps and Elwood recharge projects. Reduced availability in January through March affects the Tamarack I project in Colorado, and reductions in April and May have resulted in limited spring recharge diversions into the CPNRD and NPPD canals.

An investigation of the specific causes of reduced excess flow availability is beyond the scope of this accounting memo, but the EDO intends to pursue such an effort separately, as well as expanding the excess flows white paper to include the more recent years and an evaluation of the effects of annual hydrologic condition (used for project scoring) versus real-time hydrologic condition (used for operations and accounting).

II. INTRODUCTION

The Platte River Recovery Implementation Program (PRRIP or Program) is a cooperative effort between the U.S. Department of the Interior and the states of Colorado, Nebraska, and Wyoming to improve streamflow and habitat conditions in a critical reach of the central Platte River for the benefit of threatened and endangered species, including the whooping crane, piping plover, interior least tern, and pallid sturgeon. The Program provides Endangered Species Act (ESA) compliance for water users within the Platte River basin upstream of the Loup River confluence including the North Platte River, South Platte River, Platte River, and tributaries.

The Program's First Increment[4] Water Objective is to reduce deficits to U.S. Fish and Wildlife Service (USFWS) target flows[5] by an average of 130,000 acre-feet per year (AFY) to 150,000 AFY, as measured at Grand Island, Nebraska. Three initial state water projects—Wyoming's Pathfinder Environmental Account (EA)[6], Nebraska's Lake McConaughy EA, and Colorado's Tamarack I groundwater recharge project—are credited with providing 80,000 AFY towards the First Increment Water Objective. Per Program Milestone #4, the remaining 50,000 AFY to 70,000 AFY is to be developed through implementation of the Water Action Plan (WAP).

Program WAP projects rely on two major sources of water:

- Diversions of Platte River streamflows in excess of USFWS targets (excess flows), for intentional groundwater recharge through existing canals and reservoirs.

[4] The Program's First Increment is the 13-year period from January 1, 2007 through December 31, 2019.
[5] Program Document, Attachment 5, Section 11, Appendix A-5.
[6] The Pathfinder EA and the Wyoming Account (aka Pathfinder Municipal Account) were created through the Pathfinder Modification Project, which was completed in 2012 to reclaim Pathfinder Reservoir storage capacity lost to sedimentation over a century of operation.

- Leasing or otherwise directly acquiring water supplies from other users in the Platte River basin.

Table 1 identifies current Program water projects and the initial year of operation. If the project was already operational before the start of the First Increment, 2007 is recognized as the first year of operation for Program purposes.

Table 1. Program Water Projects Operational in 2018.

Project	First Year of Operation	Number of Years of Operation
State Water Projects		
Tamarack I	2007	12
Lake McConaughy EA – Storable Natural Inflows (SNI)	2007	12
Pathfinder EA	2012	7
Water Action Plan Projects		
No-Cost NCCW[1]	2007	12
Phelps County Canal Groundwater Recharge	2011	8
Pathfinder Municipal Account Lease	2012	7
Elwood Reservoir Recharge	2015	4
CPNRD[2] Recharge (Thirty Mile, Cozad, and Orchard-Alfalfa canals)	2015	6
NPPD[3] Recharge (Gothenburg and Dawson County canals)	2015	4
Cook Recapture Well (effectively part of the Phelps recharge project)	2016	3
CNPPID[4] Irrigator Lease	2016	3
CPNRD Pilot Exchange Project (Surface Water Lease)	2018	1

[1] NCCW = Net Controllable Conserved Water
[2] CPNRD = Central Platte Natural Resources District
[3] NPPD = Nebraska Public Power District
[4] CNPPID = Central Nebraska Public Power and Irrigation District

A. Purpose of Memo

This 2018 PRRIP Water Projects Accounting Memorandum is a new document prepared by the Program's Executive Director's Office (EDO) to summarize the operations of the Program's three state water projects and those projects implemented under the WAP. While updates on the development and operation of WAP projects have been presented to the Program's Governance Committee (GC) and the Water Advisory Committee (WAC) at regular intervals throughout the First Increment, this memo represents the first comprehensive reporting on the operations and accounting of Program water projects in one document[7]. It is intended that this accounting memo will be updated annually.

[7] A stand-alone Phelps County Canal Groundwater Recharge Project report was prepared for each year of operation from 2012-2013 through the 2016-2017 non-irrigation season. The inclusion of the Phelps County Canal Groundwater Recharge Project in this memo replaces the project-specific report beginning with calendar year 2018.

Regular reviews and documentation of operations and accounting for Program water projects were anticipated in the Program Document, including in the Milestones Document[8]. Specifically, steps needed for successful completion of Milestone #4 include the following:

> 4.6. The Governance Committee will ensure that projects implemented under this Water Action Plan are operated in accordance with approved operating plans and that they are having the intended effects on Program purposes.
>
> 4.7. The Governance Committee will ensure that water produced by projects implemented under this Water Action Plan is included in approved tracking and accounting procedures and that these projects are coordinated with other Program activities including other water projects and with the management of the Environmental Account.

Appendix B of the Water Plan Reference Material[9] also addressed the need for these reviews as a means of validating and, if necessary, revising the operations assumptions made in order to estimate the shortage reduction credit resulting from a Program water project (i.e., score analysis).

> 7. Annual Review of Program Water Projects Operations Relative to Project Descriptions and Operating Plans During the Program First Increment.
>
> The following steps are generally used when evaluating actual Program Water Plan project operations relative to project descriptions upon which the reduction in shortage credit is based:
>
> > 7.1) Use relevant project operation data, stream gage data, and the Program's water tracking and accounting reports and compare with
> >
> > 7.2) Project description and operation information subsequently included within the [Central Platte River OPSTUDY] Model to calculate the reduction in shortage credited towards the Program's First Increment of 130,000-150,000 af of shortage reduction.
>
> Because the modeling assumptions include very simplified representations of ranges of District operations, actual annual operating data are not expected to "match up" with the modeling assumptions. If, however, data on actual operations indicates over time that the "operating assumptions" in the model are unrealistic, the operating assumptions in the model can be updated and the resulting change in scoring of shortage reduction towards the First Increment objective determined. Significant differences between actual

Accounting for Phelps presented herein also includes diversions made for recharge and Cook Well pumping in fall 2017, which were not captured in the 2016-2017 Phelps recharge report.

[8] Program Document, Attachment 2.

[9] Program Document, Attachment 5, Section 11.

operating data over time and operating assumptions which suggest to FWS that the operating assumptions are unrealistic must first be brought to the Governance Committee.

Thus, not only is the preparation of this accounting memo consistent with the Program Document, it also has the benefit of providing to the GC estimates of the actual volumes of water that are available to test the various hypotheses within the Adaptive Management Plan as the Program reaches the end of the First Increment and prepares to move forward into the planned First Increment Extension.

B. Accounting Memo Content

Included in this memo is a reporting of water volumes contributed to or purchased by the Program during the past year:

- Excess flows that were diverted for recharge during calendar year 2018[10];
- Storable Natural Inflows (SNI) credited to the Lake McConaughy EA during the non-irrigation season months of January-April 2018 and October-December 2018; and
- Water credited to the Lake McConaughy EA in September-October 2018, after the end of the irrigation season.

This memo also includes a cumulative accounting of Program water returns to the Platte River and credits for reductions of target flow shortages at Grand Island for the period 2007-2018. Although some Program water projects—specifically diversion operations and associated permits for groundwater recharge—tend to straddle calendar years during the non-irrigation season, the EDO has synced all water project accounting to a calendar year basis. Thus, as indicated above, this memo documents recharge diversions and accruals to the Lake McConaughy EA during calendar year 2018, even if winter/spring and fall diversions were administered under different permits. To the extent possible, accretions from groundwater recharge were estimated through the end of 2018.

The appendices to this memo consist of extensive supporting documentation, including Water Service Agreements (WSAs) or lease agreements between the Program and other entities, permits issued by the Nebraska Department of Natural Resources (NDNR) for diversions from the Platte River, and invoices for water paid by the Program. As the Program does not own the infrastructure used for existing recharge projects, nor does it have the appropriate legal standing, it is the responsibility of the districts with which the Program has partnered (CNPPID, CPNRD, and NPPD) to apply for and secure the necessary permits from the NDNR to divert excess flows. For several recharge projects, diversions early in the year and diversions later in the year are covered under separate permits[11], but at this point all WSAs and lease agreements have been extended through the end of the First Increment on December 31, 2019.

[10] Tamarack I accounting is presented through the irrigation year ending in October 2018.

[11] This permitting scenario is a result of most recharge projects first operating in the early non-irrigation season months (September-December) and the continued operation of these projects under a succession of temporary one-

C. Accounting Process

Excess flows are generally diverted for recharge during the non-irrigation season months between September and April, when the canal systems are not in use for the delivery of water to irrigators for crop production. This water seeps into the underlying alluvial groundwater aquifers and migrates back towards the Platte River over time, eventually emerging as baseflow accretions. Unit response functions from numerical groundwater models are used to calculate the timing and volume of these return flows. Currently, the Program has developed these response functions for the Phelps County Canal and Elwood Reservoir groundwater recharge projects and is in the process of developing them for the CPNRD and NPPD canal recharge projects; this work will be completed in coordination with those districts and the NDNR in time for the next iteration of this memo.

Once the timing and volume of return flows from intentional groundwater recharge are calculated, the EDO routes this water from the point or reach of entry to the river to Grand Island using transit loss factors developed using the Water Management Committee (WMC) Loss Model[12], an approach consistent with that used for WAP project scoring. Routing loss volumes are a product of the real-time hydrologic condition (as evaluated by the EDO using methods developed by the USFWS), the percentage loss rates from the WMC Loss Model, and the distance the water travels in the river to reach Grand Island. After the volume reaching Grand Island is calculated, it is checked against flow records to estimate the amount to be credited as shortage reductions at times when streamflows are below target flows.

Program water leasing projects primarily rely on surface water sources, with the objective of accumulating controllable water supplies in the Lake McConaughy EA. There are presently six individual projects or surface water sources contributing to the Lake McConaughy EA, each discussed in Section IV below. However, once credited to the Lake McConaughy EA, the water becomes one indistinguishable supply that is released at the discretion of the USFWS to meet specific downstream water needs. Releases from the Lake McConaughy EA are routed from the Kingsley Dam to Grand Island based on Platte Water Accounting Program (PWAP) results generated and provided by the NDNR, then compared against shortages at Grand Island to estimate the amount of operational shortage reduction credit.

D. Operations Accounting vs Project Scoring

It is critical to remember that the process of operations accounting for Program water projects is not the same as project scoring. Accounting is an analysis of what actually happened during real-time project operations (inputs, outputs, water reaching Grand Island, etc.). Scoring is an

year excess flow diversion permits issued by the NDNR. The exception is the CPNRD groundwater recharge project, which was granted permanent excess flow diversion permits for the Thirty Mile, Cozad, and Orchard-Alfalfa canals in 2015.

[12] The WMC Loss Model was first developed by the Water Management Committee as part of the Water Conservation/Supply Reconnaissance Study (Boyle et al. 1999, Chapter 7 and Appendix E), covering the period 1975-1994. The model period was updated to include 1995-2006 as part of the Water Management Study, Phase I (Boyle 2009). Use of the WMC Loss Model for routing in WAP project score analyses was approved by the GC in 2010 (GC Meeting Minutes, June 2010).

analysis for planning purposes to estimate the capacity of a Program water project to reduce deficits to USFWS target flows at Grand Island. As a result of inherent differences between the analytical approaches, operational yields or shortage credits should not be expected to match approved project scores.

Accounting relies on actual volumes of water leased or recharged; real-time gaged streamflows as recorded at Grand Island since the start of the First Increment (or whenever project operations subsequently began); and real-time hydrologic condition, which can vary throughout the calendar year based on near-term flow and climate conditions. In contrast, project scoring is based on assumed project operations; OPSTUDY modeled streamflow for the 1947-1994 period; and an annual hydrologic condition based on the total modeled streamflow for the calendar year at Grand Island. In addition, project scores are often negotiated values based on analysis of several potential operational scenarios developed by the EDO in coordination with the Program's Scoring Subcommittee. **Table 2** shows approved or recommended for the state water projects and several WAP projects; several other active WAP projects not shown in the table have not yet been scored.

Table 2. Program Water Project Scores

Project	Score [AF]
State Water Projects	
Tamarack I	80,000
Lake McConaughy EA	
Pathfinder EA	
Water Action Plan Projects	
Phelps County Canal Groundwater Recharge Project	2,700
Pathfinder Municipal Account Lease	6,350
No-Cost NCCW	260
Cook Recapture Well	160
Elwood Reservoir Recharge[1]	2,800
Sub-total =	12,270
Total =	**92,270**

[1] Score analysis for Elwood Reservoir Recharge was reviewed by the Scoring Subcommittee in August 2018, but the recommended score of 2,800 AF has not yet been approved by the Governance Committee.

To the extent that project scores and operational yields can be directly compared, the differences will be addressed in the appropriate section later in this memo. At this juncture, following Year 12 of the Program's First Increment, there are a few identifiable factors in addition to those described above that may be influencing project operational yields relative to scores.

Perhaps the most significant of these is time. For accounting analyses, there is at most 12 years of operational data (2007-2018), and more often less, whereas project scores are based on model results averaged over 48 years. Due to the nature of subsurface groundwater flow through alluvial materials, accretions from recharge projects lag behind the time of diversion and recharge by months or years. Program recharge projects are exhibiting generally increasing accretions in each successive year as a cumulative effect of ongoing operations, but these projects have not operated long enough to reach the sort of steady state returns that are expected

to result from relatively consistent operations and inputs over an extended period. With scores based on decades of modeled operations and most project operations still in single-digit years, it is simply not yet possible to draw any definitive conclusions regarding long-term performance of Program water projects.

Another important factor is the availability of divertible excess flows during the First Increment compared to OPSTUDY hydrology. In 2016, the EDO developed a draft white paper[13] (see **Appendix A**) evaluating excess flows at Grand Island for 2007-2015 versus 1947-1994. Key findings are as follows:

- For OPSTUDY hydrology and the Grand Island gage record over 1947-1994, the average annual excess flows are very similar (438 cfs vs 444 cfs). Excess flow patterns over the full time series and on an annual average basis are also quite similar, but there is still enough temporal variability in the availability of excess flows to create differences between project scores and operational yields[14].

- Using gage records, average annual excess volume for 1947-1994 is 386,300 AF; for 2007-2015 the average is 476,800 AF. Median annual excess volumes are nearly identical at 180,100 AF and 180,500 AF, respectively. The First Increment (2007-2015) average volume is skewed high by the occurrence of very high flows in just a few years and months[15].

- In January through May, average monthly excesses during 2007-2015 are less than 1947-1994 (ranging from 125 cfs less in January to 426 cfs less in March)[16].

- During the 2007-2015 period, in all months of the year, more than half of years (at least 5 out of 9) have seen monthly excess flows below the 1947-1994 averages. This is particularly pronounced in February (9 out of 9 years) and March/April (8 out of 9 years)[17].

The EDO white paper concludes that the First Increment has generally experienced less availability of excess flows at Grand Island on a monthly basis when compared to 1947-1994 historical hydrology, regardless of First Increment annual average excess flows is skewed by a few high-flow years. This reduced availability of divertible excesses particularly affects the Tamarack I, Phelps, and Elwood recharge projects during the winter months and the CPNRD and NPPD canal recharge projects in the spring. Consequently, it is reasonable to conclude that average First Increment operational yields to date for water projects relying on divertible excess flows will mostly likely be less than corresponding project scores based on 1947-1994 hydrology.

[13] Excess Analysis White Paper. PRRIP – ED Office Draft, May 5, 2016.
[14] From Table 3, Figure 13, and Figure 15 in the Excess Analysis White Paper.
[15] From Table 2 in the Excess Analysis White Paper.
[16] From Figure 10 in the Excess Analysis White Paper.
[17] From Figure 11 in the Excess Analysis White Paper.

Determining the reasons why excess flows are lower is beyond the scope of this accounting memo, but the EDO intends to conduct a more robust investigation of the topic at a later date. Without pinpointing any specific causes, it is likely to be a combination of both climatic and operational factors within the Platte River basin. The EDO also plans to expand the original 2016 white paper include an evaluation of excess flows availability under the annual and real-time hydrologic conditions.

III. GROUNDWATER RECHARGE

The diversion of excess flows into Program recharge projects in the Central Platte occurs mostly during the non-irrigation season. A general operations scheme is as follows, subject to the timing of changes in USFWS target flows and the availability of divertible excess flows:

- The CPNRD and NPPD canals will generally switch to recharge operations immediately after irrigation diversions end in mid-September. Diversions may continue until early October, then potentially again from mid-November into December.

- The CNPPID will typically perform necessary system maintenance after the irrigation season, followed by a release from the Lake McConaughy EA in coordination with the USFWS from late-October to mid-November during the fall whooping crane migration. Diversions into Phelps County Canal and Elwood Reservoir for recharge will typically commence in mid- to late-November and continue until early- to mid-February unless changes in target flows make excess flows unavailable, there are ice issues, or, in the case of Phelps, threshold groundwater elevations are approached or exceeded.

- If excess flows are available, the CPNRD and NPPD canals may divert for recharge in the spring. However, it is strongly desired to time spring recharge diversions such they can continue directly into the start of the irrigation season[18]. If the canals were to be wetted in the spring during recharge operations and then stopped, it could encourage vegetation growth that would be detrimental to irrigation operations. Spring diversions for recharge in the canals have been less common than fall diversions.

Except for limited recharge recapture pumping, the Program has no operational control over the timing of baseflow accretions after diversions are made. Still, the total volume of accretions reaching Grand Island is of significance in the accounting analyses because groundwater recharge projects provide ongoing benefits to the river by consistently increasing baseflows as recharged water slowly returns to the river. The following sections summarize the operations and accounting for WAP groundwater recharge projects, as well as the Tamarack I project in Colorado.

[18] For example, an invoice from NPPD dated June 28, 2016 states "…Dawson County Canal diverted for groundwater recharge from April 6-24, prior to NPPDs normal irrigation operations which began on April 25th."

A. Tamarack I

The Tamarack I groundwater recharge project is Colorado's contribution to the Program's three initial state water projects. Located along the last 35 miles of the South Platte River upstream of the Colorado-Nebraska state line, Tamarack I diverts from the river to recharge ponds when there are flows in excess of USFWS targets at Grand Island and there is simultaneously no call on the South Platte River in Colorado. The sandy soils of northeastern Colorado and large groundwater depth allow the ponded water to seep into the underlying alluvial aquifer and migrate back to the South Platte River at rates that are much higher than other Program recharge projects in central Nebraska. The Tamarack I project is funded by Colorado water users in the South Platte Basin through the South Platte Water-Related Activities Program (SPWRAP), and shortage reductions are credited at no cost to the Program.

Tamarack I includes 16 dedicated riverside wells at the Tamarack State Wildlife Area near Crook, Colorado and the Heyborne project lift station between Ovid and Julesburg. Together, these dedicated projects deliver water to 10 recharge ponds. In addition, recharge credits are leased from 10 private wells and from the Peterson and Settlers ditches near Julesburg, which deliver water to about 60 recharge ponds. About 40% of Tamarack I recharge credits are attributable to dedicated projects and 60% to private recharge projects.

Construction of project facilities utilized by Tamarack I began as early as 1997, and the project was operational at the inception of the Program's First Increment in 2007. Additional wells were installed in 2013 to increase capacity, and a pipeline installed beneath Interstate 76 in 2017 provides access to additional recharge sites at a greater distance from the river. Four wells damaged by flooding in 2015 are anticipated to resume operations in 2019.

Colorado submits a Tamarack I report to the Program each year, including monthly and annual accounting of credits for shortage reduction, as calculated at the Colorado-Nebraska state line. The most recent Tamarack I report, from April 2019, is included in **Appendix B**. Diversions to Tamarack I facilities are greatest in December and January, and most credits for shortage reductions occur between February and May. **Table 3** summarizes Tamarack I operational accounting since the Program began in 2007.

373 **Table 3. Tamarack I Accounting (all values in AF, rounded to the nearest 10)**

Irrigation Year[1]	Tamarack I Net Diversions in Reach (Gross-Evap)	Tamarack I Total Accretions in Reach	Tamarack I Total Accretions at State Line	Tamarack I Credits for Shortage Reduction at State Line	Tamarack I Credits Reaching Grand Island
2007	16,290	12,592	4,110	3,290	2,850
2008	25,990	21,801	10,890	6,760	6,020
2009	2,600	9,855	7,570	6,590	5,600
2010	27,370	20,359	16,200	7,290	6,670
2011	79,310	42,631	26,230	2,740	2,470
2012	26,200	39,536	24,000	9,210	8,030
2013	17,940	23,281	12,330	6,600	5,590
2014	16,780	21,481	17,130	12,930	10,770
2015	35,200	29,401	24,390	11,080	10,230
2016	49,870	38,579	25,970	8,400	7,690
2017	29,240	35,744	24,860	8,620	7,730
2018	27,610	31,425	23,250	11,510	10,350
Total, 2008-2018	**338,110**	**314,093**	**212,820**	**91,730**	**81,150**
Average, 2008-2018	**30,740**	**28,550**	**19,350**	**8,340**	**7,380**

374 [1] The Program began January 2007. Calculated total and average values exclude the incomplete Irrigation Year
375 2007, which began November 2006.

376 Based on Colorado's analyses, credits for shortage reduction at the Colorado-Nebraska state line
377 totaled 11,510 AF for the irrigation year[19] ending in October 2018 and averaged 8,340 AF for the
378 complete irrigation years 2008-2018. This is less than the 10,000 AF score credited to Tamarack
379 I due to less available divertible winter flows during the First Increment since 2007 compared to
380 the 1947-1994 OPSTUDY hydrology used for scoring. Colorado elaborated on this issue in the
381 April 2019 Tamarack I Report:

382 > The 10,000 ac-ft goal has not yet been reached on average because the flow frequency for
383 > excess to targets has been less for the start years of PRRIP as compared to the historic
384 > period. December through March are the months of greatest excess and for the historic
385 > period of 1947 through 1994, 59% of these months had excess flows above target flows.
386 > However for the first 12 years of the Program for December through March, only 40% of
387 > these months had excess flows, thus limiting the amount of water available for Tamarack
388 > 1 operations. An estimate of the Tamarack 1 credit achievable if actual flows similar to
389 > historic excesses had occurred for the beginning years of the Program can be estimated as
390 > follows: divide the actual 8,340 ac-ft average…by the water availability ratio of 0.678
391 > (=40/59) which results in 12,300 ac-ft.

[19] An irrigation year runs from November 1 of the previous year through October 31 of the current year. The irrigation year is used here for consistency with reporting by the State of Colorado.

This is consistent with the findings of the 2016 EDO Excess Analysis White Paper, which showed available excesses from 2007-2015 to be below 1947-1994 averages from January through May. For the specific months referenced in the context of Tamarack I, December exhibited an increase in monthly average excesses of 125 cfs, but that was more than offset lower monthly average excess flows in January (125 cfs less), February (263 cfs less), and March (426 cfs less)[20].

The possibility of actual project yield being lower than the credited score was recognized in the Program Document and is acceptable because the Tamarack I project was constructed and is operated as planned. The EDO performed additional calculations to route the Tamarack I water from the Colorado-Nebraska state line to Grand Island, where the credits for shortage reduction have averaged 7,380 AF.

B. Phelps County Canal Groundwater Recharge Project and Cook Recapture Well

The Phelps County Canal Groundwater Recharge Project was initiated with pilot-scale operations during the 2011-12 non-irrigation season and expanded to full-scale operations starting with the 2012-2013 non-irrigation season. Excess flows are diverted at the CNPPID's Tri-County Supply Canal headgate near North Platte and carried through that system to the Phelps County Canal headgate. Diversions into the Phelps County Canal are measured in a flume at Mile Post (MP) 1.6 and the canal is checked at MP 13.3 in order to pool water for recharge operations. After the canal is filled for recharge, diversions of excess flows are adjusted to achieve an equilibrium between the diversion and seepage (recharge) rates. Groundwater levels are tracked by the EDO through a network of monitoring wells in the area between the canal and the Platte River. Once started during the non-irrigation season, Phelps recharge operations generally continue as long as excess flows are available, threshold groundwater elevations are not exceeded, and the CNPPID infrastructure utilized for the project is not threatened by icy conditions.

This WAP project is operated under a succession of WSAs between the Program and the CNPPID, which must obtain a temporary permit from the NDNR each year for the diversion of excess flows. The WSA and temporary permits[21] for the 2018 recharge diversions are included in **Appendix C**. Invoices from CNPPID show diversions into the Phelps County Canal for Program recharge totaling 3,257.8 AF in calendar year 2018[22]. Recharged water is routed from the canal to the Platte River using a unit response function, then routed downriver to Grand Island by accounting for transit losses. Volumes of recharged water exceed the invoiced diversions because estimates of additional seepage between the canal headgate and the flume at MP 1.6 are included in the accounting analysis based on the average seepage rate from MP 1.6 to MP 13.3. The Phelps County Canal is located along the edge of a terrace above the Platte River floodplain, only a mile or two from the river channel for most of the canal extent used for

[20] From Figure 10 in the Excess Analysis White Paper.
[21] In past years, recharge diversions into Phelps County Canal and Elwood Reservoir were covered under separate permits from the NDNR. The temporary recharge permit A-19617, issued on November 30, 2018, combined both of those projects (and several other recharge projects served by CNPPID) under one permit.
[22] Invoiced Phelps recharge diversions between September 15, 2017 and December 31, 2017, not previously accounted for in the 2016-2017 Phelps recharge report, totaled 2,671.2 AF.

recharge, which allows the seepage returns to reach the river in a relatively short amount of time (generally months rather than years).

The Cook Well can be operated by the EDO, generally between March and November, to recapture water recharged through the Phelps County Canal and deliver that water into the Platte River during times of target flow shortages. Cook Well pumping is reported annually to the Tri-Basin NRD; according to the most recent report, 19,220,100 gallons (59 AF) of Phelps recharge water was pumped between late-August and November 2018[23]. The 2015 permit for the Cook Well and the pumping report for 2018 are included in **Appendix C**.

Table 4 presents the results of accounting analyses for the Phelps County Canal Groundwater Recharge Project and Cook Recapture Well since operations began in 2011. Originally, 50 percent of total Phelps recharge diversions were allocated to the Program; since late 2015, the Program allocation has generally (but not consistently) been 75 percent. Reported values for calendar year 2018 reflect Phelps recharge diversions for the Program in January-February 2018 and again in November-December 2018.

Table 4. Phelps County Recharge and Cook Well Projects Yields

Year	Invoiced Diversions[1] (AF)	Amount Recharged[2] (AF)	Cook Well Pumping[3] (AF)	Lagged Accretions[4] (AF)	Yield at Grand Island[5] (AF)	Deficit Reductions to Target Flows[6] (AF)
2011	2,710	3,200	0	400	300	0
2012	1,685	1,900	0	1,500	1,200	800
2013	4,418	5,000	0	3,200	2,500	1,800
2014	1,173	1,300	0	1,600	1,400	1,000
2015	3,613	4,100	0	2,200	2,000	900
2016	5,182	5,900	117	3,700	3,400	1,100
2017	3,687	4,200	152	3,600	3,100	1,600
2018	3,258	3,700	59	3,200	2,800	1,800
Total	**25,700**	**29,300**	**330**	**19,400**	**16,700**	**9,000**
Average	**3,200**	**3,700**	**110**	**2,400**	**2,100**	**1,100**

[1] Annual values for Invoiced Diversions are exact, most other values are calculated estimates rounded to the nearest 100.
[2] Estimated amounts recharged into the aquifer, including additional calculated seepage between the canal headgate and the MP 1.6 flume.
[3] Cook Well Pumping volumes from annual well reports submitted to Tri-Basin NRD. The calculated average for Cook Well pumping reflects only three years of operations.
[4] Includes the amount accreting to the river as the recharge slowly moves in the aquifer to the river in addition to amount recaptured by Cook well.
[5] Accounts for transit losses between the location of river accretions and Cook Well returns to Grand Island.
[6] Calculated using real time hydrologic conditions.

[23] Cook Well pumping reported for 2017 totaled 49,454,100 gallons (151.8 AF).

As shown in Table 2, the combined score for the Phelps County Canal Groundwater Recharge Project and the Cook Recapture Well is 2,700 AF + 160 AF = 2,860 AF. The original 2013 score analysis[24] for Phelps recharge assumed the Program was allocated 50 percent of diversions, recharge, and score credit (later increased to 75 percent). In that analysis, scenarios were evaluated with the Program share of diversions ranging from 4,622 AF to 4,809 AF. Through eight years of project operations to date, in only one year (2016) did Program diversions equal or exceed that range, regardless of whether the allocation was 50 percent or 75 percent.

The 2016 Cook Well score analysis[25] was based on the relative change in the overall Phelps recharge score with the addition of a recapture well. With only three years of operations data, the total annual well pumping has not yet equaled or exceeded the approved score, let alone the additional pumping that would be necessary to achieve the score after accounting for river transit losses before reaching Grand Island. While **Figure 1** shows that there are generally upward trends in both invoiced diversions for Phelps recharge and resulting deficit reductions at Grand Island, the annual average deficit reduction of 1,100 AF is less than the approved score of 2,860 AF. This appears to be largely the result of actual diversions for recharge into Phelps County Canal that are less than the diversions assumed in the score analysis and lower than expected Cook Well pumping throughout the initial years of project operations. The unit response function now used to route recharged water through the aquifer may have a somewhat slower rate of return compared to the original Phelps groundwater model, therefore also contributing to operational yields that are less than the project score.

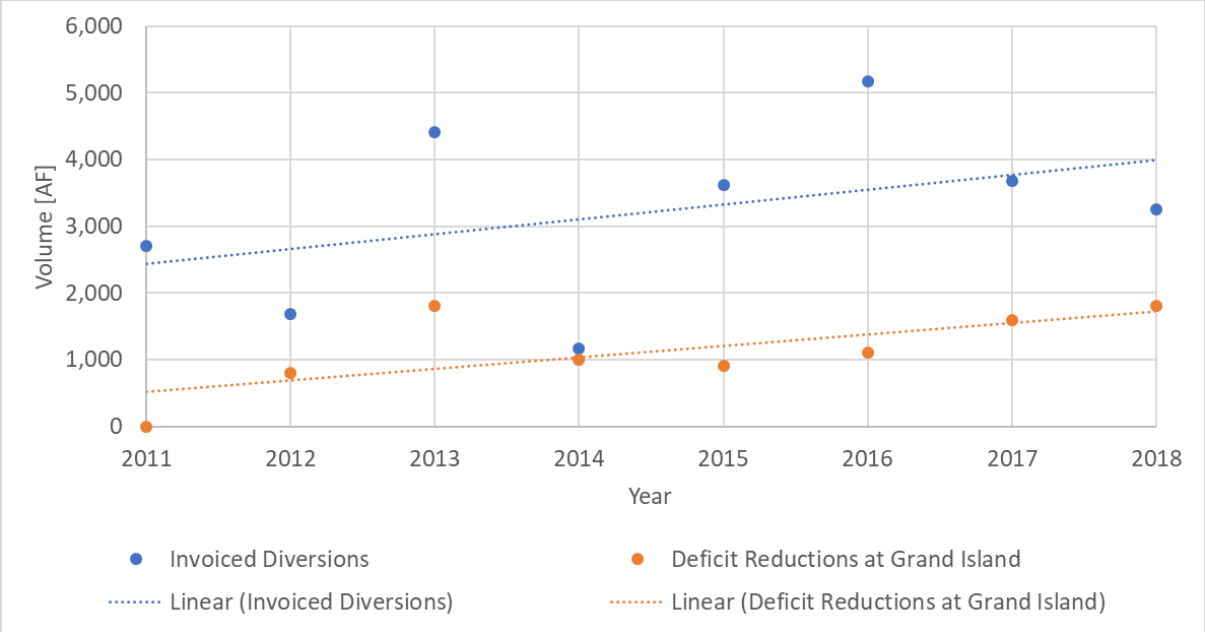

Figure 1. Phelps recharge invoiced diversions and deficit reductions, 2011-2018

[24] Phelps County Canal Groundwater Recharge Recommended Score and Scoring Analysis. PRRIP – ED Office Final, November 27, 2013.

[25] Phelps Groundwater Recapture Scoring Analysis of the Cook Tract Well. PRRIP – ED Office, August 30, 2016.

C. Elwood Reservoir Recharge Project

Elwood Reservoir was constructed in the late-1970s and is owned and operated by the CNPPID to provide supplemental irrigation water to the E-65 canal system. The reservoir sits on top of porous soils and leaks significantly into the underlying groundwater aquifer. Groundwater modeling shows that about 24 percent of the water that seeps from Elwood Reservoir migrates southward towards the Republican River basin, but most of the water (about 76 percent) flows through the subsurface in a north to northeasterly direction, a portion of which eventually emerges as baseflow accretions in the Platte River upstream of Overton. Some water that seeps from Elwood Reservoir may also be intercepted by Plum Creek, a tributary stream which lies between the reservoir and the Platte River, and conveyed to the river much faster than through groundwater migration.

The Program and the CNPPID first entered into a WSA for intentional groundwater recharge through Elwood Reservoir in 2015. The project functions as a means to re-time excess flows, which are diverted at the CNPPID's Tri-County Supply Canal headgate and carried through that system to a point upstream of Johnson Lake, where the water is turned into the E-65 Canal. Diverted excess flows travel along the E-65 Canal to the Carl T. Curtis Pump Station, where the water is pumped into Elwood Reservoir. The pumping rate is a function of water surface elevation in the reservoir, with higher rates when the reservoir is low and lower rates when the reservoir is high, but there must be a minimum of 75 cfs in order to pump into the reservoir.

The WSA and temporary diversion permits for 2018 Elwood Reservoir recharge are included in **Appendix D**. The original October 2017 WSA allocated 50 percent of Elwood recharge to the Tri-Basin NRD and the State of Nebraska and 50 percent to the Program, up to a maximum volume of 8,000 AF. This was amended in January 2018 to increase the maximum volume for which the Program can be billed to 12,000 AF and again in November 2018, increasing the upper limit to 30,000 AF. Invoices show that a total of 14,915.5 AF was pumped into Elwood Reservoir for Program recharge during calendar year 2018.

Minus a small amount of evaporation losses, it is assumed for accounting purposes that all water pumped into Elwood Reservoir for the Program seeps out as groundwater recharge. Elwood recharge is routed through the groundwater aquifer using a response function developed for the project score analysis that accounts for returns to the Platte River both directly and via Plum Creek. Return flows reaching the Platte River are routed to Grand Island then compared against target flow shortages to estimate a volume of deficit reductions resulting from the project in a given calendar year.

Table 5 provides the results of Elwood recharge accounting since the project was initiated in 2015. The amounts recharged shown in the table for each calendar year reflect the volume of seepage from the reservoir, not the volume pumped into the reservoir. For example, some water added to the reservoir for recharge purposes in December 2018 seeped out by the end of that calendar year, but most of the seepage will continue into 2019 and will therefore show up in the amount recharged in calendar year 2019. Also notable is the small volume of lagged accretions compared to amounts recharged since 2015. Elwood Reservoir is much farther from the Platte River than the Phelps County Canal (about 8 miles along a direct flow path), so the travel times

for groundwater migration are much greater. The Program is pursuing development of a recapture well network between Elwood Reservoir and the Platte River in order to accelerate this timeline and increase the near-term effectiveness of Elwood recharge for reducing deficits to target flows.

Table 5. Elwood Reservoir Groundwater Recharge Project Yields

Year	Invoiced Diversions[1] (AF)	Amount Recharged[2] (AF)	Lagged Accretions[3] (AF)	Yield at Grand Island[4] (AF)	Deficit Reductions to Target Flows[5] (AF)
2015	14,785	3,700	10	10	0
2016	2,880	5,800	750	660	220
2017	11,524.3	7,000	1,500	1,100	610
2018	14,915.5	8,500	2,000	1,700	1,000
Total	**44,100**	**25,000**	**4,200**	**3,600**	**1,800**
Average	**11,000**	**6,200**	**1,100**	**890**	**460**

[1] Annual values for Invoiced Diversions are exact, all other values are rounded.
[2] Estimated amounts recharged into the aquifer.
[3] Amount accreting to the river upstream of Overton, NE as the recharge slowly moves in the aquifer to the river.
[4] Accounts for transit losses between the location of river accretions to Grand Island.
[5] Deficit reductions are calculated using real time hydrologic conditions.

Of the 44,300 AF diverted into Elwood Reservoir for the Program by the end of calendar year 2018, approximately 25,000 AF had seeped from the reservoir as groundwater recharge, 2,300 AF was lost to evaporation, and 17,000 AF remained in storage in the reservoir itself. Of the total seepage volume, 4,200 AF had returned to the Platte River as lagged accretions, and the balance of 20,700 AF either migrated towards the Republican River or remained in aquifer storage en route to the Platte River.

Through the first four years of Elwood recharge operations, the total lagged accretions and deficit reductions at Grand Island represent only a fraction of the 44,300 AF of invoiced diversions, and annual average values are even less. Time is the dominant factor here, with the increased time to recharge through the reservoir compared to the canal recharge projects, and the extended time required to traverse the distance between Elwood Reservoir and the river through groundwater migration. The average deficit reduction of 460 AF is well below the recommended score of 2,800 AF, but the annual data show increased deficit reduction in each successive year. It may take a decade or longer, but if Elwood recharge continues to operate as it has, the project should continue on a trajectory which leads to a steady state with average annual deficit reductions eventually lining up with the score.

D. CPNRD Canal Recharge

The Program and the CPNRD signed a water use lease agreement in December 2013, which remains in effect at the present, under which the CPNRD provides up to 20,500 AF per year to the Program through a combination of transferred surface water and accretions from groundwater recharge in the Thirty Mile, Cozad, and Orchard-Alfalfa canals. Groundwater recharge

operations rely on divertible excess flows during the non-irrigation season and first occurred under the current lease agreement in 2013. The NDNR granted permanent permits to divert excess flows for groundwater recharge in March 2015; the individual permits for each of the three canals are included in **Appendix E**. An amendment to the lease agreement, effective in January 2017, modified the rate structure for transferred surface water and groundwater accretions.

Due to a lack of available excess flows, there were no recharge diversions into any of the three CPNRD canals in spring 2018 and any diversions in the fall were minimal. The CPNRD currently bills the Program for calculated groundwater accretions rather than diversions or net recharge volume. Each year's billing includes some accretions from water that was recharged in that year, plus lagged accretions that accumulate from each previous year of recharge, back to 2013 in the case of the CPNRD canals. Given the limited recharge diversions into the canals in 2018, the Program was billed for 1,866 AF of lagged accretions resulting from past CPNRD canal recharge. **Table 6** provides the CPNRD accretions data for 2013-2018. Values for 2014 are from CPNRD spreadsheets provided in subsequent years; all other values are based on CPNRD invoices and supporting documentation.

Table 6. Baseflow Accretions from CPNRD Canal Recharge, 2013-2018

Year	Thirty Mile (AF)	Cozad (AF)	Orchard-Alfalfa (AF)	Combined (AF)
2013	491	145.9	339	975.9
2014	850	83	215	1,148
2015	796	204	639	1,639
2016	892	308	620	1,820
2017	1,583	306	488	2,377
2018	1,282	251	333	1,866
Total	**5,900**	**1,300**	**2,600**	**9,800**
Average	**980**	**220**	**440**	**1,640**

The EDO is working with the CPNRD to update the computational tools for estimating the timing and volume of baseflow accretions from recharge in the three canals. As reliable supporting data is not yet available, this accounting memo does not include routing to Grand Island or calculation of shortage reduction credits. It is anticipated that such information will be included in the next iteration of this memo.

E. NPPD Canal Recharge

The Program first signed a WSA with the NPPD for groundwater recharge in the Gothenburg and Dawson County Canals in 2015, and non-irrigation season diversions of excess flows were first made in September of that year. The current WSA, included in **Appendix F**, went into effect on January 1, 2017 and expires December 31, 2019, at the end of the Program's First Increment. In order to operate the recharge project each year, the NPPD must apply for and secure new temporary diversion permits from the NDNR; the permits that were in effect during calendar year 2018 are also included in **Appendix F**.

Per the terms of the WSA, the NPPD bills the Program for net recharge, calculated as diversions measured at the canal headgates minus measured returns. There were no recharge diversions into the Gothenburg Canal during spring 2018; in fall 2018, 680 AF were diverted from the river resulting in 617 AF of net recharge. Likewise, spring 2018 saw no recharge diversions into the Dawson County Canal but fall 2018 diversions of 2,666 AF produced 2,084 AF of net recharge. **Table 7** shows the diversion and net recharge volumes for the NPPD canals; data is presented on a seasonal basis to emphasize the differences between spring and fall recharge diversions. Values are based on invoices and supporting data submitted to the Program, as well as recharge reports prepared by NPPD for the NDNR.

Table 7. NPPD Canal Diversions and Net Recharge

	Gothenburg Canal		Dawson County Canal	
Season	Diversion (AF)	Net Recharge (AF)	Diversion (AF)	Net Recharge (AF)
Fall 2015	1,609	1,525	3,303	2,845
Spring 2016	0	0	1,397	1,309
Fall 2016	6,019	4,653	5,628	3,471
Spring 2017	0	0	0	0
Fall 2017	0	0	4,040	3,594
Spring 2018	0	0	0	0
Fall 2018	680	617	2,666	2,084
Total	**8,307**	**6,795**	**17,033**	**13,303**
Spring Average	**0**	**0**	**466**	**436**
Fall Average	**2,077**	**1,699**	**3,909**	**2,999**

There are stark differences between spring and fall recharge diversions, both in frequency and magnitude. As discussed previously, there are operational reasons for not diverting recharge water in the spring if there is uncertainty about being able to transition immediately from recharge to normal irrigation operations. Additionally, the lack of spring recharge diversions is consistent with the 2016 EDO Excess Analysis White Paper findings that excess flows availability during the First Increment has been less in the early spring months (March, April, May) than during the 1947-1994 historical period.

The EDO will be working with the NPPD to develop response functions for estimating the timing and volume of baseflow accretions from recharge in the three canals. As reliable data is not yet available, this water projects accounting memo does not include routing to Grand Island or calculation of shortage reduction credits. It is anticipated that such information will be included in the next iteration of this memo.

IV. LAKE MCCONAUGHY

Establishment of an Environmental Account in Lake McConaughy to provide water for instream use to benefit downstream fish and wildlife was one of the terms of the 1998 FERC license

renewals for the operation of the reservoir and hydropower plant. The Lake McConaughy EA and a portion of the water contributed thereto (i.e., storable natural inflows, discussed below) serve as Nebraska's contributions to the Program's initial state water projects. Water available in the Lake McConaughy EA from all sources of supply is recorded under permit A-17695[26], which was approved by the NDNR in May 1999 and is included in **Appendix G**. A maximum of 200,000 AF may be available in the account at any given time, but if the water level in Lake McConaughy reaches regulatory capacity, the EA automatically resets to 100,000 AF by addition or subtraction depending on whether the EA volume was above or below 100,000 AF.

In 2018, there were six total sources of water contributing to the Lake McConaughy EA, a combination of initial state water projects for the Program and water projects implemented under the WAP:

- Storable Natural Inflows
- Pathfinder EA
- Pathfinder Municipal Account Lease
- No-Cost NCCW
- CNPPID Irrigator Lease
- CPNRD Surface Water Lease

The following sections discuss these individual water supply sources contributing to the Lake McConaughy EA as well as the aggregate releases from the account.

A. Storable Natural Inflows

Nebraska's contribution to the Program's initial state water projects includes 10 percent of the Storable Natural Inflows (SNI) entering Lake McConaughy during the October through April non-irrigation season months. The volume of SNI water is based on measurements from the North Platte River at Lewellen, Nebraska gage (USGS 06687500), which is located at the upstream end of the reservoir. The 10 percent SNI allocation is credited to the Lake McConaughy EA. **Table 8** presents SNI yields for the Lake McConaughy EA since the inception of the First Increment in 2007. In calendar year 2018, SNI credited to the Lake McConaughy EA from January 1-April 30 and October 1-December 31 totaled 47,198 AF.

[26] This includes, but is not limited to, water from the No-Cost NCCW, CNPPID irrigator lease, and CPNRD surface water transfer WAP projects, as evidenced by the October 2018 letters from the NDNR, confirming credits to the Lake McConaughy EA in that month. See Appendices H, I, and J.

642 **Table 8. Lake McConaughy EA Storable Natural Inflows (SNI) Yields**

Year	Storable Natural Inflows Credited to EA[1] (AF)
2007	34,500
2008	37,400
2009	39,700
2010	37,500
2011	27,200
2012	43,800
2013	39,600
2014	45,000
2015	49,300
2016	53,700
2017	57,100
2018	47,200
Total	**512,000**
Average	**42,700**

643 [1] Amount of storable natural inflow available to the Lake McConaughy EA during the months of October through
644 April. This is 10 percent of the total Lake McConaughy SNI.

645 ## B. Pathfinder EA Releases

646 The Pathfinder EA, with a capacity of 33,493 AF, represents Wyoming's contribution to the
647 initial state water projects for the Program. Completed as part of the Pathfinder Modification
648 Project, the Pathfinder EA first made releases in 2012. Water that accrues to the account from
649 runoff during the spring and summer months is released at the end of the irrigation season and
650 routed down the North Platte River. These releases, minus river transit losses, are recaptured in
651 the Lake McConaughy EA. Releases from the Pathfinder EA in September 2018 totaled 20,469
652 AF, of which an estimated 17,545 AF reached Lake McConaughy. **Table 9** shows the history of
653 Pathfinder EA releases and deliveries to the Lake McConaughy EA over the period 2012-2018.

654 **Table 9. Pathfinder Environmental Account Yields**

Year	Releases Measured at Pathfinder Dam (AF)	Deliveries to Lake McConaughy[1] (AF)	Transit Losses (AF)	Transit Losses (%)
2012	21,600	19,700	1,900	9%
2013	14,400	13,100	1,300	9%
2014	32,600	28,800	3,800	12%
2015	30,300	29,100	1,200	4%
2016	33,100	28,500	4,600	14%
2017	30,300	28,000	2,300	8%
2018	20,500	17,500	2,900	14%
Total	**182,700**	**164,700**	**18,000**	**10%**
Average	**26,100**	**23,500**	**2,600**	**10%**

C. Pathfinder Municipal Account Lease

In 2011, the Program signed an agreement with the Wyoming Water Development Office (WWDO) to lease water from the Pathfinder Municipal Account[27]. The agreement, which is included in **Appendix H**, required advance payment for 38,400 AF assuming baseline releases of 4,800 AF per year for the period 2012-2019. Additional water (up to 4,800 AF more) may be available for a maximum Municipal Account release of 9,600 AF each year[28], and the Program accepted additional water in several years. As a result, the last of the original 38,400 AF that was pre-paid was released in 2017, but the agreement included a provision to allow the Program to continue purchasing additional Municipal Account water through the end of the First Increment.

Leased water is released from the Municipal Account at the end of the irrigation season and flows down the North Platte River to the Lake McConaughy EA. Transit losses are assessed, reducing the amount of Municipal Account water credited to the Lake McConaughy EA. Once in Lake McConaughy, the Municipal Account water loses its unique identity and becomes part of the combined Lake McConaughy EA supply. In 2018, the Program purchased 8,100 AF from the Pathfinder Municipal Account, which included the 4,800 AF base delivery plus an additional 3,300 AF. The purchased water was released from Pathfinder Reservoir in September 2018; after accounting for transit losses, an estimated 6,943 AF reached and was credited to the Lake McConaughy EA. **Table 10** shows the annual Municipal Account release volumes and the amounts reaching Lake McConaughy since the beginning of operations under the lease agreement in 2012.

Table 10. Pathfinder Municipal Account Lease Yields[1]

Year	Releases Measured at Pathfinder Dam (AF)	Deliveries to Lake McConaughy (AF)	Transit Losses (AF)	Transit Losses (%)
2012	4,800	4,400	430	9%
2013	4,800	4,400	420	9%
2014	9,600	8,500	1,100	12%
2015	9,600	9,200	370	4%
2016	4,800	4,100	670	14%
2017	9,600	8,900	730	8%
2018	8,100	6,900	1,200	14%
Total	**51,300**	**46,400**	**4,900**	**10%**
Average	**7,300**	**6,600**	**700**	**10%**

[1] Values > 1,000 rounded to nearest 100; values < 1,000 rounded to nearest 10.

[27] The Pathfinder Municipal Account was created as part of the Pathfinder Modification Project and has a capacity of 20,000 AF.

[28] In the spring of each year, the WWDO provides an estimate of Municipal Account water available to the Program. The Program, in consultation with the USFWS EA Manager, then decides whether to accept available water above the 4,800 AF baseline release. By mid-summer, the WWDO may revise the amount available based on runoff accruals to the Municipal Account during the intervening months.

D. No-Cost NCCW

Net Controllable Conserved Water (NCCW) in Lake McConaughy was made available through the implementation of conservation projects in compliance with a 1992 settlement agreement between the CNPPID and the National Wildlife Federation (NWF). The project concept was defined in the 1997 Cooperative Agreement, and a portion of the NCCW yield made available through U.S. Bureau of Reclamation (USBR) funding was recognized as a WAP project with the inception of the Program in 2007.

The NCCW resulted from the following conservation measures implemented within the CNPPID irrigation systems:

- Canal distribution and delivery improvements such as installation of pipelines, canal compaction, canal lining, structure automation, etc.
- On-farm efficiency improvements including installation of center pivots and flow meters, modification of irrigation schedules, etc.
- Operational adjustments to Elwood Reservoir to minimize seepage losses.

These measures reduced irrigation water demands downstream of Lake McConaughy. As a result, water that would have been released from Lake McConaughy before the conservation measures now remains stored in the reservoir.

Per Article 402 of the CNPPID's 1998 FERC license for the Kingsley Dam Project, the volume of NCCW water resulting from conservation projects partially funded by the USBR is to be added to the Lake McConaughy EA each year at no cost to the Program. This volume was consistently found to be 314 AF in successive reviews over a period of 15 years. Each year, the CNPPID makes a request to the NDNR to add the No-Cost NCCW to the Lake McConaughy EA on or about October 1. As shown in **Table 11**, a yield of 314 AFY has been credited to the Lake McConaughy EA in most years since 2007. No-Cost NCCW was not credited in 2010 and 2011 because it would have been lost to account resets. A letter from NDNR to CNPPID confirming the October 2018 credit is included in **Appendix I**.

Table 11. Annual No-Cost NCCW Yield

Year	Project Yield Credited to Lake McConaughy EA (AF)
2007	314
2008	314
2009	314
2010	0
2011	0
2012	314
2013	314
2014	314
2015	314
2016	314
2017	314
2018	314

E. CNPPID Irrigator Lease

Beginning with the 2016 irrigation season, the Program and CNPPID entered into a series of temporary agreements to lease water directly from irrigators within the CNPPID systems. Irrigators agree to fallow or dryland farm designated parcels, which are typically odd-shaped or otherwise difficult to irrigate. The project operated as a pilot program from 2016 to 2018, at which point it was extended for 5 years, through the 2023 irrigation season. In order to carry out the project, the CNPPID must declare a full allocation, in which case individual irrigators cannot trade water amongst themselves and the Program is the only potential customer for water leasing. The Program pays a fee to the CNPPID to administer the irrigator leasing program.

For each acre enrolled in the irrigator lease program, the Program is credited with 9 inches (0.75 AF) in the Lake McConaughy EA, on or about October 1 following the end of the irrigation season. Enrollment was originally capped at 2,000 acres, but participation has grown each year of project operation, and the new 5-year lease agreement set a cap of 3,000 acres beginning with the 2019 irrigation season.

Table 12 shows the acres enrolled and volume credited to the Lake McConaughy EA during each year of the pilot program. Documents included in **Appendix J** include the leasing agreement for the 2018 growing season, an amendment to that agreement increasing maximum enrollment to 2,100 acres, an invoice for the 2,055 acres enrolled in 2018, and the letter from NDNR to CNPPID confirming that 1,541 AF (0.75 AF/acre x 2,055 acres) was credited to the Lake McConaughy EA in October 2018.

Table 12. Annual Enrollment in CNPPID Irrigator Lease Program

Irrigation Season	Acres Enrolled	Volume Credited to Lake McConaughy EA (AF)
2016	1,037	778
2017	1,275	956
2018	2,055	1,541

In a continuation of the trend of increasing annual enrollment, 2,948 acres are enrolled in the irrigator lease Program for the forthcoming 2019 irrigation season, which is expected to result in a credit of 2,211 AF to the Lake McConaughy EA in October 2019.

F. CPNRD Surface Water Lease

Under the provisions of a December 2013 water use lease agreement[29], the CPNRD committed to provide up to 20,500 AF per year[30] to the Program through a combination of transferred surface water and accretions from groundwater recharge in the Thirty Mile, Cozad, and Orchard-Alfalfa canals. The agreement specifies that the source of the transferred surface water is existing natural flow water rights held by the three canals for irrigation purposes, to be made available from irrigated lands that relinquish surface water supplies and instead irrigate with groundwater pumped from existing wells.

For the first three years of project operations, beginning in 2015, the CPNRD calculated the net volume of transferrable surface water based on analyses of crop consumptive use and the depletions resulting from the switch to groundwater pumping. Available natural flow water was diverted and measured at the canal headgates, and appropriate volumes were immediately returned to the river in real time during the irrigation season. This occurred regardless of whether the river was in excess or shortage relative to USFWS target flows, producing a scenario—particularly in normal to wet years—in which the Program was paying for significantly larger volumes of transferred surface water than actually served to reduce real-time target flow deficits.

To make better use of the transferred surface water, the approach was modified in 2018 through implementation of a "pilot exchange project" in which natural flow water to which the CPNRD canals are entitled was not delivered to the canals (i.e., it was retained in Lake McConaughy) and credited to the Lake McConaughy EA following the end of the irrigation season. This pilot exchange project was executed under a Memorandum of Understanding (MOU) between the CNPPID and CPNRD and with approval from the NDNR. The Program's water use lease agreement with CPNRD was also amended to accommodate the crediting of transferred surface water to the Lake McConaughy EA. Letters exchanged between CNPPID and NDNR in October

[29] The water use lease agreement was first amended effective January 1, 2017 to modify the rate structure for surface water transfers and groundwater accretions.

[30] The terms of the lease agreement specify that "CPNRD shall provide a minimum of fifty percent of all available water returned to the Platte River for instream use to the [Program]" but "CPNRD does not guarantee any minimum amount of stream flow augmentation through Transferred Surface Water or Ground Water Recharge."

2018 confirm that 14,251 AF associated with the pilot exchange project was credited to the Lake McConaughy EA in that month. The water use lease agreement, amendments, and documentation pertinent to the pilot exchange project are included in **Appendix K**.

It is anticipated that the CPNRD surface water transfer project will be conducted in a similar manner involving similar volumes of water in 2019. Given the complete change in approach to the project, no accounting is provided for the 2015-2017 surface water transfers, but the 2018 pilot exchange project is reflected in the aggregate accounting for the Lake McConaughy EA in the next section.

G. Combined Accruals and Releases from the Lake McConaughy EA

As described previously, all sources of water credited to the Lake McConaughy EA become a common supply under the A-17695 permit. Releases from the Lake McConaughy EA to benefit threatened and endangered species downstream are overseen by the USFWS in coordination with the CNPPID. The USFWS EA Manager prepares an Annual Operating Plan (AOP), which outlines priorities for the timing, target flow rates, and purpose of planned releases from the Lake McConaughy EA during the upcoming year. Releases are generally timed to coincide with events such as the spring and fall whooping crane migrations; other releases are made for channel maintenance and species benefits for interior least terns and piping plovers. The final 2018 AOP is included in **Appendix G**.

The EDO developed an accounting of Lake McConaughy EA operations since the beginning of the Program's First Increment in 2007. This accounting includes total contributions to the EA from all water sources; losses due to evaporation, seepage, and reservoir resets; total releases from the EA; water volumes reaching Grand Island; and reductions to target flow deficits at Grand Island. The Lake McConaughy EA accounting is presented in **Table 13**. In 2018, accruals to the account totaled nearly 87,800 AF before losses, and the USFWS cumulatively released 89,300 AF, resulting in deficit reductions of about 73,300 AF at Grand Island.

Total and average values are shown in Table 12 for all years in the First Increment to date (2007-2018) as well as the period 2012-2018 to emphasize the significant shift in Lake McConaughy EA operations once the Pathfinder Modification Project was completed in 2012 and began making releases from the Pathfinder EA and the Pathfinder Municipal Account. In the seven years since 2012, 76 percent of all accruals to the Lake McConaughy EA occurred and 85 percent of all releases were made, providing 91 percent of the deficit reductions attributable to the Lake McConaughy EA.

Table 13. Lake McConaughy EA Accruals, Releases, and Reductions to Target Flow Deficits

Year	Gross Accruals to EA[1] (AF)	Net Losses[2] (AF)	Net Water: Accruals - Losses (AF)	Total EA Releases[3] (AF)	Net Yield at GI[4] (AF)	Reductions to Deficits[5] (AF)
2007	34,800	17,300	17,500	34,400	24,400	13,000
2008	37,700	17,700	20,000	30,100	17,800	13,600
2009	40,000	9,200	30,800	23,000	13,300	8,200
2010	37,800	8,900	28,900	0	0	0
2011	27,500	47,200	-19,700	0	0	0
2012	68,100	11,100	57,000	81,000	40,900	40,600
2013	57,400	5,400	52,000	74,600	56,100	29,000
2014	82,600	6,400	76,200	45,800	37,600	37,600
2015	88,000	9,300	78,700	51,500	43,500	42,600
2016	87,400	43,700	43,700	23,300	18,200	15,700
2017	95,200	7,500	87,600	142,300	123,300	97,200
2018	87,800	6,000	81,800	89,300	74,600	73,300
Total, 2007-2018	**744,300**	**189,700**	**554,500**	**595,300**	**449,700**	**370,800**
Average, 2007-2018	**62,000**	**15,800**	**46,200**	**49,600**	**37,500**	**30,900**
Total, 2012-2018	**566,500**	**89,400**	**477,000**	**507,800**	**394,200**	**336,000**
Average, 2012-2018	**80,900**	**12,800**	**68,100**	**72,500**	**56,300**	**48,000**

[1] Total volume of water credited to the Lake McConaughy EA including 10% of SNI, the Pathfinder EA, Pathfinder Municipal Account lease, No-Cost NCCW, the CNPPID irrigator lease pilot program, and the CPNRD pilot exchange project (2018 only). All sources of water into the Lake McConaughy EA are viewed as a combined volume for operational purposes, but WAP projects contributing to the EA are scored independently.
[2] Losses due to evaporation, seepage and EA resets when reservoir fills to capacity.
[3] Releases were made to reduce target flow shortages and for other environmental or learning purposes.
[4] Accounts for transit losses between Lake McConaughy releases to Grand Island.
[5] Calculated using real time hydrologic conditions.

The Pathfinder EA and Lake McConaughy EA are assumed for accounting purposes to be credited with a combined score of 70,000 AF[31]. The score analysis is understood to have been based on the premise of releasing water as needed to fill modeled shortages at Grand Island, an approach that likely does not correspond to the release priorities specified by USFWS in the

[31] In the 2005 Water Plan Reference Materials (Program Document, Attachment 5, Section 11, Appendix B), it states that "…the initial Program projects…were evaluated and determined using the [Central Plate River OPSTUDY] Model during NEPA review to provide an average reduction in shortage of 80,000 acre-feet per year. The shortage reduction assigned to each project individually has not been determined (at this time)…" In the Program Document description of the Tamarack I project (Attachment 5, Section 3), it is stated that "…Tamarack I is estimated to develop an average annual yield of at least 10,000 acre-feet during times of target flow shortages…" Although there is no known documentation explicitly stating so, it is assumed by the EDO that if the three state projects collectively provide 80,000 AF of shortage reduction, and Tamarack I provides 10,000 AF of shortage reduction, then the Pathfinder EA and Lake McConaughy EA together provide 70,000 AF of shortage reduction.

AOP and is not necessarily operationally feasible. Score analyses for WAP projects that contribute to the Lake McConaughy EA treat the projects as though they are operated individually rather than as part of a larger collective supply[32]. Through 2018, two of the four WAP projects contributing to the Lake McConaughy EA have approved scores, bringing the combined score to 76,610 AF.

The Program continues to pursue additional water supplies for the Lake McConaughy EA, most recently adding the CPNRD pilot exchange project in 2018. With new water sources contributing to the Lake McConaughy EA added throughout the First Increment, neither of the annual average reductions to deficits volumes shown in Table 13 are particularly representative of the collective performance of these projects. However, it is instructive, as shown in **Figure 2**, that both total releases from the Lake McConaughy EA and reductions to deficits at Grand Island as a result of those releases exhibit upward trends across the duration of the First Increment.

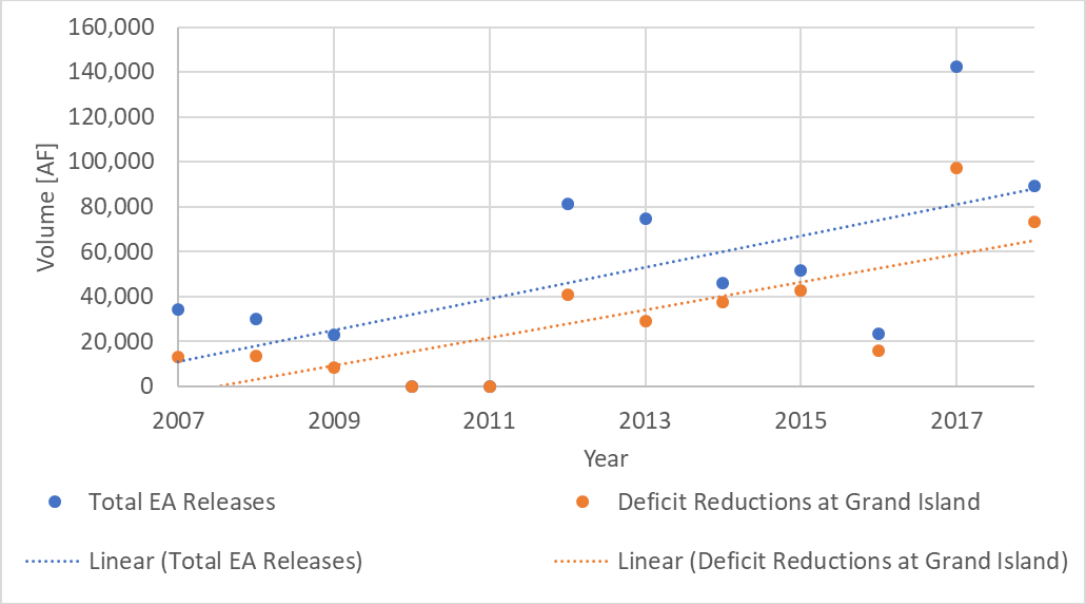

Figure 2. Lake McConaughy EA Releases and Deficit Reductions, 2007-2018

In general, greater release volumes from the Lake McConaughy EA result in greater deficit reductions at Grand Island, although the degree of efficiency may not be consistent, in part due to other purposes for releases (e.g., environmental and learning). For example, in 2017, which had record releases exceeding 142,000 AF (including a May-June pulse release above target flows), only 68 percent resulted in deficit reductions, but 82 percent of releases resulted in deficit reductions in 2018. Ultimately, releases from the Lake McConaughy EA are made at the discretion of the USFWS according to the AOP. Over the course of extended Program operations, the timing, magnitude, and purpose of those releases relative to target flow deficits at Grand Island will significantly influence whether the Lake McConaughy EA the contributing WAP projects will produce operational yields similar to approved project scores.

[32] Section IV.A. of the May 2019 draft CNPPID irrigator lease score memo elaborates on the rationale for this approach.