


STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES

PETITION TO THE NEBRASKA DEPARTMENT OF NATURAL RESOURCES
FOR LEAVE TO FILE OR CONSIDER AN APPLICATION FOR A NEW
SURFACE WATER APPROPRIATION WITHIN A MORATORIUM OR STAY AREA
UNDER TITLE 457 N.A.C. CHAPTER 23

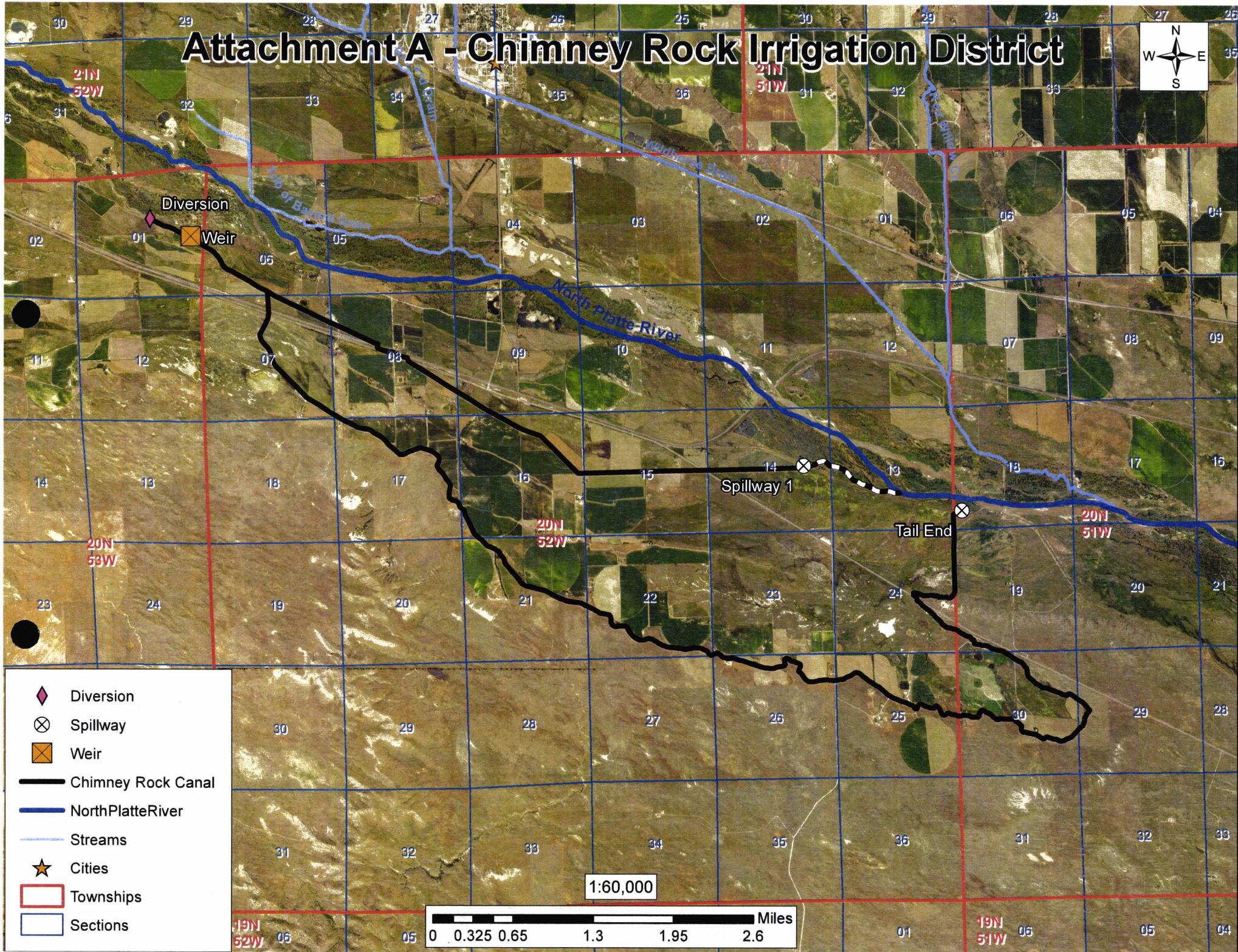
Complete items 1 through 5 by printing in ink or typing the appropriate information and by placing an X in the appropriate box. Attach supporting documentation and a \$10 non-refundable filing fee.	For Department Use Only
<p>1. Name and address of petitioner:</p> <p>Chimney Rock Irrigation District 9659 Road 77 Bayard NE 69334</p> <p>E-mail address: rogereirich@yahoo.com Telephone No. (308) 641-2291</p>	<p>Modification No.: VAR-6163 Date Filed: 3-28-2017 Time Filed: 8:21 am SW Appropriation No.: _____ (if applicable) Right ID No.: _____ (if applicable) Water Division: 1-A Receipt No.: A-4913 Amount: \$10.00</p>
<p>2. Check the situation that applies:</p> <p><input type="checkbox"/> Application Already Filed Application Number: _____</p> <p><input checked="" type="checkbox"/> Application Not Filed (Enclose copy of proposed application)</p>	
<p>3. Description of proposed project:</p> <p>Temporary appropriation in divert excess flows outside of irrigation season for groundwater recharge and stream baseflow enhancement.</p> <p>Chimney Rock will divert up to 60 cfs at its headgate on the North Platte River, located in the SW1/4NE1/4 of Sec. 1, Twn 20 N, Rg 53 W, Scotts Bluff County.</p>	
<p>4. The Proposed Project — (Check all that apply):</p> <p><input type="checkbox"/> 001.01 — Is a non-consumptive use</p> <p><input type="checkbox"/> 001.02 — Will replace (offset) any consumptive use (Attach Offset Plan)</p> <p><input checked="" type="checkbox"/> 001.03 — Is for possible unappropriated water (Attach Analysis)</p> <p><input type="checkbox"/> 001.04 — Existed before the stay or moratorium (Attach Proof)</p> <p><input type="checkbox"/> 001.05 — Addresses a public safety issue (Attach Explanation)</p> <p><input type="checkbox"/> 001.06 — Is a temporary use for public construction (<10 AF)</p>	
<p>5. Other reason why a variance should be granted:</p> <p>See attached supplemental information on anticipated excess flows and the benefits of recharge for reaching integrated management plan and PRRIP goals.</p>	
<p>3-14-17 Date</p>	<p> Signature of Applicant (or authorized agent)</p>

Send to the following address (along with \$10 non-refundable filing fee):

State of Nebraska
Department of Natural Resources
301 Centennial Mall South / PO Box 94676
Lincoln, Nebraska 68509-4676
(402) 471-2363

mod-03282017-6163-pet i (45)

Attachment A - Chimney Rock Irrigation District



Variance Petition Supplemental Information

Chimney Rock Irrigation District (Petitioner) submits this variance petition, pursuant to Department Rules Title 457 N.A.C. 23, to request leave to file a temporary natural-flow appropriation for the purpose of diverting excess flows during the non-irrigation season. Petitioner desires to partner with the North Platte Natural Resources District (NRD) to divert excess flows into its main canal and allow such diverted water to seep through the canal perimeter and recharge the aquifer beneath the canal, less any spills back to the river or its tributaries that may occur during operation of the canal. Petitioner provides the following information in support of this variance petition, along with a copy of the draft application for a temporary appropriation; a copy of the five-year agreement which the Petitioner and the North Platte Natural Resources District have executed to take advantage of excess flows when available; and a copy of the executed Task Order for anticipated Spring 2017 excess-flow diversion opportunities.

Title 457 N.A.C. 23.001.03, Unappropriated water: The Petitioner has reason to believe that unappropriated water in excess of “state-protected flows,” including those flows necessary to meet appropriations held by Central Nebraska Public Power and Irrigation District when in priority, and target flows required for compliance with the Platte River Recovery Implementation Program (PRRIP) may be available, prior to the beginning of the 2017 irrigation season. As of February 22, 2017, the snowpack in the upper North Platte Basin was at 124% of average (Figure 1), and more snow is expected in the mountains which feed the North Platte drainage before snowmelt season begins. This forecast does not include any spring precipitation event that may add to the total water supply in the North Platte Basin prior to the beginning of irrigation season.

Lower North Platte with Non-Exceedence Projections
Based on Provisional SNOTEL Data as of Feb 27, 2017

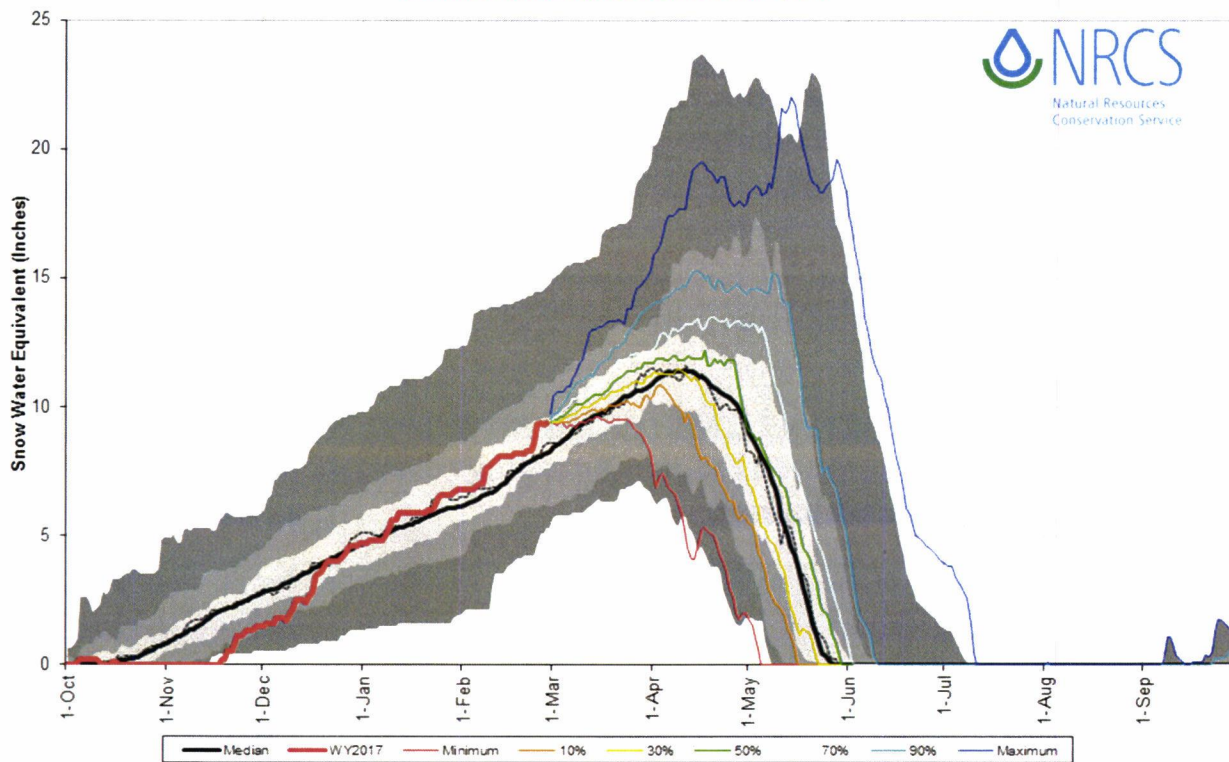


Figure 1: Current and projected snow-water equivalent of snowpack in the lower North Platte Basin below Seminoe Reservoir. (http://www.weather.gov/riw/cms_snotel_quicklinks_graphs, accessed February 27, 2017)

To compound the current state of above-average snowpack, all the US Bureau of Reclamation reservoirs in Wyoming are already full, except for Guernsey, which has been drained for spillway reconstruction (Figure 2).

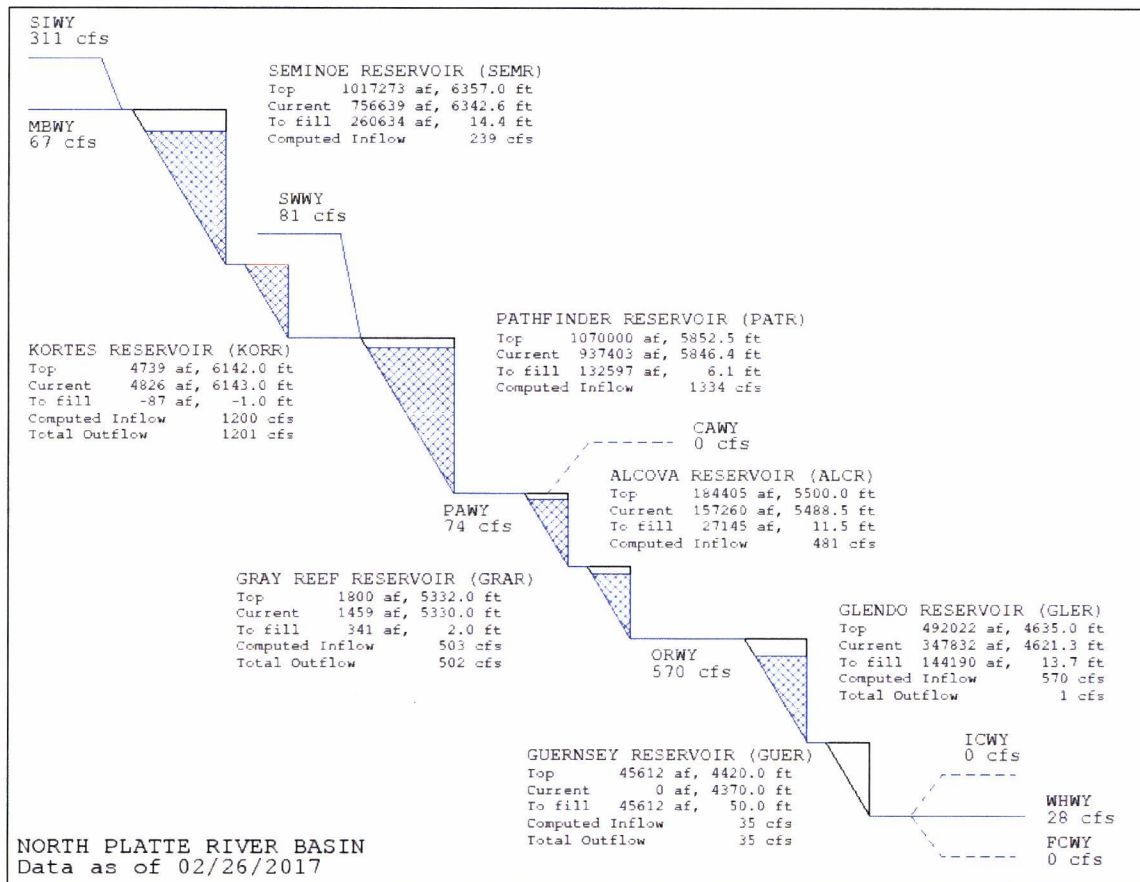


Figure 2: TEACUP model of current Wyoming reservoir levels in the North Platte River system. (https://www.usbr.gov/gp-bin/hydromet_teacup.pl, accessed February 27, 2017)

The Bureau has stated that it will need to release water from storage to make room for snowmelt runoff later in the season, though no flooding conditions are currently forecast for the North Platte system as a result of these releases or snowmelt runoff (Figure 3). These releases, along with any additional releases that may be required to maintain the desired level of storage in the reservoir system through spring and early summer, may generate additional excess flows through the North Platte River system beyond what existing appropriations could either store or beneficially use.

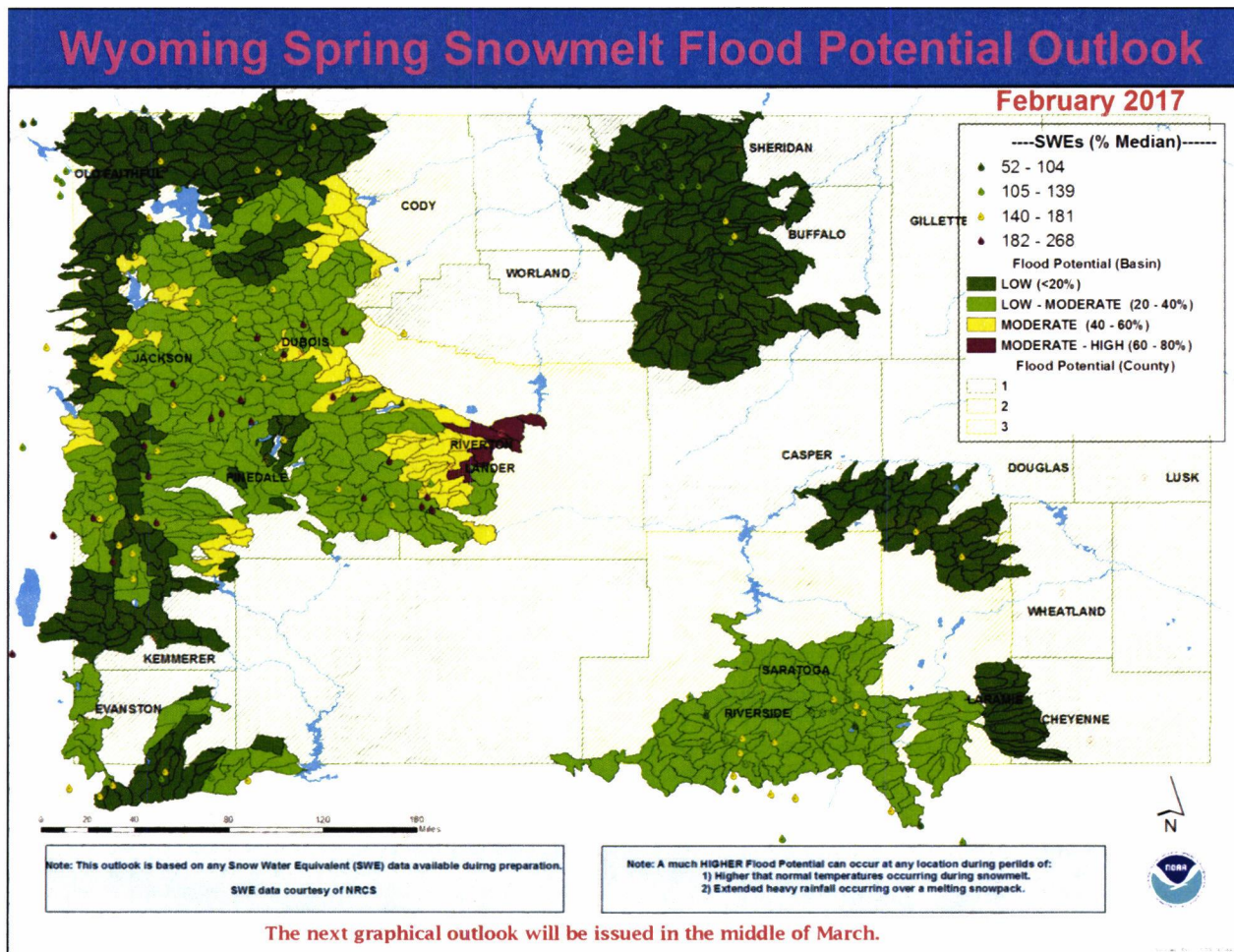


Figure 3: Spring flood potential forecast for the upper North Platte basin, based on anticipated rate of snowmelt and reservoir storage. Note that this outlook does not incorporate abnormally high temperatures, which would accelerate snowmelt, or heavy precipitation events occurring during the snowmelt season. (http://www.weather.gov/riw/cms_snotel_quicklinks_graphs, accessed February 27, 2017)

Because of the factors discussed above, high spring flows along the North Platte River are anticipated to occur before irrigation season begins. Petitioner and its partner, the North Platte NRD, believe that these flows will be in excess of both PRRIP target flows and state-protected flows that are required to be available prior to June 1.

Title 457 N.A.C. 23.002, Good cause: The North Platte NRD is currently implementing a joint integrated management plan (IMP) and a basinwide integrated management plan (BWP) with the Department of Natural Resources (DNR). As part of this plan, the NRD is required to offset depletions to streamflow caused by groundwater uses begun after July 1, 1997; subsequent increments of the IMP and BWP will include additional offset requirements to achieve or

maintain a fully appropriated condition. In addition, Nebraska's compliance with PRRIP requires that shortages to target flows be reduced by 130,000 to 150,000 acre-feet per year. To accomplish both of these purposes, Petitioner and the North Platte NRD will partner once again to divert excess flows this spring, if available, to recharge the aquifer. Recharge gained will return as baseflow to the North Platte River, thereby retiming excess spring flows back to the river at other times of the year when flows are needed and reducing potential shortages during key seasons (e.g., irrigation).

The North Platte NRD has previously partnered with irrigation districts and canal companies to divert excess flows to alleviate flood conditions on the North Platte River and recharge the aquifer through canal seepage. In 2011, spring and fall diversions resulted in approximately 11,341 acre-feet of accretion to the North Platte River over fifty years (see Table 2, *Upper Platte River Recharge and Flood Mitigation Demonstration Project*, DNR Technical Memorandum January 2013). Diversions in the spring of 2016 added approximately 18,000 acre-feet of recharge to the aquifer, based on preliminary estimates. Petitioner and the North Platte NRD see an additional opportunity during Spring 2017 to divert anticipated excess flows for additional recharge and retiming benefits to the aquifer and the river. These benefits will ensure that the NRD and the state of Nebraska continue to meet depletion-offset targets for integrated management planning and PRRIP.

Conclusion: Petitioner presents this information in support of its variance petition for leave to file an application for a temporary, one-year, appropriation to divert excess flows in the nonirrigation season. Diversions and, as applicable, spills will be monitored to provide a record of the amount available for recharge, and these data will be reported to DNR as part of the integrated-management annual reporting requirements. Diversions will provide recharge to the alluvial aquifer, which will become baseflow accretions to the North Platte River over time. Previous such recharge diversions have provided ample benefit to streamflow and have assisted the North Platte NRD in meeting the goals of its IMP and of the BWP, as well as providing another mechanism for Nebraska to comply with PRRIP streamflow goals.

STATE OF NEBRASKA
DEPARTMENT OF NATURAL RESOURCES
APPLICATION FOR A PERMIT TO APPROPRIATE WATER

Complete items 1 through 10 by printing in ink or typing the appropriate information and by placing an X in the appropriate box. **For Department Use Only**

1. Name and address of owner of land under proposed project. Names must be exactly as described on the deed or document transferring ownership of property. Landowner must sign the application.

Chimney Rock Irrigation District
9659 Road 77
Bayard NE 69334

E-mail address: rogereirich@yahoo.com Telephone No. (308) 641-2291

Filed in the office of the Department of
Natural Resources at _____ a.m./p.m.
on _____

Application No. _____

2. Name, address, and telephone number of applicant if different than landowner.

Map No. _____

Water Division _____

Receipt No. _____ Amount _____

Right ID _____

E-mail address: _____ Telephone No. () _____

3a. A permit is sought to:

Use natural flow Use impounded water*

3b. A permit is sought for the purpose of:

Irrigation Manufacturing Domestic

Other _____

Temporary** Baseflow enhancement through GW recharge

4a. Identify the source of water (name of stream or reservoir).

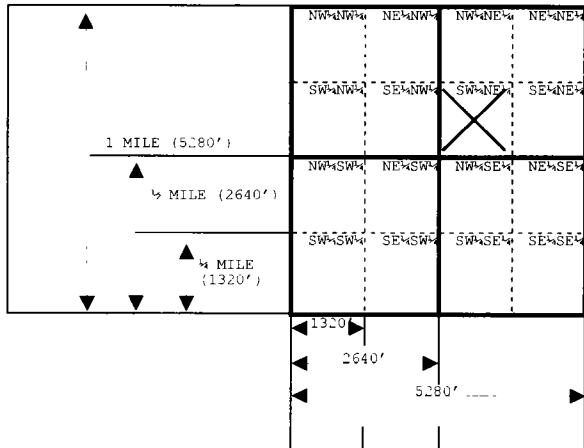
North Platte River

4b. If applicable, identify the facility name for transporting water from the source (portable pump, name of canal or pipeline).

Chimney Rock Canal

5. Identify the location of the Headgate Pump

Section 1, Township 20 North, Range 53 E W County Scotts Bluff



The box at left represents one square mile (section). Place an X within each appropriate 40-acre tract to indicate the location(s) of each headgate or pump.

If applicable, indicate the height, in feet, of any diversion or check dams on the line below.

7 ft

* A separate permit to impound water must be obtained.
** A temporary permit may be granted for a maximum of one year.

6. If applicable, identify the location of lands by 40-acre subdivisions that will be irrigated.

LEGAL SUBDIVISIONS	Sec.	Twp.	Rge.	No. of Acres	LEGAL SUBDIVISIONS	Sec.	Twp.	Rge.	No. of Acres
TOTAL NUMBER OF ACRES TO BE IRRIGATED:									0.0

Enclosed is an aerial photograph that I have marked to show the approximate location of land to be irrigated as described above.

7. State the approximate quantity of water desired for

appropriation. 60

- Gallons per minute
 Cubic feet per second
 Acre-feet (impounded water)

8a. State the estimated time required for completion of all water diversion facilities.

completed

8b. State the earliest date when water will have been used for beneficial purposes.

April 1, 2017, or as soon as water is available

9. Will this project be constructed under a federal program, receive federal funding, or have federal planning assistance?

No Yes If yes, explain: _____

10. I certify that am familiar with the information contained in this application, and that to the best of my knowledge and belief such information is true, complete and accurate.

_____ Date

_____ Signature of owner or owner's authorized agent (with proper documentation)

A final project map may accompany this application or must be filed within six months following departmental approval of this application, drawn in accordance with NAC Title 457 – Rules for Surface Water, Chapter 10, (<http://dnr.nebraska.gov/swr/surface-water-rules>). At the request of the applicant, the Department will assist with preparation of the project map.

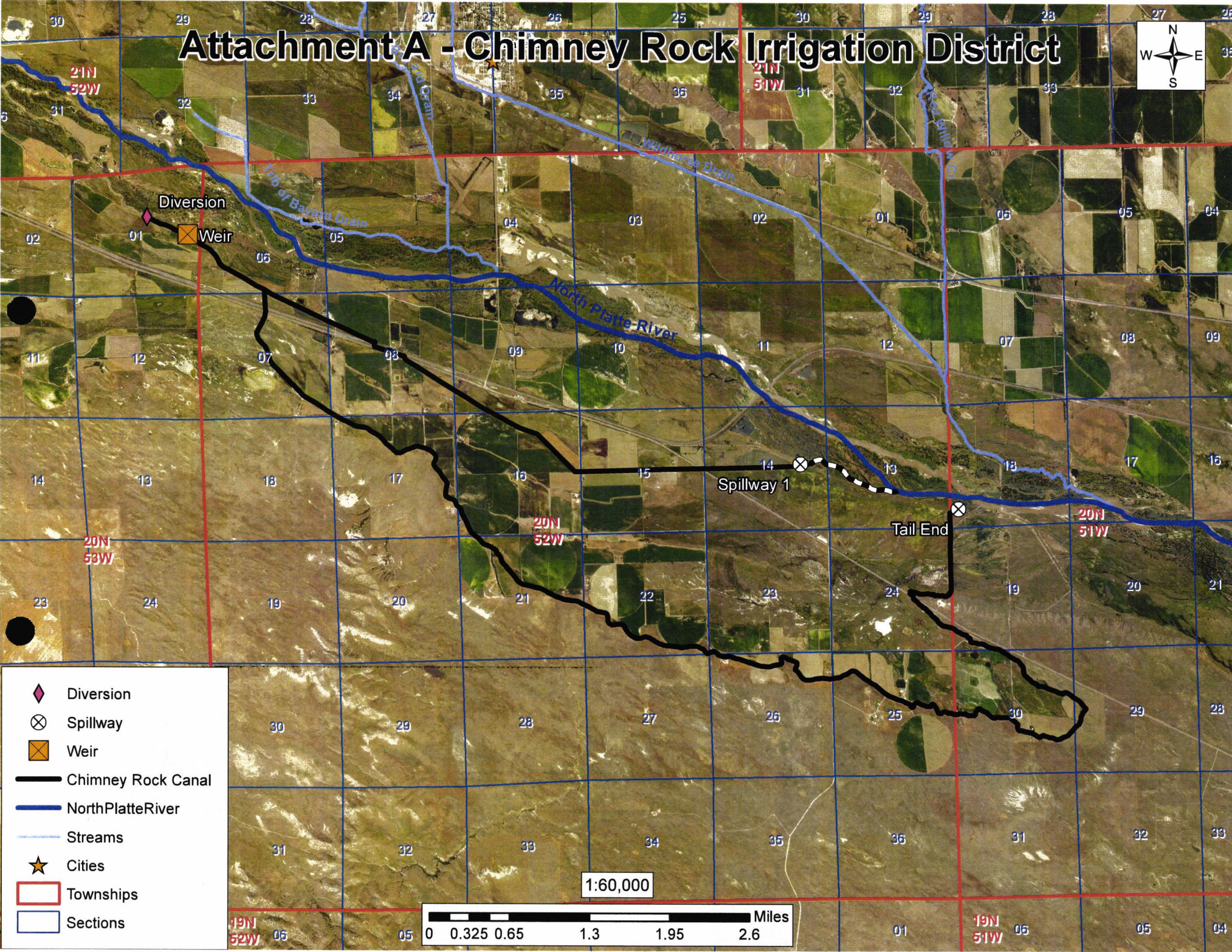
This form must be completed in full. An incomplete or defective application will be returned with 90 days being allowed for resubmission. Failure to resubmit a corrected application within this period shall cause dismissal of the application and consequent loss of priority and fees.

A non-refundable filing fee, payable to the Department of Natural Resources, computed from the table below must accompany this application. Forward this application and applicable fees to:

State of Nebraska
 Department of Natural Resources
 301 Centennial Mall South / P.O. Box 94676
 Lincoln, Nebraska 68509-4676
 (402) 471-2363

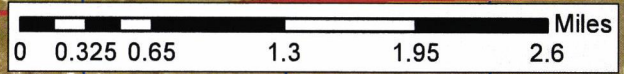
Nature of Use	Cost	Nature of Use	Cost
Domestic	\$10	Manufacturing	
Agricultural		General	\$10
Irrigation from Stream		Power Generation for each theoretical 50 horsepower	\$5
0-1,000 acres	\$200	Other	\$10
Each additional 1,000 acre unit	\$100		
or portion thereof in excess of the first 1,000 acre unit			
Irrigation from Storage Reservoir			
0-1,000 acres	\$50		
or portion thereof in excess of the first 1,000 acre unit			
Each additional 1,000 acre unit	\$25		
or portion thereof in excess of the first 1,000 acre unit			

Attachment A - Chimney Rock Irrigation District



- ◆ Diversion
- ⊗ Spillway
- ⊠ Weir
- Chimney Rock Canal
- NorthPlatteRiver
- Streams
- ★ Cities
- ▭ Townships
- ▭ Sections

1:60,000



Attachment B

1.0 Introduction

Chimney Rock Irrigation District (Applicant) submits this application for a temporary appropriation to divert anticipated excess flows for groundwater recharge and stream baseflow enhancement in the North Platte River. This application includes the following supplemental components, in addition to the application form DNR Form APA-001:

Map of canal (Attachment A)

Application narrative discussing excess flows and beneficial use (Attachment B)

DNR Order granting Variance Petition VAR-____, allowing Chimney Rock Irrigation District to file the attached application (Attachment C)

Agreement and 2017 Task Order executed by Chimney Rock Irrigation District and North Platte NRD for excess flow diversion (Attachment D)

Upper Platte River Recharge and Flood Mitigation Demonstration Project: Part of the Conjunctive Management Toolbox, DNR January 2013 Technical Memorandum (Attachment E)

Chimney Rock Irrigation District desires to obtain a temporary, one-year, appropriation to divert excess natural flow during the non-irrigation season, for the purpose of groundwater recharge and stream baseflow enhancement. Applicant has partnered with the North Platte Natural Resources District (NRD) again this year to take advantage of anticipated excess flows, and the recharge benefits to be realized from the proposed diversions will assist the NRD in meeting its integrated management plan (IMP) obligations. In addition, the stream baseflow enhancement that will be realized will provide water toward meeting Nebraska's obligations under the Platte River Recovery Implementation Program (PRRIP).

Applicant proposes to divert up to 60 cfs at its headgate located in the SW¹/₄NE¹/₄ of Section 1, Township 20 North, Range 53 West of the 6th P.M., Scotts Bluff County, Nebraska, on the North Platte River. Of the total amount diverted, an anticipated 20 cfs will be spilled back to the North Platte River at the two spill locations, first on Spillway #1, located in the SE¹/₄NE¹/₄ of Section 14, Township 20 North, Range 52 West of the 6th P.M., and second on the Tail End Spillway located in the SW¹/₄SW¹/₄ of Section 18, Township 20 North, Range 51 West of the 6th P.M., both located in Morrill County, Nebraska. The locations of the Applicant's main canal, river diversion, and spill(s) are shown on the map labeled Attachment A. Water will be diverted at the headgate and run through the main canal but not through the system laterals. That water which does not spill back to the North Platte River will be allowed to soak through the canal perimeter, providing recharge to the underlying aquifer, as has occurred on these projects in previous years.

2.0 Excess flows

The Applicant believes that excess flows will be available along the North Platte River prior to the beginning of the 2017 irrigation season; the potential for excess flows following the 2017

Attachment B

irrigation season cannot be assessed at this time. As of February 22, 2017, the snowpack in the upper North Platte Basin was at 124% of average, and more snow is expected in the mountains which feed the North Platte drainage before snowmelt season begins (Figure 1). This level of snowpack is in line with previous years in which spring excess flows have occurred. This forecast does not include any spring precipitation event that may add to the total water supply in the North Platte Basin prior to the beginning of irrigation season.

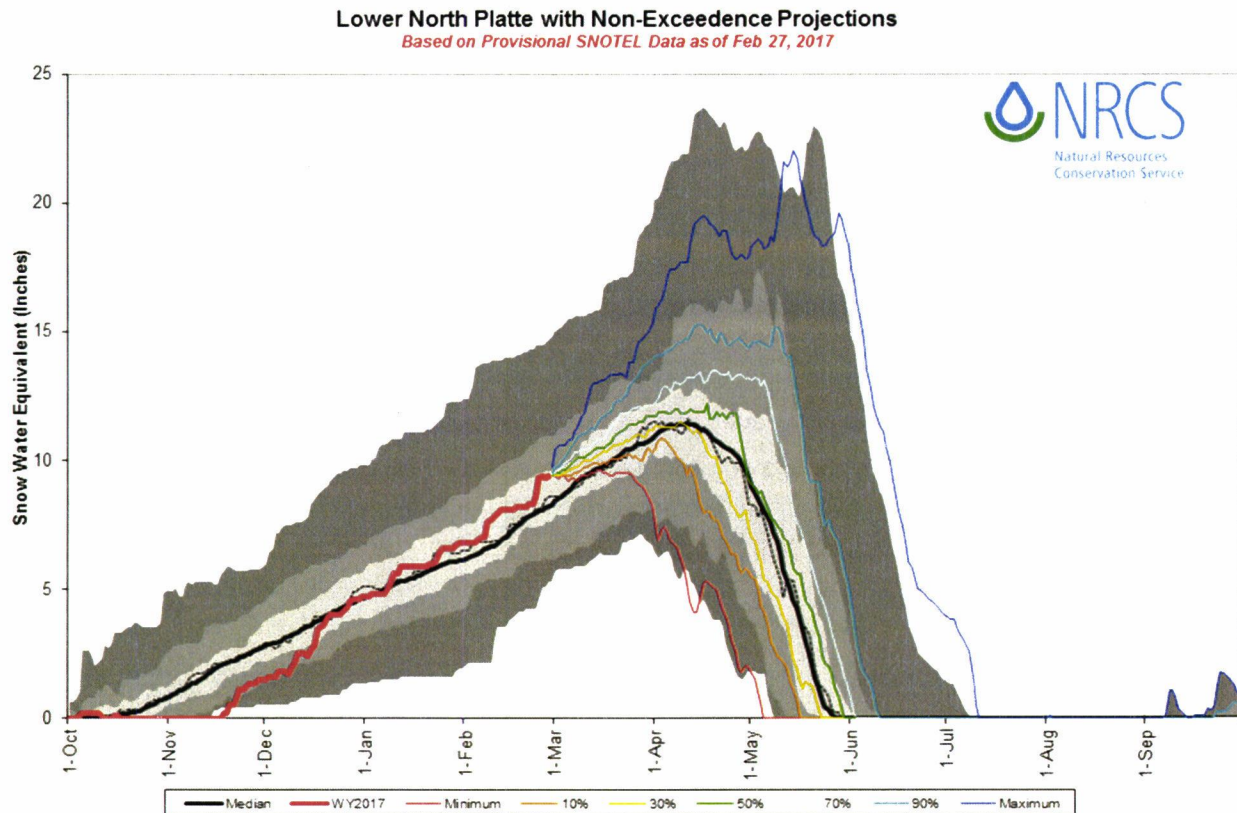


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To compound the current state of above-average snowpack, all the US Bureau of Reclamation reservoirs in Wyoming are already full, except for Guernsey, which has been drained for spillway reconstruction (Figure 2).

Attachment B

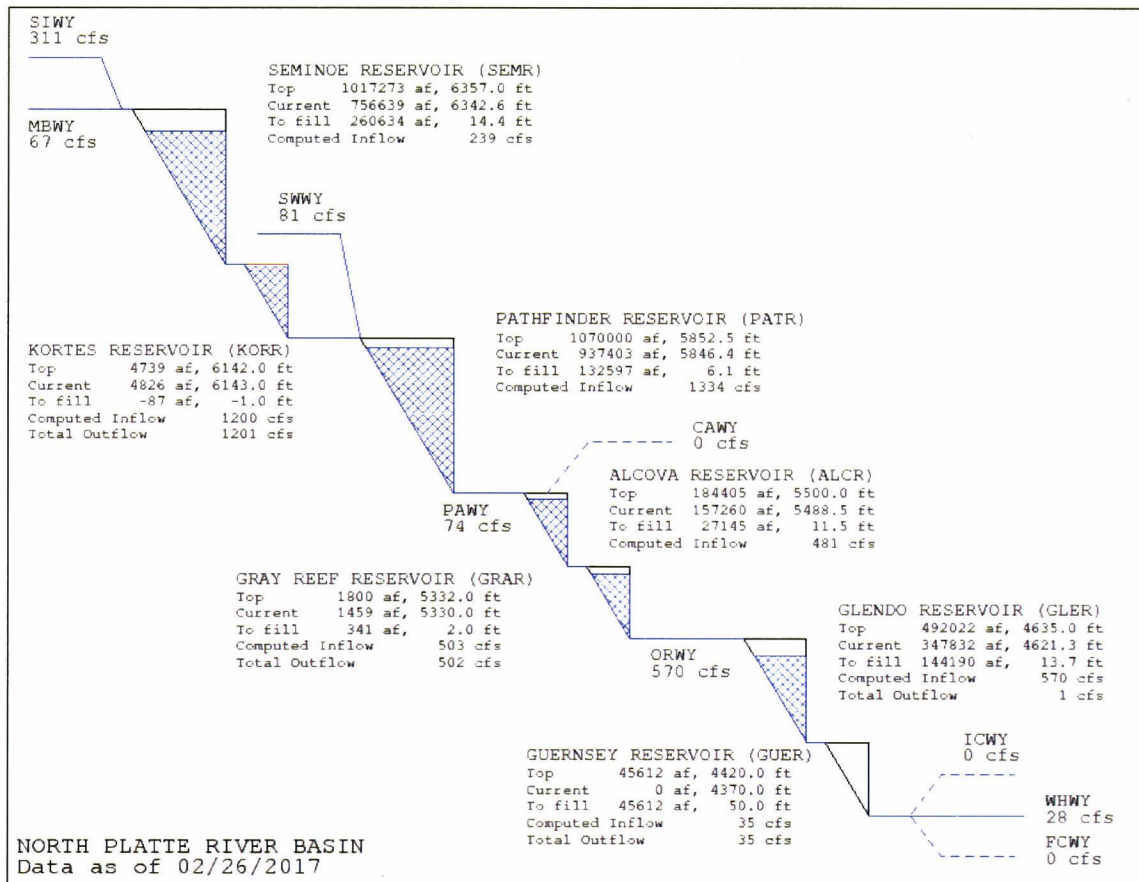


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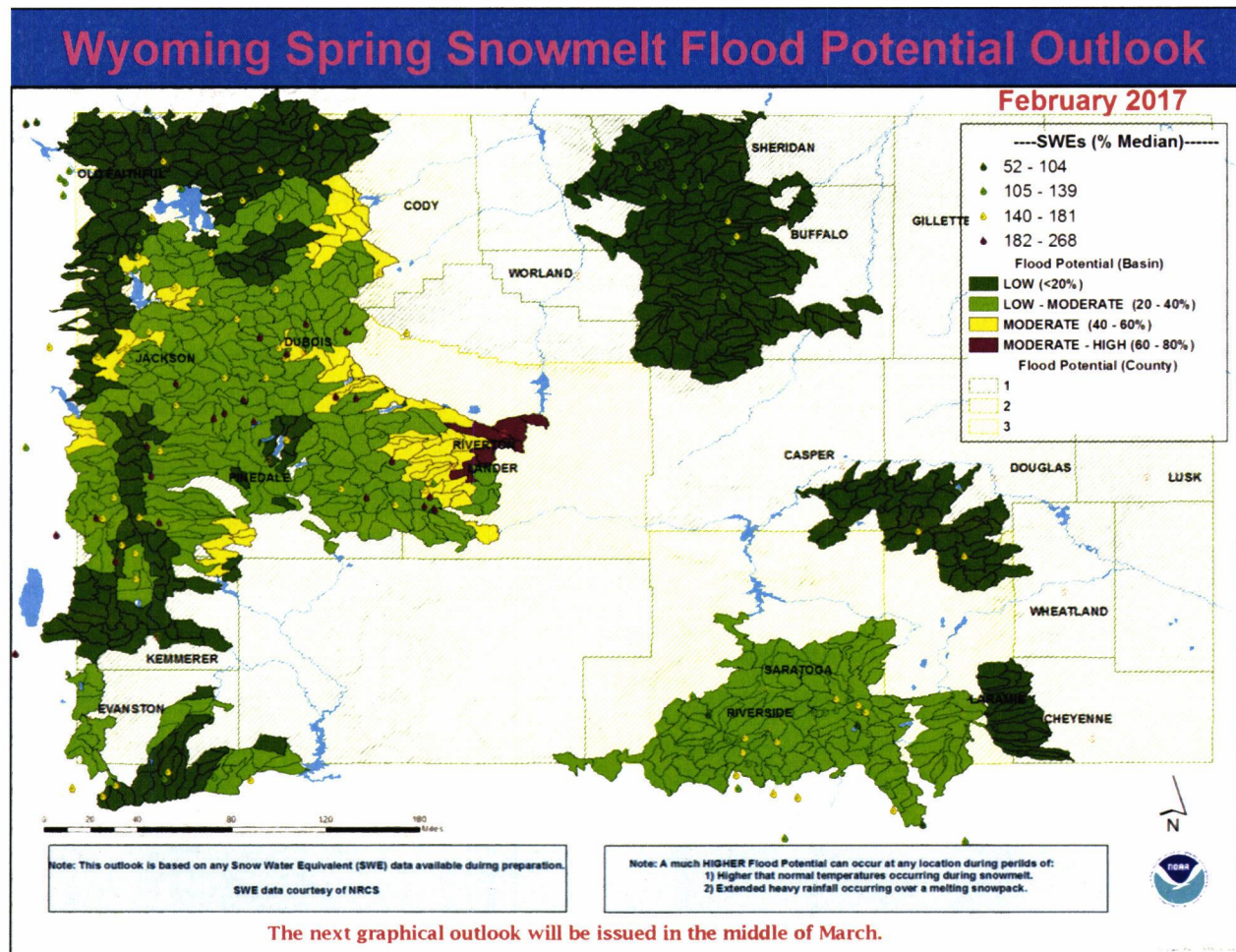


Figure 3: Spring flood potential forecast for the upper North Platte basin, based on anticipated rate of snowmelt and reservoir storage. Note that this outlook does not incorporate abnormally high temperatures, which would accelerate snowmelt, or heavy precipitation events occurring during the snowmelt season. (http://www.weather.gov/riw/cms_snotel_quicklinks_graphs, accessed February 27, 2017)

Because of the factors discussed above, high spring flows along the North Platte River are anticipated to occur before the 2017 irrigation season begins. The Applicant and its partner, the North Platte NRD, believe that these flows will be in excess of both PRRIP target flows and state-protected flows that are required to be available prior to June 1.

3.0 Beneficial Use of Canal Recharge

3.1 Canal Recharge and Stream Baseflow Accretions

Applicant and the North Platte NRD have previously partnered to divert excess flows for groundwater recharge, which subsequently enhances the stream baseflow in the North Platte

Attachment B

River. Previous diversion projects in the North Platte NRD occurred in the spring and fall of 2011, as well as the spring of 2016. Below is a set of tables detailing the canals that were used for groundwater recharge during these previous events, along with the estimated amount of recharge that occurred for each canal.

Table 1: Diversion and recharge data from Spring 2011 excess flow diversion project. Estimated recharge values may be refined based on Robust Review of integrated management activities, currently being undertaken by the Platte Basin Coalition and its consultants.

Spring 2011 Excess Flow Diversion Data					
Irrigation District/ Canal Company	Diversion Dates	Total Days Diverted	Total Diversion (AF)	Estimated Canal Loss %	Estimated Recharge (AF)
Pathfinder	4/1/11 - 4/15/11	15	12,718	55%	6,995
Farmers	4/5/11 - 5/7/11	33	20,288	49%	9,941
Enterprise	4/1/11 - 5/1/11	31	2,443	42%	1,026
Central	4/6/11 - 5/15/11	40	627	42%	263
Castle Rock	4/3/11 - 5/3/11	31	1,497	41%	614
Minatare	4/1/11 - 4/30/11	30	2,437	24%	585
Nine Mile	4/15/11 - 5/14/11	30	1,579	68%	1,074
Chimney Rock	4/1/11 - 5/1/11	31	1,004	45%	452
Belmont	4/1/11 - 5/1/11	31	2,084	53%	1,105
Lisco	4/13/11 - 5/13/11	31	2,229	32%	713
Total			46,906		22,767

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Table 2: Diversion and recharge data from Fall 2011 excess flow diversion project. Estimated recharge values may be refined based on Robust Review of integrated management activities, currently being undertaken by the Platte Basin Coalition and its consultants.

Fall 2011 Excess Flow Diversion Data					
Irrigation District/ Canal Company	Diversion Dates	Total Days Diverted	Total Diversion (AF)	Estimated Canal Loss %	Estimated Recharge (AF)
Central	9/24/11 - 10/29/11	36	1,028	34%	350
Castle Rock	10/5/11 - 11/12/11	39	1,077	43%	463
Minatare	10/1/11 - 11/2/11	33	2,380	29%	690
Nine Mile	9/14/11 - 10/24/11	41	1,106	68%	752
Chimney Rock	9/24/11 - 11/9/11	47	2,963	30%	874
Belmont	9/24/11 - 11/9/11	47	2,009	51%	1,015
Lisco	9/23/11 - 10/23/11	31	1,516	47%	713
Winters Creek	9/23/11 - 11/7/11	46	882	31%	269
Total			12,961		5,125

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Table 3: Diversion and recharge data from Spring 2016 excess flow diversion project. Estimated recharge values may be refined in the future based on additional model analyses.

Spring 2016 Excess Flow Diversion Data					
Irrigation District/Canal Company	Diversion Dates	Total Days Diverted	Total Diversion (AF)	Estimated Canal Loss %	Estimated Recharge (AF)
Minatare	5/17/16 - 5/19/16	3	50	24%	12
Lisco	4/14/16 - 4/18/16	5	155	32%	50
Mitchell	5/27/16 - 6/8/16	13	3,590	28%	1,005
Castle Rock	5/16/16 - 6/20/16	36	2,701	41%	1,108
Northport	5/17/16 - 6/6/16	21	3,905	81%	3,174
Belmont	4/1/16 - 6/09/16	70	7,150	53%	3,790
Farmers	6/1/16 - 6/15/16	15	19,765	94%	18,580
Total			37,316		27,718

Note that the recharge values in Tables 1 through 3 indicate the amount of water infiltrated into the aquifer and do not represent anticipated changes in stream baseflow that will result from these recharge projects. Anticipated stream baseflow benefits from previous excess-flow diversions will be calculated as part of the integrated management plan Robust Review, which is currently ongoing. DNR published a Technical Memorandum in January 2013 entitled, *Upper Platte River Recharge and Flood Mitigation Demonstration Project: Part of the Conjunctive Management Toolbox*, that provides some preliminary methods for calculating the streamflow benefits anticipated from the 2011 excess-flow diversions (Attachment E). Tables 2 and 3 of this Technical Memorandum summarize these initial calculations and are abstracted as Tables 4 and 5 below for reference.

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Table 4: Reproduction of Table 2 from DNR January 2013 Technical Memorandum, showing estimated annual baseflow accretions to Platte River system, in acre-feet, from 2011 excess-flows diversions. (*Upper Platte River Recharge and Flood Mitigation Demonstration Project: Part of the Conjunctive Management Toolbox*, DNR January 2013 Technical Memorandum, p. 9)

Year	NPNRD	SPNRD	TPNRD	TBNRD	CPNRD	Annual
2011	3	3	422	0	634	1,062
2012	83	44	853	21	671	1,672
2013	229	89	868	69	590	1,844
2014	328	105	805	104	511	1,853
2015	381	107	724	121	445	1,777
2016	405	102	644	126	392	1,669
2017	414	95	574	125	348	1,555
2018	413	88	513	121	311	1,446
2019	406	81	461	115	281	1,344
2020	396	75	416	109	255	1,251
2021	384	69	378	103	233	1,167
2022	371	64	345	97	214	1,091
2023	357	59	316	91	198	1,022
2024	343	55	291	86	183	959
2025	330	51	269	81	171	903
2026	317	48	250	77	159	851
2027	305	45	233	72	149	804
2028	293	42	218	68	140	761
2029	281	40	204	65	132	722
2030	271	38	191	62	124	685
2031	260	36	180	59	118	652
2032	251	34	170	56	111	621
2033	241	32	161	53	106	593
2034	233	30	152	51	100	567
2035	224	29	145	48	96	542
2036	216	28	138	46	91	519
2037	209	26	131	44	87	498
2038	202	25	125	43	83	478
2039	195	24	119	41	80	460
2040	189	23	114	39	77	442
2041	183	22	109	38	74	426
2042	177	21	105	36	71	410
2043	171	21	101	35	68	396
2044	166	20	97	34	66	382
2045	161	19	93	33	63	369
2046	157	18	90	32	61	357
2047	152	18	86	30	59	346
2048	148	17	83	30	57	335
2049	144	17	80	29	55	324
2050	140	16	78	28	53	315
2051	136	16	75	27	52	305
2052	132	15	73	26	50	296
2053	129	15	70	25	48	288
2054	126	14	68	25	47	280
2055	122	14	66	24	46	272

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Year	NPNRD	SPNRD	TPNRD	TBNRD	CPNRD	Annual
2056	119	13	64	23	44	265
2057	117	13	62	23	43	258
2058	114	13	61	22	42	251
2059	111	12	59	21	41	244
2060	108	12	57	21	40	238
10vr	3,056	787	6,281	911	4,439	15,474
50yr	11,341	1,913	11,991	2,753	8,171	36,168

Table 5: Portion of Table 3 from DNR January 2013 Technical Memorandum, showing estimated baseflow accretions to Platte River system, in acre-feet, from 2011 excess-flows diversions, by individual canals located in the North Platte NRD. Canals downstream of Lake McConaughy have been removed. Data for certain canals shown in this table may differ from that shown in Tables 1 and 2 above; this likely reflect additional sources of information used to generate the values in Tables 1 and 2, which was not used in the DNR Technical Memorandum. (*Upper Platte River Recharge and Flood Mitigation Demonstration Project: Part of the Conjunctive Management Toolbox*, DNR January 2013 Technical Memorandum, p. 10)

Project	Spring Diversion	Fall Diversion	Total Diversion	Total Recharge	10-year Benefit	50-year Benefit
Pathfinder Canal	12,718	0	12,718	5,087	178	1,690
Farmers Canal	18,425	0	18,425	8,660	1,470	4,471
Enterprise Canal	2,559	0	2,559	1,689	287	872
Winters Creek Canal	0	882	882	42	7	22
Central Canal	524	1,022	1,545	331	56	171
Castle Rock Canal	1,595	1,069	2,664	1,198	42	398
Minatare Canal	2,709	2,338	5,048	1,207	205	623
Nine Mile Canal	1,521	1,114	2,635	1,850	314	955
Chimney Rock Canal	948	2,965	3,913	1,049	178	542
Belmont Canal	2,241	2,965	5,206	2,789	98	926
Lisco Canal	2,229	1,516	3,746	1,301	221	672
Totals:	45,469	13,871	59,341	25,203	3,056	11,342

The information presented in Tables 4 and 5 will also be reviewed during the Robust Review process and may not represent final accepted values. The magnitude and timing of streamflow benefits from excess-flow diversion events are clear from these tables, however, and indicate the streamflow benefits that may be expected from additional excess-flow diversions, such as that proposed in this application.

3.2 Integrated Management Plan and PRRIP Benefits

The recharge and baseflow accretion benefits described in Section 3.1 above provide offsets for groundwater depletions to streamflow from post-1997 uses, as required by the joint IMP adopted

Attachment B

by the North Platte NRD and DNR, as well as the basinwide integrated management plan, to which the North Platte NRD and DNR are parties. In addition, the streamflow accretions realized from canal recharge provide water toward PRRIP goals of reducing shortages to target flows by 130,000 to 150,000 acre-feet per year. Because streamflow benefits accrue to the river over a long period of time, the total benefits from excess-flow diversions for recharge continue to materialize decades after the diversion events themselves. These long-term accretions will ensure that the North Platte NRD and the State of Nebraska continue to meet their respective depletion-offset obligations into the future.

The proposed temporary appropriation for excess-flow diversion will provide additional depletion-offset water toward meeting IMP and PRRIP goals. As with previous excess-flow diversions, the benefits from diverting excess flows under the proposed appropriation will continue to accrue to the North Platte River for many years, which will assist the NRD and Nebraska in meeting the goals of the next increment of IMPs. Groundwater recharge, streamflow accretion, and depletion offsets are all recognized beneficial uses of surface water, particularly in a fully or overappropriated area. The temporary appropriation requested here, if granted, will be put to beneficial use through the partnership between Applicant and the North Platte NRD, as outlined in the contract and 2017 task order included as Attachment D to this application.

4.0 Effects on other appropriators

The excess flows discussed in Section 2.0 above are expected to be more than sufficient to provide for PRRIP target flows, as well as for "state-protected flows," a term of art intended to encompass flows needed to satisfy appropriators whose appropriations may be in priority at a given point in time. During the non-irrigation season, this term includes water that Central Nebraska Public Power and Irrigation District could expect to flow into Lake McConaughy, when its appropriations are in priority. These flows also include water for instream-flow and other excess-flow appropriations held by entities downstream of Lake McConaughy, including the Central Platte NRD.

The temporary appropriation sought under this application will receive a 2017 priority date, if granted, and will be permitted to divert when the appropriation is in priority. Just as with any other surface-water appropriation along the North Platte River, the Applicant will not be able to divert excess flows unless and until senior downstream appropriators are satisfied, and the appropriation will be subject to water administration. In an excess-flow event, however, streamflow is consistently present in quantities that will satisfy all in-priority appropriations, as well as PRRIP target flows. Consequently, the granting of this proposed temporary appropriation will have no adverse effect on downstream senior appropriators.

Attachment B

5.0 Conclusion

Chimney Rock Irrigation District requests this temporary appropriation for the purpose of diverting excess flows during the non-irrigation season. Diverted water will be run through the Applicant's main canal, and that water which is not spilled back to the river will be allowed to soak away through the canal perimeter to recharge the aquifer. The Applicant has partnered with the North Platte NRD to accomplish this project, which will provide streamflow accretions that assist the NRD and the State of Nebraska in meeting IMP and PRRIP streamflow goals. The Applicant has presented information showing the likelihood of excess flows being available during the non-irrigation season, as well as an outline of the benefits to be expected from the beneficial use of water under the proposed appropriation.

THIS AGREEMENT entered into on this 14th day of October, 2016, by the NORTH PLATTE NATURAL RESOURCES DISTRICT, hereinafter referred to as the "DISTRICT," and CHIMNEY ROCK IRRIGATION DISTRICT, hereinafter referred to as the "IRRIGATOR."

WITNESSETH:

WHEREAS, the Irrigator has surface water appropriation(s) for natural flow from the North Platte River and/or its tributaries and the necessary conveyance structure(s) to transmit such natural flow; and

WHEREAS, the District and the Nebraska Department of Natural Resources have jointly developed and agreed to implement an integrated management plan (IMP) which describes investigating projects to enhance and improve water supply, including the development of new infrastructure and other groundwater projects for the purpose of providing net accretions to the river; and

WHEREAS, the District or the Nebraska Department of Natural Resources may request the Irrigator to 1) divert natural flow into the Irrigator's delivery system during periods when streamflow is in excess of US Fish and Wildlife Service target flows and state-protected flows, without subsequent consumptive use for irrigation, in order to assist the District in its efforts to 1) achieve flood prevention and study groundwater recharge and/or groundwater discharge to streamflow, or 2) other projects with the purpose of meeting the goals and objectives of the IMP; and

WHEREAS, the Irrigator is willing to assist the District to meet the objectives of the IMP in exchange for compensation; and

NOW THEREFORE, in consideration of the mutual covenants made, the compensation agreed to, and other good and valuable consideration the receipt of which is hereby acknowledged, the parties agree as follows:

I. SCOPE OF SERVICES

The Irrigator will make available the diversion structures of the Chimney Rock canal and the services of a ditch rider or staff member, for the term of this Agreement, to assist District efforts to meet the objectives of the IMP, which may include, but not be limited to, the diversion of streamflows in excess of target flows and state-protected flows for the purpose of retiming streamflow, and any monitoring activities necessary to further understanding of the effects of such activities on streamflow. These efforts will be carried out in accordance with Task Authorizations developed under this Agreement and approved by the Irrigator and District. The purpose of this Agreement is to set forth the terms and conditions applicable to such efforts. During the term of this Agreement, the details of timing and payment shall be described and set forth in separate, numbered Task Authorizations, issued pursuant to the terms of this Agreement.

Should a particular Task Authorization ever require revision, such revision shall be accomplished through an amendment to that individual Task Authorization.

II. DURATION OF AGREEMENT

This Agreement is effective on the date signed by the last party and remains effective for five (5) years from the effective date. There will be no extension or renewal of this Agreement unless further agreed to in writing by the parties.

III. THE IRRIGATOR AGREES TO PERFORM AS FOLLOWS:

- A. The Irrigator agrees to divert, only upon request from the District and in accordance with a particular Task Authorization then in operation, up to 600 cfs of natural flow surface water and convey such water through its delivery system.
- B. The Irrigator further agrees not to apply to consumptive use for irrigation any of the water diverted subject to this Agreement.
- C. The Irrigator represents and affirms that, in accordance with all relevant regulations, statutes, and/or procedures, the Irrigator has complied or will comply with all requirements necessary to allow it to enter into this Agreement and perform all actions herein required. If the Irrigator has not complied, or in the future fails to comply, with all relevant regulations, statutes, and/or procedures, this contract is null and void.
- D. The Irrigator retains the right to suspend or terminate its performance under this Agreement 1) in the event of threatened damage to any of its facilities; 2) threatened injury or damage to the person or property of third parties; 3) if any provisions of the Agreement subjects any part of the Irrigator's appropriation to cancellation, reduction, or loss under the laws of the State of Nebraska then in effect; or 4) adversely affects its ability to provide irrigation service during its irrigation season. The Irrigator's sole judgement in these matters will control. In the event that the Irrigator must suspend or terminate its performance pursuant to this paragraph, then it shall promptly notify the District by telephone and in writing.

IV. THE DISTRICT AGREES TO PERFORM AS FOLLOWS:

- A. The District's total annual payment under the five (5) year term of this contract cannot exceed \$150 per cfs of excess flows diverted for flood relief and canal recharge.

- B. Payment will be made according to the terms of each Task Authorization, but not later than 6 months after the last date the Irrigator has diverted under the terms of any individual Task Authorization.
- C. The District will assist the Irrigator in obtaining all necessary permits from the Department for the purpose of diverting excess flows under this agreement.

V. THE PARTIES MUTUALLY AGREE AS FOLLOWS:

- A. The parties agree that Irrigator has retained and reserved the rights to any additional water that it would be entitled to receive under agreements and contracts between the Bureau of Reclamation or any other entity and the Irrigator that are outside of the provisions of this Agreement.
- B. In executing this Agreement, the parties shall comply with all other applicable state and federal laws.

CHIMNEY ROCK IRRIGATION DISTRICT (IRRIGATOR)

Tom Mc President 10-14-16
Name and Title Date

NORTH PLATTE NATURAL RESOURCES DISTRICT (DISTRICT)

John Berge General Manager 10/14/16
Name and Title Date

MARCH 1, 2017, TASK ORDER #17-1 TO NORTH PLATTE NATURAL RESOURCES DISTRICT AGREEMENT #6 FOR EXCESS FLOW DIVERSIONS

I. THE IRRIGATOR AGREES TO PERFORM AS FOLLOWS:

- A. The Irrigator agrees to divert natural flow surface water and convey such water through its delivery system, beginning when directed by the Nebraska Department of Natural Resources (NDNR) Bridgeport Field Office Supervisor after April 1, 2017, as needed to alleviate flooding conditions on the North Platte River, or to take advantage of excess flows available in the North Platte River. The period of diversion for this purpose will be the duration of the excess flow event, from the beginning date of this task order and until the excess flows of such event are no longer available. To receive any compensation under North Platte Natural Resources District (District) Agreement 6, the Irrigator must in good faith divert flows into its system and convey such water for the period of time designated above and as directed by NDNR's Bridgeport field office and the District but which cannot be quantified precisely at this time. A flat rate fee payable to the Irrigator will be agreed upon by all parties prior to diversion of any excess flows.
- B. Prior to the date of the end of the excess flow event, as determined by NDNR, the Irrigator retains the right to suspend or terminate its performance under this Agreement 1) in the event of threatened damage to any of its facilities; 2) threatened injury or damage to the person or property of third parties; 3) if any provisions of the Agreement subjects any part of the Irrigator's appropriation to cancellation, reduction or loss under the laws of the State of Nebraska, then in effect; 4) adversely affects its ability to provide irrigation service during its irrigation season; or 5) the Irrigator commences irrigation deliveries. The Irrigator's sole judgement in these matters will control. In the event that the Irrigator must suspend or terminate its performance pursuant to this paragraph, then it shall promptly notify the District by telephone and in writing. In such events, the District will accordingly determine, based upon the benefit received, any reduction in the payment made to Irrigator.

II. THE DISTRICT AGREES TO PERFORM AS FOLLOWS:

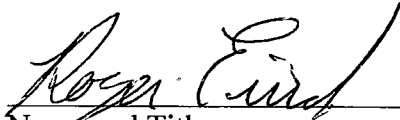
- A. Payment will be for no more than \$150 per cfs diverted for flooding mitigation and canal recharge, and will be provided not later than ninety (90) days following the conclusion of diversion for these purposes.
- B. The District will work with NDNR to determine the measurements or methods needed to estimate project benefits (e.g. diversions and return flows). The District will make the agreed-upon measurements in conjunction with NDNR.

III. OTHER CONDITIONS

- A. FORCE MAJEURE - The Irrigator shall not be liable for any delay or failure to perform its obligations under this Agreement caused by an event or condition beyond the reasonable control, and not caused by the fault or negligence, of the Irrigator, including, but not limited to, failure of facilities, flood, earthquake, storm, lightning, fire, severe cold or other weather event, which delays or prevents performance, which the Irrigator could not reasonably have avoided by exercise of due diligence and foresight. Upon the occurrence of such an event or condition, the obligations of the Irrigator under this Agreement shall be excused and suspended without penalty or damages, provided that the Irrigator shall give the District prompt notice of such event or condition. In such events, the District will accordingly determine, based upon the benefit received, any reduction in the payment made to Irrigator.


- B. LIABILITY – Except for injury or damage caused by the District’s intentional or grossly negligent acts, the District shall not be liable or held responsible for any injury or damage to the Irrigator’s facilities, personnel, or equipment, or any other person or entity’s property.

CHIMNEY ROCK IRRIGATION DISTRICT (Irrigator)

 Vice President
Name and Title

3-14-17
Date

NORTH PLATTE NATURAL RESOURCES DISTRICT (District)

 General Manager
John Berge, General Manager

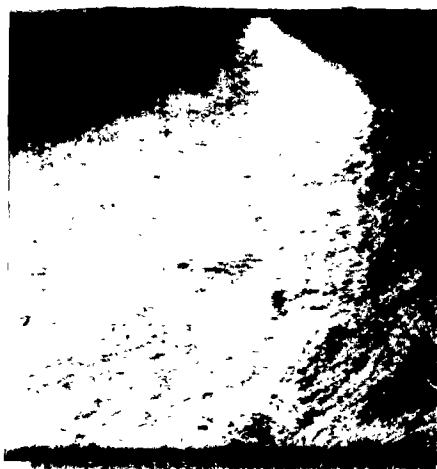
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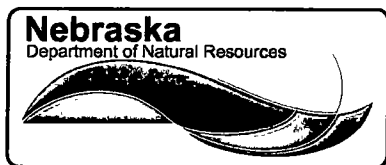
**Nebraska Department of Natural Resources
Integrated Water Management Division**

**Upper Platte River Recharge and Flood
Mitigation Demonstration Project:**

Part of the Conjunctive Management Toolbox



Technical Memorandum- January 2013



Integrated Water Management Division
Nebraska Department of Natural Resources

Technical Memorandum

This technical memorandum (TM) is intended to provide a brief or preliminary summary of a project or experiment without extensive technical analysis. It is not intended to be so in depth that one be able to recreate the experiment based upon the information given, but rather to present a broad overview of the methods and analysis while highlighting the results and conclusions. Although the content is of a technical manner, the TM should be understood by an audience with a general scientific background.

Acknowledgements

The Department would like to thank the natural resources districts and the Irrigation Districts for their hard work, collaborative efforts, and perseverance in carrying out this project. Cooperators include: Central Platte, North Platte, South Platte, Tri-Basin, and Twin Platte Natural Resources Districts; Bridgeport Irrigation District; Castle Rock Irrigation District; Central Irrigation District; Central Nebraska Public Power and Irrigation District; Chimney Rock Irrigation District; Cozad Canal Company; Enterprise Irrigation District; Farmers Irrigation District; Keith Lincoln County Irrigation District; Lisco Irrigation District; Minatare Canal Company; Nebraska Public Power District; Nine Mile Irrigation District; Pathfinder Irrigation District; Paxton-Hershey Water Company; Platte Valley Irrigation District; South Side Irrigation Company; Suburban Irrigation District; Thirty Mile Canal Company; Western Irrigation District; and Winters Creek Canal Company. Without the efforts of all of these parties, this project would not have been as successful.

Funding for the project includes the Central Platte, North Platte, South Platte, Tri-Basin, and Twin Platte Natural Resources Districts; and the Nebraska Environmental Trust.

1.0 Summary

Twenty-one irrigation districts participated in the Spring 2011 Recharge and Flood Mitigation project during the months of April and May. Twenty irrigation districts participated in the Fall 2011 Recharge and Flood Mitigation project during the months of September through December. In order to quantify the volume of water that was recharged by the canals, canal losses were developed for each canal. Canal losses were calculated using diversion and spill discharge measurements or were estimated from existing data sources. Based on the diversion records and calculated losses, recharge volumes were calculated by canal and summarized by natural resource district (NRD). Recharge volumes for each canal were used in conjunction with response functions developed by the technical committee under the Platte Basin Habitat Enhancement Program (PBHEP) to calculate estimated accretions/depletions to the Platte River.

2.0 Method

A total of 23 canals that divert water from the North Platte River, the South Platte River, and Platte River participated in the 2011 Recharge Project in the spring, fall, or both. Each individual canal began diverting at different times depending upon permit requirements and readiness of the canal and its operators. Average daily diversions were used to determine the amount of water that entered each canal for a total of 30 days during the spring. Average daily diversions were used to determine the amount of water that entered each canal subsequent to irrigation operations during the fall. Average daily diversions were used until diversions stopped in the fall, regardless of the number of days. Several of the canals were forced to shut down their canals during the recharge time period due to extreme weather conditions or to make repairs on the canal. The period of time for those canals was extended to include 30 days of actual diversions, with the exception of Pathfinder Irrigation District. Pathfinder Irrigation district did not participate for the full 30 days during the spring due to additional operational requirements of the district.

The Department of Natural Resources' (Department) Bridgeport Field Office was tasked with conducting and coordinating discharge measurements at the spill locations for each canal in order to do water balance calculations. Due to demands on the field office associated with the high water levels during the 2011 water year, a number of canal spills went unmeasured. If canal spill measurements were available, water balance calculations were conducted to determine the percentage of the total diversion that was lost. If measurements were not available, estimates of canal loss were taken from the STELLA model developed under the COHYST 2010 project. Estimated and calculated canal losses were compared against historical seepage measurements and operational efficiencies used and developed by the irrigation districts. Table 1 summarizes the participating projects, the method used to determine canal loss, and the total number of days considered during the spring and fall.

Irrigation Project	Method	Spring Diversion Days	Fall Diversion Days
Pathfinder Canal	Measurement	15	0
Farmers Canal	Measurement	30	0
Enterprise Canal	Measurement	30	0
Winters Creek Canal	Measurement	0	46
Central Canal	Measurement	30	36
Castle Rock Canal	Measurement	30	39
Minatare Canal	Measurement	30	33
Nine Mile Canal	Measurement	30	41
Chimney Rock Canal	Measurement	30	47
Belmont Canal	Seepage Runs	30	47
Lisco Canal	Measurement	30	31
Keith Lincoln Canal	Measurement	30	37
Suburban Canal	Measurement	30	33
North Platte Canal	Model	30	31
Paxton Hershey Canal	Model	30	45
Phelps County Canal	Measurement	0	100
Thirty Mile Canal	Model	30	32
Orchard Alfalfa Canal	Model	30	38
Gothenburg Canal	Model	30	34
Cozad Canal	Model	30	31
Dawson Co. Canal	Model	30	34
Kearney Canal	Model	30	9
Western Canal	Measurement	30	75
Western Ponds	Measurement	41	49

Table 1: Projects diverting excess Platte River basin flows for flood mitigation and seepage demonstration during the spring and fall of 2011.

2.1 Measured Canal Loss & Recharge Volume

Water balance calculations were performed on the canals when and where discharge measurements of the spills were available. Some canals had only one spill measurement while other canals had several. For each spill measurement taken the rate of water measured at the canal spill was subtracted from the average daily diversion rate to determine the rate of canal loss. The loss was then divided by the average daily rate of diversion to calculate a daily loss as a proportion of the total volume of water diverted. The equations used are shown below. For canals with multiple measurements the average loss was calculated and used in the next step of the analysis. An example is given below from the Minatare Canal. Four spill measurements were taken with loss rates calculated as 21 percent, 25 percent, 23 percent, and 36 percent. The average value for these calculations is 26 percent. To estimate a total volume of diverted water that seeped into the ground or recharged, the average loss value was multiplied by the volume

diverted. The volume diverted was calculated based upon multiplying the average daily diversion rate (in cubic feet per second) for each day by 1.9835, converting it to a daily volume (acre-feet per day). The daily volumes were summed to calculate the total volume diverted. For Minatare, the total spring diversion was 2,709 acre-feet (AF) and the average loss value was 26 percent. The resultant recharge volume is 704 AF.

$$\text{Canal Loss \%} = \left(\frac{\text{daily diversion rate} - \text{rate measured at spill}}{\text{daily diversion rate}} \right) * 100\%$$

This equation simplifies as follows:

$$\begin{aligned} \text{Canal Loss \%} &= \left(\frac{\text{daily diversion rate}}{\text{daily diversion rate}} - \frac{\text{rate measured at spill}}{\text{daily diversion rate}} \right) * 100\% \\ &= \left(1 - \frac{\text{rate measured at spill}}{\text{daily diversion rate}} \right) * 100\% \end{aligned}$$

The final simplified equation is the version used in the spreadsheet calculations (see appendix A).

Minatare					
Date	Diversion Rate (cfs)	Measured at Spill (cfs)	Spill Location	Loss	
4/5/2011	48	37.7	Minatare Spill	21%	
4/13/2011	44	33.1	Minatare Spill	25%	
4/20/2011	40	30.9	Minatare Spill	23%	
4/26/2011	49	31.3	Minatare Spill	36%	
				Measured:	26%
				*Estimated:	
				Used:	26%

$$\text{Canal Recharge} = \text{Canal Diversion} * \frac{\text{Canal Loss \%}}{100\%}$$

$$\text{Minatare Canal Recharge} = 2709 \text{ AF} * \frac{26\%}{100\%} = 704 \text{ AF}$$

2.2 Modeled Canal Loss & Recharge Volume

Estimates of average canal loss based upon total water diverted were obtained from the STELLA model. The loss estimates in the STELLA model were developed by HDR Engineering, Inc. for

the COHYST study. Loss estimates from the STELLA model were calculated at 32 percent¹ of the canal's total diversion. For example, Paxton Hershey Canal did not have measured spill data, the total volume diverted was 1724 AF and the loss rate, from STELLA, was 32 percent so the calculated volume of water recharged was 552 AF.

2.3 Western Canal and Pond Loss & Recharge Volume

Western Canal losses were calculated using the water balance method based on discharge measurement at the canal's spill. In addition to the canal recharge, nine ponds were used as recharge pits to increase the overall amount of recharge to the system. Twin Platte Natural Resource District (TPNRD) placed staff gages at each of the pond sites and established volume quantities at each respective gage height. The staff gages were then read by TPNRD weekly to determine the rate of seepage per day for each pond. Recharge activities varied for each pond, but most of the ponds operated for 41 days. The recorded number of days for each pond was used to calculate the recharge at each site. Diversions into the pond were not used to adjust the water balance calculation when determining the loss along Western Canal. Most of the recharge ponds were not diverting water on the days where discharge measurements were conducted at the canal spill. In addition, the quantity of water diverted from the canal into the ponds was within the discharge measurement error band at the spill.

2.4 Accretions to the Platte River

Estimates of canal and pond recharge volume were combined with depletion functions developed by the technical committee under the PBHEP program to estimate the recharge effects on flows in the Platte River, or accretions. The depletion functions are defined for six zones within each NRD. Legal sections corresponding to the extent of the canal where water was routed were used to calculate an average zone number to determine the appropriate response curve. The depletion functions represent a fixed change that persists through time; therefore, an accretion function was developed to represent the recharge water occurring as a discrete pulse during a single year. This was accomplished by shifting the depletion function curve by one year (one time increment on the curve) and subtracting the shifted value from the original depletion function, thus creating a response function. The response function was then multiplied by the canal loss value to estimate Platte River accretions for the next 50 years. Figure 1 provides an example. Different canals and different distribution patterns regarding diverted flows create different temporal patterns of accretions (figure 2).

¹ Engel, J., unpublished data, COHYST 2010, Canal Seepage Estimates.
Upper Platte River Recharge and Flood Mitigation Demonstration Project:
Part of the Conjunctive Management Toolbox
Technical Memorandum – January 2013

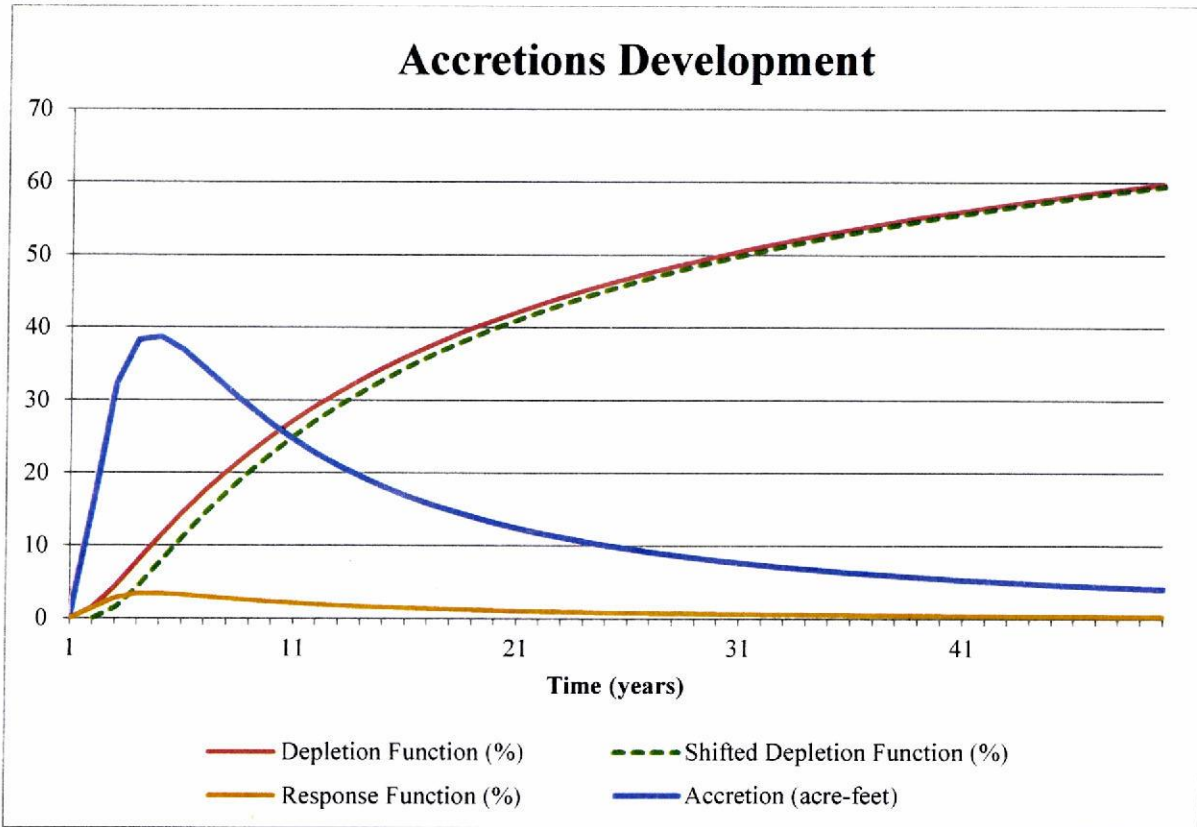


Figure 1: Cartoon illustrating temporal accretions estimation process using PBHEP zone functions (Depletion Functions) to create response function and estimated accretions. Below is a table showing the numbers used to generate the response function and an example of the calculations done to get the estimated accretions.

Year	1	2	3	4	5	6	7	8	9	10
Depletion Function (%)	0.083	1.496	4.353	7.737	11.155	14.412	17.442	20.234	22.800	26.684
Shifted Depletion Function (%)	0.000	0.083	1.496	4.353	7.737	11.155	14.412	17.442	20.234	22.800
Response Function (%)	0.083	1.413	2.857	3.384	3.419	3.257	3.030	2.792	2.565	2.357

Canal Loss = 1132 AF in year 1

$$Accretion_{year\ 1} = 1132\ AF * \frac{0.083\%}{100\%} = 0.94\ AF$$

$$Accretion_{year\ 10} = 1132\ AF * \frac{2.357\%}{100\%} = 26.68\ AF$$

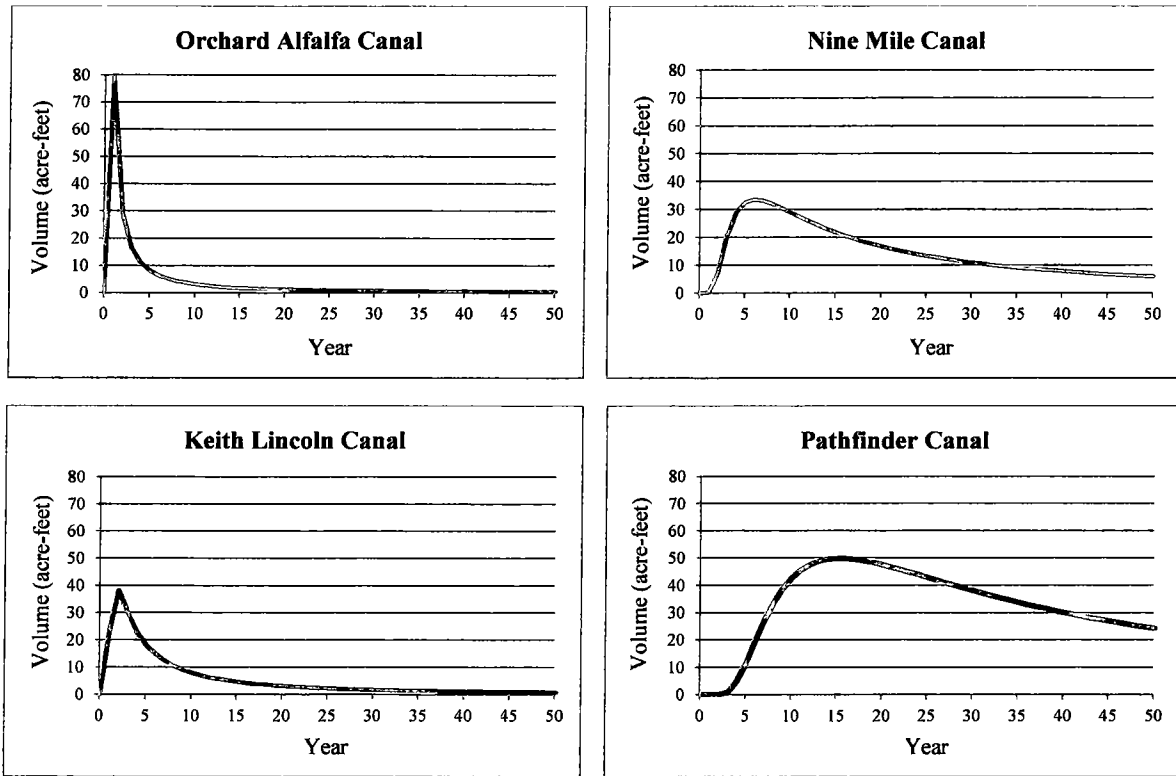


Figure 2: Accretions estimated from four different canals illustrating a variety of temporal patterns in estimated accretions to the Platte River.

3.0 Summary of Results

Results are summarized for each canal and the Western Canal Pond seepage project. These results are then aggregated by natural resources district. The estimated accretions to Platte River streamflow in each natural resources district is shown in table 2. These results estimate that the annual accretion during the first decade is approximately 1,000 to 1,500 AF per year and residual accretions greater than 500 AF per year will persist for 25 years. NRD specific estimates show a 50-year benefit to streamflow of between 2,000 and 12,000 AF, with total 50-year benefits around 36,000 AF. Table 3 presents the canal specific source data indicating that approximately 140,000 AF of water was diverted, of which about 65,000 AF is estimated to have seeped into groundwater storage. This indicates that much of the benefit from this single seepage demonstration may persist well beyond the 50-year planning horizon presented here. Water use and management practices in the interim will fundamentally effect the realization of these benefits, though this project has provided options that would not have been available if the Department and its collaborating partners had not taken the opportunity to divert and store abundant excess flows in the Platte River throughout 2011.

Year	NPNRD	SPNRD	TPNRD	TBNRD	CPNRD	Annual Total
2011	3	3	422	0	634	1062
2012	83	44	853	21	671	1672
2013	229	89	868	69	590	1844
2014	328	105	805	104	511	1853
2015	381	107	724	121	445	1777
2016	405	102	644	126	392	1669
2017	414	95	574	125	348	1555
2018	413	88	513	121	311	1446
2019	406	81	461	115	281	1344
2020	396	75	416	109	255	1251
2021	384	69	378	103	233	1167
2022	371	64	345	97	214	1091
2023	357	59	316	91	198	1022
2024	343	55	291	86	183	959
2025	330	51	269	81	171	903
2026	317	48	250	77	159	851
2027	305	45	233	72	149	804
2028	293	42	218	68	140	761
2029	281	40	204	65	132	722
2030	271	38	191	62	124	685
2031	260	36	180	59	118	652
2032	251	34	170	56	111	621
2033	241	32	161	53	106	593
2034	233	30	152	51	100	567
2035	224	29	145	48	96	542
2036	216	28	138	46	91	519
2037	209	26	131	44	87	498
2038	202	25	125	43	83	478
2039	195	24	119	41	80	460
2040	189	23	114	39	77	442
2041	183	22	109	38	74	426
2042	177	21	105	36	71	410
2043	171	21	101	35	68	396
2044	166	20	97	34	66	382
2045	161	19	93	33	63	369
2046	157	18	90	32	61	357
2047	152	18	86	30	59	346
2048	148	17	83	30	57	335
2049	144	17	80	29	55	324
2050	140	16	78	28	53	315
2051	136	16	75	27	52	305
2052	132	15	73	26	50	296
2053	129	15	70	25	48	288
2054	126	14	68	25	47	280
2055	122	14	66	24	46	272
2056	119	13	64	23	44	265
2057	117	13	62	23	43	258
2058	114	13	61	22	42	251
2059	111	12	59	21	41	244
2060	108	12	57	21	40	238
10yr Benefit	3056	787	6281	911	4439	15474
50yr Benefit	11341	1913	11991	2753	8171	36168

Table 2: Estimated annual accretions to the Platte River summarized by Natural Resources District. Units are acre-feet.

Project	Spring Diversion	Fall Diversion	Total Diversion	Total Recharge	10 year Benefit	50 year benefit
Pathfinder Canal	12718	0	12718	5087	178	1690
Farmers Canal	18425	0	18425	8660	1470	4471
Enterprise Canal	2559	0	2559	1689	287	872
Winters Creek Canal	0	882	882	42	7	22
Central Canal	524	1022	1545	331	56	171
Castle Rock Canal	1595	1069	2664	1198	42	398
Minatare Canal	2709	2338	5048	1207	205	623
Nine Mile Canal	1521	1114	2635	1850	314	955
Chimney Rock Canal	948	2965	3913	1049	178	542
Belmont Canal	2241	2965	5206	2789	98	926
Lisco Canal	2229	1516	3746	1301	221	672
Keith Lincoln Canal	1349	1914	3263	1676	833	1259
Suburban Canal	1230	1781	3010	1527	759	1147
North Platte Canal	2842	4245	7088	3616	1798	2716
Paxton Hershey Canal	1724	2483	4207	1691	425	1011
Western Ponds (TP)	0	0	0	3013	758	1801
Thirty Mile Canal	4134	5141	9275	2968	1640	2317
Orchard Alfalfa Canal	732	1871	2603	833	592	716
Gothenburg Canal	4641	5729	10370	3318	741	1915
Cozad Canal	1335	1714	3049	976	364	663
Dawson Co. Canal	2652	3450	6101	1952	104	741
Kearney Canal	4528	3832	8360	2675	997	1818
Phelps Canal	0	5558	5558	5163	911	2753
Western Canal (30% SP, 70% TP)	4528	15158	19687	9695	2439	5796
Western Ponds (SP)	0	0	0	392	55	174
Totals:	75,165	66,746	141,911	64,699	15,474	36,168

Table 3: Estimation of 10 and 50 year accretions to the Platte River by canal or contracting entity. Units are acre-feet.

Appendix A – Spreadsheet Calculations

A spreadsheet named *Recharge_2011_Final.xlsx* was developed to conduct the recharge calculations and is summarized according to the individual tabs of the spreadsheet below.

Tab 1: “2011_Seepage Extent”

This table is a tabulation of legal sections where water was routed in each canal. It is based upon data contained in maps provided by Irrigation Districts in coordination with the Department’s Bridgeport Field Office showing locations where water was routed during the project. These maps are available with the permit filings and can be obtained by contacting the Department.

Tab 2: “Response zone f’n”

Response functions corresponding to six zones for each natural resources district are included in this tab. Functions assume a permanent introduced stress and were developed by the PBHEP technical committee² using COHYST databases and the Hunt³ (1999) equation. Zone averages calculated by relating the section data from Tab 1 to the response function zone maps (Appendix B) are reported in this tab as well. The spatial relation was performed in ArcGIS. This tab also notates the natural resources district assigned to each canal, as well as the Response Function Zone.

Tab 3: “Total Diversions Spring”

Average daily diversion rates in cubic feet per second from April 1, 2011, through May 31, 2011, for each canal were imported into the spreadsheet from the Platte Water Accounting Program (PWAP) database⁴. Those rates were used to generate a daily volume of water, in acre-feet, diverted using the conversion factor of 1.9835. The gray cells represent the 30 days of diversions that were used to calculate the total acre-feet of water diverted during the recharge period.

Tab 4: “Recharge Rates Spring”

Data from the discharge measurement conducted by Department field office staff and provided by Tom Hayden were entered into the spreadsheet to determine the daily and average percentage of canal loss. Each measurement rate was compared to the average daily diversion rate to calculate a loss value for that day. Multiple daily loss values for one canal were averaged to arrive at a final loss values for a single canal. For canals where measurements were not available,

² Approved by the PBHEP administrators as part of the “Trial Protocol for PBHEP Funds” at the April 7, 2010, meeting in North Platte, NE (Platte Basin Habitat Enhancement Project. *Meeting of the PBHEP Administrators*. 7 April 2010) and, after editorial changes (Czaplewski, Mark. “FW: Revised PBHEP Protocol with Depletion Zone Figures.” Email to PBHEP Administrators. June 17, 2010), finalized on June 30, 2010 (Czaplewski, Mark. “PBHEP.” E-mail to PBHEP Sponsors and Partners. June 30, 2010).

³ Hunt, B. (1999), Unsteady Stream Depletion from Ground Water Pumping. *Ground Water*, 37: 98–102.

⁴ PWAP is an accounting program used by the Department of Natural Resources Bridgeport Field Office to apportion natural flow and track storage.

Appendix A – Spreadsheet Calculations

estimates from the COHYST 2010 STELLA model were entered. The canals are organized by natural resource districts.

Tab 5: “Div + Recharge by NRD Spring”

Based upon the data in the “Total Diversions Spring” tab and “Recharge Rates Spring” tab, the total volume of water recharged is calculated and listed in acre-feet for each canal. The canal diversions and recharge rates are then summarized and listed by natural resources district. Individual canal values relating to each of the NRDs were assigned according to the table in Tab 2 and are reported in the sheet. Because Western Canal is within the bounds of two NRDs, the canal recharge was distributed as 70 percent Twin Platte NRD and 30 percent South Platte NRD. Of the nine ponds utilized under Western Canal, seven of the ponds were located inside Twin Platte NRD and two ponds were located in South Platte NRD. The ponds were measured individually and diversions and canal recharge were assigned according to the NRD where they exist.

Tab 6: “Total Diversions Fall”

Average daily diversions rates in cubic feet per second from September 1, 2011, through November 14, 2011, for each canal were imported into the spreadsheet from the PWAP database. Those rates were used to generate a daily volume of water, in acre-feet, diverted using the conversion factor of 1.9835. Average daily diversions from September 1, 2011, through January 5, 2012, for the Phelps Canal were imported into the spreadsheet from the PWAP database. January diversions for the Phelps Canal are included in this report for 2011. The gray cells represent the days of diversions that were used to calculate the total acre-feet of water diverted during the recharge period.

Tab 7: “Recharge Rates Fall”

Data from the discharge measurement conducted by Department field office staff and provided by Tom Hayden were entered into the spreadsheet to determine the daily and average percent of canal loss. Each measurement rate was compared to the average daily diversion rate to calculate a loss value for that day. Multiple daily loss values for one canal were averaged to arrive at a final loss values for a single canal. For canals where measurements were not available, estimates from the STELLA model were entered. For the Phelps canal, daily monitoring and spill estimation information was provided by Cory Steinke from Central Nebraska Public Power and Irrigation District (CNPPID).

Tab 8: “Div + Recharge by NRD Fall”

Based upon the data in the “Total Diversions Fall” tab and “Recharge Rates Fall” tab, the total volume of water diverted and recharge is calculated and listed in acre-feet for each canal. The

Appendix A – Spreadsheet Calculations

canal diversions and recharge rates are then summarized and listed by natural resource districts. Individual canal values relating to each of the NRDs were assigned according to the table in Tab 2 and are reported in the sheet. Because Western Canal is within the bounds of two NRDs, the canal recharge was distributed as 70 percent Twin Platte NRD and 30 percent South Platte NRD. Of the nine ponds utilized under Western Canal, seven of the ponds were located inside Twin Platte NRD and two ponds were located in South Platte NRD. The ponds were measured individually and diversions and canal recharge were assigned according to the NRD where they exist.

Tab 9: “Total Recharge by NRD 2011”

Data from the “Div + Recharge by NRD Spring” and “Div + Recharge by NRD Fall” tabs are listed in this tab by canal and summed to show the total recharge during 2011.

Tab 10: “Spring Response”

Data from the “Div + Recharge by NRD Spring” and “Response zone f’n” tabs are incorporated in this tab by canal to create annual accretion functions and accretions by canal.

Tab 11: “Fall Response”

Data from the “Div + Recharge by NRD Fall” and “Response zone f’n” tabs are incorporated in this tab by canal to create annual accretion functions and accretions by canal.

Tab 12: “2011summary”

Data from the “Spring Response” and “Fall Response” tabs are incorporated in this tab to aggregate annual accretions by NRD. Data from the “Spring Response” and “Fall Response” tabs, as well the “Div + Recharge by NRD Spring,” “Div + Recharge by NRD Fall,” and the “Total Recharge by NRD 2011” tabs were used to create a diversions and benefits summary by canal.

Appendix B – Response Function Zone Maps by NRD

The following maps were drafted by the PBHEP administrators for the purpose of evaluating the expected relative effects of proposed projects. The maps were developed using simple distance calculations as well as location-specific information believed to influence the relative similarity or difference among projects geographically. The maps are considered draft and while informative are not intended to represent a definitive quantitative assessment of relative response. Modeling tools currently in development are anticipated to provide a more robust measure of the spatial distribution of meaningful response function zones that are expected to supersede these maps upon their completion. The attached maps illustrate the response function zones one (1) through five (5). Response zone 6 is assumed to be any remaining area within the respective natural resources districts.

Appendix B – Response Function Zone Maps by NRD

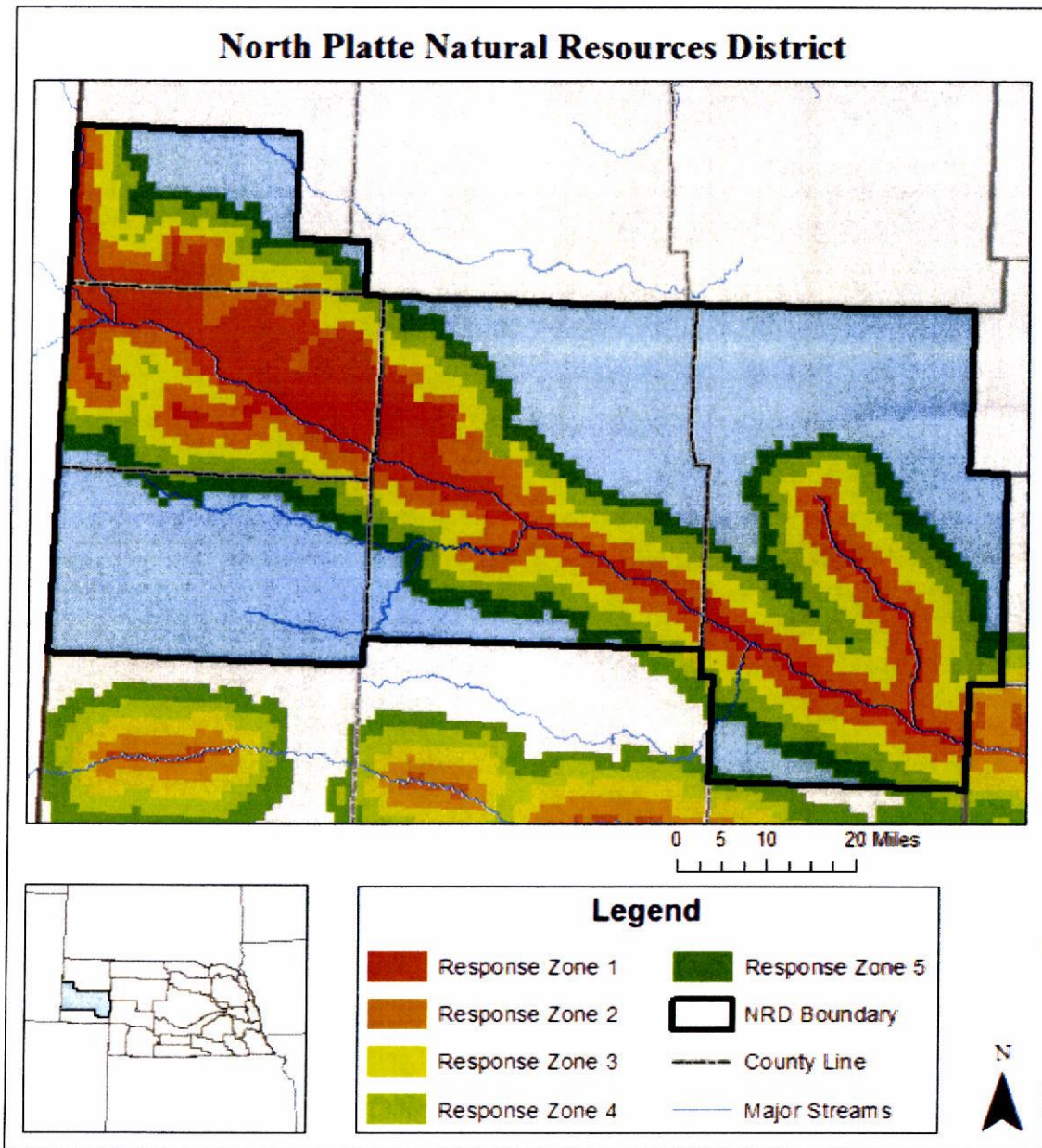


Figure 1: North Platte Natural Resources District response function zones.

Appendix B – Response Function Zone Maps by NRD

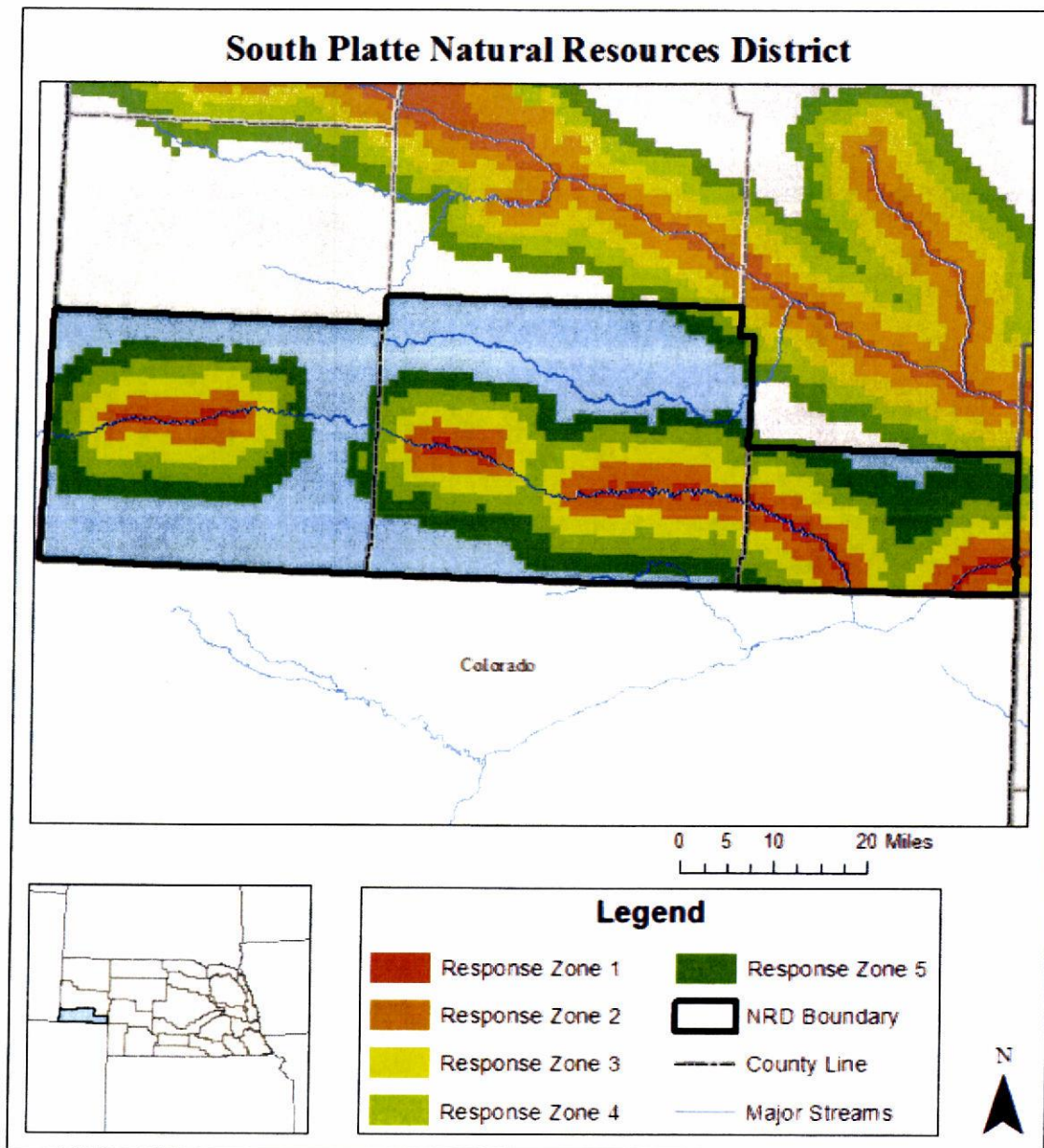


Figure 2: South Platte Natural Resources District response function zones.

Appendix B – Response Function Zone Maps by NRD

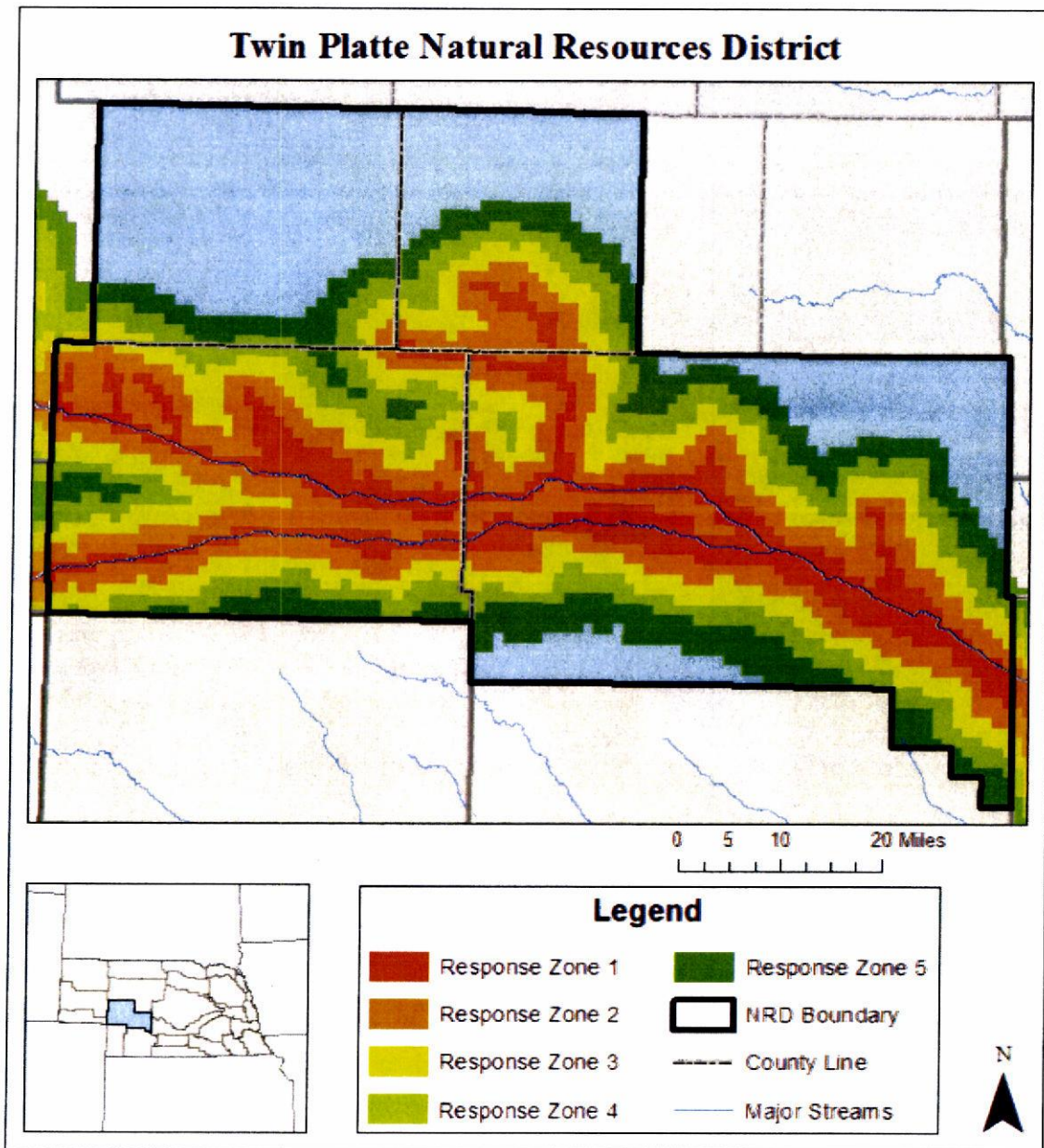


Figure 3: Twin Platte Natural Resources District response function zones.

Appendix B – Response Function Zone Maps by NRD

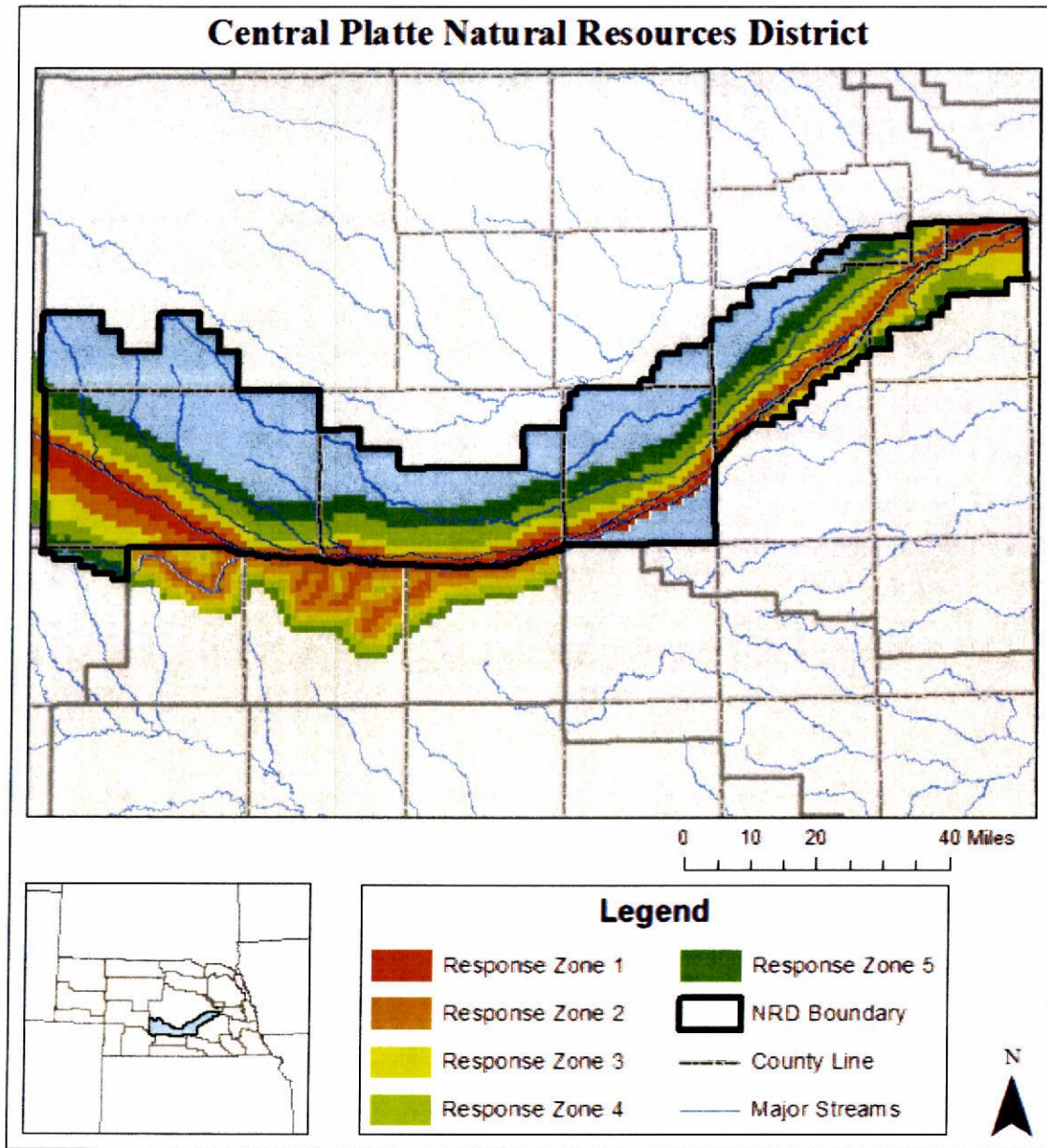


Figure 4: Central Platte Natural Resources District response function zones.

Appendix B – Response Function Zone Maps by NRD

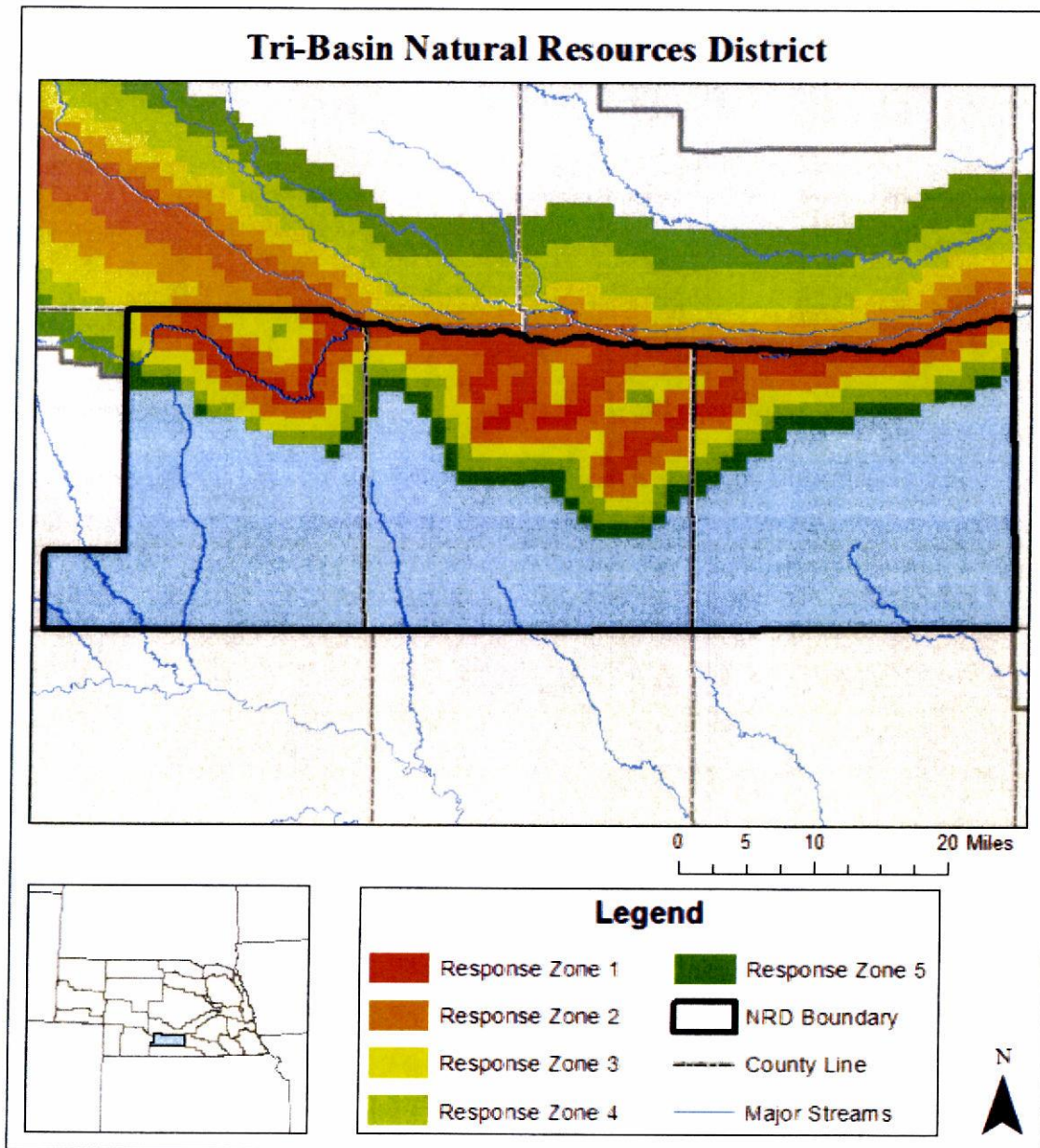


Figure 5: Tri-Basin Natural Resources District response function zones.