U.S. FISH & WILDLIFE SERVICE

INTERIOR REGION 7 – UPPER COLORADO RIVER BASIN

SAN LUIS VALLEY NATIONAL WILDLIFE REFUGE COMPLEX

DRAFT HABITAT MANAGEMENT PLAN

Joe Zinn

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ABBREVIATIONS

CCP	Comprehensive Conservation Plan
Dec	December
HMP	Habitat Management Plan
NWR	National Wildlife Refuge
Sept	September
SLVNWRC	San Luis Valley National Wildlife Refuge Complex
WRIA	Water resource inventory and assessment

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INTRODUCTION

The San Luis Valley National Wildlife Refuge Complex (SLVNWRC) Habitat Management Plan (HMP) is an operational document identifying priority restoration and infrastructure improvements that will be completed over the next five years (2021-2025). The SLVNWRC HMP encompasses three National Wildlife Refuges (NWR): Monte Vista, Alamosa, and Baca. HMP projects were largely determined based on the Complex's Comprehensive Conservation Plan (CCP; USFWS 2015) and various ecological assessments of Refuge lands (Striffler 2012, 2013a, 2013b; Heitmeyer and Aloia 2013a, 2013b. 2013c). These assessments and planning efforts identified strategies to restore ecosystem characteristics and function and improve habitat suitability for a wide array of migratory birds. Additionally, they helped identify management changes that would be more financially and ecologically sustainable.

HMP projects (Table 1) are described in the following pages, including ecological benefits and efficiencies gained (Table 2); operational considerations (Table 3); and spatial information (Figures 1-8). Relevant CCP goals and objectives and the ecological context used to make decisions supplement information in tables and figures to provide a more complete understanding of, and rational for, each project.

Implementation of this HMP will move the SLVNWRC towards a more ecologically and financially sustainable way of managing habitat resources while meeting the purposes of each refuge and fulfilling the needs of wildlife populations. The HMP is designed as a working document and Refuge staff will apply adaptive management concepts as we learn more, through habitat monitoring, and make adjustments when necessary and develop new management strategies where and when appropriate.

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TABLE 1. SAN LUIS VALLEY NATIONAL WILDLIFE REFUGE COMPLEX HMP PROJECTS SUPPORT MULTIPLE USFWS PRIORITIES.

Projects	*Priorities: Regional Director*	*Priorities: Assistant Regional Director, Refuges*	*Priorities: SLVNWRC CCP*
Monte Vista NWR			
I. Restore hydrology of Spring Creek channel		▪ Optimize use of ground and surface water ▪ Restore habitat and meet population objectives ▪ Control invasive species ▪ Ecological sustainability and improved efficiency	Landscape Conservation & Native Ecological Community Conservation goals and objectives
II. Restore hydrology of Units 14, 15, and 16			
III. Restore hydrology and improve water flow in Units 18 and 24			
Alamosa NWR			
I. Restore hydrology of Mumm Well area		▪ Optimize use of ground and surface water ▪ Restore habitat and meet population objectives ▪ Control invasive species ▪ Ecological sustainability and improved efficiency	Landscape Conservation & Native Ecological Community Conservation goals and objectives
II. Restore hydrology of Units C1, T, O, and P			
III. Restore hydrology and improve water inputs into riparian habitat			
IV. Protect/Restore ~ 180 acres of riparian habitat			
Baca NWR			
I. Restore hydrology of wet meadows in Crestone, Spanish, Willow, Cottonwood, and Deadman Creek drainages		▪ Optimize use of ground and surface water ▪ Restore habitat and meet population objectives ▪ Control invasive species ▪ Ecological sustainability and improved efficiency	Landscape Conservation & Native Ecological Community Conservation goals and objectives
II. Protect/restore riparian/stream habitat by constructing ungulate proof exclosures on Crestone, Willow, Cottonwood, and Deadman Creeks			

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TABLE 2. HABITAT MANAGEMENT PLAN PROJECTS, SUB-ACTIVITIES, ECOLOGICAL AND/OR HUMAN SAFETY BENEFITS, EFFICIENCY GAINED, AND KEY METRICS USED IN FIELD ASSESSMENTS/OBSERVATIONS.

Projects and Sub-Activities (Sequential Order)	*Ecological and/or Human Safety Benefits*	*Efficiency Gained*	*Key Metrics*
Monte Vista NWR Project I: Restore Hydrology of Spring Creek Channel			
A: Remove ditch banks and fill in existing channelized Spring Creek ditch and partially fill the Sanderson Ditch	Reduce drainage and improve water holding capacity	Increase water holding capacity in floodplain	Increased groundwater levels
	Improve surface water flow/connectivity in floodplain	Improved water management ability	Extent and quality of desirable plant community
	Increase quality of desired short emergent habitat in floodplain	Reduced infrastructure maintenance needs	
	Improve flooding/water holding capacity/duration of floodplain soils	Reconnect active floodplain	
	Improve quality of desired short emergent habitat in floodplain		
B: Restore channel in historic location	Improve water conservation in context of management needs	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
	Increase quality of desired short emergent habitat in floodplain to benefit focal species		
	Increase quality of desired short emergent habitat in floodplain	Reduced infrastructure maintenance needs	
	Improve flooding/water holding capacity/duration of floodplain soils	Reconnect active floodplain	
	Improve quality of desired short emergent habitat in floodplain		
C: Install culvert in Spring Creek in Unit 14	Increase quality of desired short emergent habitat in floodplain to benefit focal species	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
	Improve surface water flow/connectivity in floodplain	Improved water management ability	
D: Install water diversion structure and Parshall flume in Spruce Lawn ditch	Allows water to enter restored Spring Creek channel/floodplain east of Empire Canal (i.e., block water entering Spruce Lawn ditch	Improved water management ability	Extent and quality of desirable plant community
E: Remove north-south contour terraces and remove associated water control structures	Restoration of natural sheet flow within floodplain	Reduced infrastructure maintenance needs and water management labor	Extent and quality of desirable plant community
	Improve water conservation and efficiency in context of management needs	Reduced time/cost controlling invasive plants	Invasive plant species cover
	Improve quality of desired short emergent vegetation	Reconnect active floodplain	
	Reduced presence of invasive plant species		
Monte Vista NWR Project II: Restore hydrology of Units 14, 15, & 16			
A: Remove contour terraces and associated water control structures in Units 15 & 16	Improve water conservation in context of management needs	Reduced infrastructure maintenance needs and water management labor	Extent and quality of desirable plant community (wetland and upland)
	Improve quality of desired short emergent habitat to benefit focal species	Improved water management ability	Invasive plant species cover
	Improve water flow/connectivity of wetland habitat	Improve ability to manage desirable plant community	
	Improve upland vegetation conditions	Reduced time/cost controlling invasive plants	
	Manage expansion of invasive plant species		
B: Install water control structure (Unit 14)	Improve water flow to wetland habitat	Increased amount of water availability	Maintain water control capability
	Improve water control operation capabilities	Increased water management efficiency	Extent and quality of desirable plant

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Projects and Sub-Activities (Sequential Order)	*Ecological and/or Human Safety Benefits*	*Efficiency Gained*	*Key Metrics*
			community
	Improve quality of desired short emergent vegetation	Improve ability to manage desirable plant community	
C: Remove ditches and associated water control structures in Units 14 & 16	Reduce drainage and improve water conservation in context of management needs	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
Monte Vista NWR Project III: Restore hydrology and improve water flow in Units 18 & 24			
A: Replace water control structure out of Bowen Pond	Improve water control operation capabilities	Increased water management ability	Maintain water control capability
	Improve water flow to wetland habitat	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
	Improve/maintain hydrologic conditions for colonial waterbird nesting rookery		Colonial waterbird presence/use
B: Replace large culvert crossing in Bowen Drain	Improve water control operation capabilities	Increased water management ability	Maintain water control capability
C: Re-construction of east embankment of Bowen Pond	Improve/maintain hydrologic conditions for colonial waterbird nesting rookery	Improve/maintain ability to manage desirable plant community	Colonial waterbird presence/use
			Maintain water control capability
D: Install low water crossing in road in the northeast corner of Bowen Pond	Improve water flow/connectivity of wetland habitat	Increased water management ability	Maintain water control capability
E: Remove ditch in Unit 24	Improve water flow/connectivity of wetland habitat	Increased water management ability	Extent and quality of desirable plant community
	Improve water conservation in context of management needs	Improve ability to manage desirable plant community	Invasive plant species cover
	Improve quality of desired short emergent habitat to benefit focal species	Reduced time/cost controlling invasive plants	
	Improve upland vegetation conditions		
	Manage expansion of invasive plant species		
F: Remove drain ditches and associated water control structures surrounding old farm field in Unit 18	Improve water flow/connectivity of wetland habitat	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
	Improve quality of desired short emergent habitat to benefit focal species	Increased water management efficiency	
	Reduce drainage and improve water holding capacity	Increase water holding capacity in natural wetland areas	Increased groundwater levels
	Improve water conservation in context of management needs	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
Alamosa NWR Project I: Restore hydrology of			

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Projects and Sub-Activities (Sequential Order)	*Ecological and/or Human Safety Benefits*	*Efficiency Gained*	*Key Metrics*
Mumm Well area			
A: Remove ditch/ditch bank and associated water control structures in Unit J	Improve water flow/connectivity of wetland habitat	Improved water management ability	Extent and quality of desirable plant community
	Improve water conservation in context of management needs	Improve ability to manage desirable plant community	Invasive plant species cover
	Improve quality of desired short emergent habitat to benefit focal species	Reduced time/cost controlling invasive plants	
B: Remove Unit N1 contour terrace and associated water control structures	Restoration of natural sheet flow within wetlands	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
	Improve water conservation and efficiency in context of management needs	Reduced infrastructure maintenance needs and water management labor	Invasive plant species cover
	Improve quality of desired short emergent vegetation	Reduced time/cost controlling invasive plants	
	Reduced presence of invasive plant species		
	Restoration of natural sheet flow within wetlands	Improved ability to manage desirable plant community	Extent and quality of desirable plant community
Alamosa NWR Project II: Restore hydrology of Units C1, T, O, and P			
A: Install new water control/diversion structures (numerous Units) and remove various water control/diversion structures not used or needed	Improve water flow to wetland habitat	Increased amount of water availability	Maintain water control capability
	Improve water control operation capabilities	Increased water management efficiency	Extent and quality of desirable plant community
	Improve upland vegetation conditions	Reduced time/cost controlling invasive plants	Invasive plant species cover
	Manage expansion of invasive plant species		
Alamosa NWR Project III: Restore hydrology and improve water inputs into riparian habitat			
A: Install water diversion structures in numerous ditches to facilitate water delivery to riparian habitats	Improve water control operation capabilities	Increased water management ability	Maintain water control capability
	Improve/maintain hydrologic conditions to maintain/promote riparian vegetation (willow and cottonwood) growth and extent	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
		Improve ability to manage desirable plant community	Extent and quality of desirable plant community
Alamosa NWR Project IV: Protect/Restore ~180 acres of riparian habitat			
A: Construct two ungulate proof exclosures adjacent to the Rio Grande	Minimize elk and deer browse on willow and cottonwood	Improve ability to manage desired plant community	Extent and quality of desirable plant community
	Increase growth, density, and extent of willow and cottonwood		Habitat patch size
			Abundance of southwestern willow flycatcher territories
Baca NWR Project I: Restore hydrology of wet meadows in Crestone, Spanish, Willow,			

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Projects and Sub-Activities (Sequential Order)	*Ecological and/or Human Safety Benefits*	*Efficiency Gained*	*Key Metrics*
Cottonwood, and Deadman Creek drainages			
A: Install water control/diversion structures within the creeks and lateral ditches	Improve water flow/connectivity of wetland habitat	Improved water management ability	Maintain water control capability
	Improve water conservation in context of management needs	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
	Improve quality of desired wet meadow habitat to benefit focal species	Reduced time/cost controlling invasive plants	Invasive plant species cover
	Improve water control operation capabilities	Increased water management efficiency	
	Restoration of natural sheet flow within wetlands		
B: Remove water control/diversion structures and abandon water delivery ditches	Improve water conservation and efficiency in context of management needs	Improve ability to manage desirable plant community	Extent and quality of desirable plant community
	Improve quality of desired short emergent vegetation	Reduced infrastructure maintenance needs and water management labor	Invasive plant species cover
	Reduced presence of invasive plant species	Reduced time/cost controlling invasive plants	
Baca NWR Project II: Protect/restore riparian/stream habitat by constructing ungulate proof exclosures on various creeks			
A: Construct ungulate-proof exclosures on Crestone Creek, Willow Creek, and Cottonwood Creek	Minimize elk and deer browse on willow and cottonwood	Improve ability to manage desired plant community	Extent and quality of desirable plant community
	Increase growth, density, and extent of willow and cottonwood to benefit neo-tropical migratory birds		Habitat patch size
	Improve stream habitat conditions to benefit native fish species.		Abundance of focal bird species
			Abundance of native fish species

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TABLE 3. SLVNWR COMPLEX HABITAT MANAGEMENT PLAN PROJECTS, SUB-ACTIVITIES, TIMELINE, AND OPERATIONAL CONSIDERATIONS.

			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
Monte Vista NWR Project I: Restore hydrology of Spring Creek Channel											
A: Fill in existing channelized Spring Creek ditch and partially fill the Sanderson Ditch	2021	Sept-Dec									
Push ditch banks into ditch and level/smooth soil (27,411 linear feet)					Contract	(28,002 yard^3 x $3/yard^3) $13,880			DU	$70,126	
Remove all associated water control/diversion structures					Contract	$600					
Administration (contract oversight)			BIO (10) WG (15)	$1,205							
A Total				**$1,205**		**$14,480**				**$70,126**	**$85,811**
B: Restore channel in historic location	2021	Sept-Dec									
Excavate portions of the historic channel to facilitate water flow					Contract	$14,000			DU	$6,000	
Administration (marking location, oversight)			BIO (30) WG (30)	$3,060	Contract						
B Total				**$3,060**		**$14,000**				**$6,000**	**$23,060**
C: Install culvert in Spring Creek in Unit 14	2021	Sept-Dec									
Purchase culvert with head and tail walls					Material	$4,000					
Install culvert					Contract	$2,500					
Administration (contract oversight)			BIO (5) WG (5)	$510							
C Total				**$510**		**$6,500**					**$7,010**
D: Install Water diversion structure and Parshall flume in Spruce Lawn Ditch	2021	Sept-Dec									
Purchase water diversion structure					Material				DU	$10,000	
Purchase Parshall Flume					Material					$10,000	
Install water diversion structure					Contract					$5,000	
Remove old measuring flume and install new Parshall Flume					Contract					$5,000	

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			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
Administration (contract oversight)			BIO (5) WG (5)	$510							
D Total				**$510**						**$30,000**	**$30,510**
E: Remove north-south contour terraces and road/contour terrace on east side of Unit 3	2021	Sept-Dec									
Place soil used to create contour terraces and road back into the borrow area (5,020 linear feet)					Contract	(6,135 yard^3 x $3/yard^3) $18,405					
Remove all associated water control structures					Contract	$500					
Administration (contract oversight)			BIO (10) WG (10)	$1,020							
E Total				**$1,020**		**$18,905**					**$19,925**
Monte Vista NWR Project I Grand Total = $166,316											
Monte Vista NWR Project II. Restore hydrology of Units 14, 15, & 16											
A: Remove contour terraces in Units 15 & 16	2022	April-Dec									
Place soil used to create contour terraces back into borrow areas (24,600 linear feet)					Contract	(49,200 yard^3 x $3/yard^3) $147,200					
Remove all associated water control structures					Contract	$2,400					
Administration (contract oversight)			BIO (10) WG (15)	$1,205							
A Total				**$1,205**		**$149,600**					**$150,805**
B: Install water control structure (Unit 14)	2022	April-Dec									
Purchase water control structure					Material	$5,000					
Remove old structure and install new water control structure					Contract	$2,500					
Administration (contract oversight)			BIO (5) WG (5)	$510							
B Total				**$510**		**$7,500**					**$8,010**
C: Remove ditches in Units 14 & 16	2022	April-Dec									

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			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
Push ditch banks into ditch to fill and, if needed, bring in fill material (4,460 linear feet)					Contract	(4,460 feet. x $1.50/feet) $6,690					
Remove all associated water control/diversion structures					Contract	$200					
Administration (contract oversight)			BIO (5) WG (5)	$510							
C Total				**$510**		**$6,890**					**$7,400**
Monte Vista NWR Project II Grand Total = $166,215											
Monte Vista NWR Project III. Restore hydrology and improve water flow in Units 18 & 24											
A: Replace water control structure out of Bowen Pond	2023	April-Dec									
Purchase water control structure					Material	$8,000					
Remove old water control structure and install new water control structure					Contract	$5,000					
Administration (contract oversight)			BIO (5) WG (5)	$510							
A Total				**$510**		**$13,000**					**$13,510**
B: Replace large culvert crossing in Bowen Drain	2023	April-Dec									
Purchase culvert with wing-walls					Material	$15,000					
Remove old culvert and install new culvert					Contract	$10,000					
Administration			BIO (8) WG (10)	$890							
B Total				**$890**		**$25,000**					**$25,890**
C: Reconstruction of east embankment of Bowen Pond	2023	April-Dec									
Raise level of existing bank by a minimum of 10 inches. Requires hauling and placing of pit-run (1,410 yd^3 or 2,115 tons)					Contract	$24,035					
Administration (contract oversight)			BIO (5) WG (20)	$1,065							

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			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
C Total				**$1,065**		**$24,035**					**$25,100**
D: Install low water crossing in road in the northeast corner of Bowen Pond	2023	April-Dec									
Purchase 40 feet of road matting					Material	$20,000					
Remove approx.. 3 feet of road height					Contract	$500					
Place road matting and haul in and place approx.. 20 cubic yards of pit-run					Contract	$2,000					
Administration (contract oversight)			BIO (10) WG (20)	$1,390							
D Total				**$1,390**		**$22,500**					**$23,890**
E: Remove Ditch in Unit 24	2023	April-Dec									
Push ditch banks into ditch (3,250 linear feet)					Contract	(3,250 feet x $1.50/feet) $4,875					
Administration (contract oversight)			BIO (5) WG (5)	$510							
E Total				**$510**		**$4,875**					**$5,385**
F: Remove ditch/ditch bank in Unit 18	2023	April-Dec									
Use existing ditch banks to fill ditch and haul in additional material if needed (6,760 linear feet)					Contract	(26,288 yard^3 x $3/yard^3) $78,864					
Remove all associated water control/diversion structures					Contract	$900					
Administration (contract oversight)			BIO (10) WG (20)	$1,390							
F Total				**$1,390**		**$79,764**					**$81,154**
Monte Vista NWR Project III. Grand Total = $174,929											
Alamosa NWR Project I. Restore hydrology of Mumm Well area											
A: Remove ditch bank and fill in ditch in Unit J	2024	April-Dec									
Place ditch bank material into ditch (3,366 linear					Contract	(3,366 yard^3 x					

			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
feet)						$3/ yard^3) $10,098					
Remove all associated water control/diversion structures					Contract	$400					
Administration (contract oversight)			BIO (5) WG (5)	$510							
A Total				**$510**		**$10,498**					**$11,008**
B: Remove contour terrace in Unit N1	2024	April-Dec									
Place material used to construct contour terrace back into borrow area (3,600 linear feet)					Contract	(4,000 yard^3 x $3/ yard^3) $12,000					
Remove all associated water control structures					Contract	$300					
Administration (contract oversight)			BIO (5) WG (5)	$510							
B Total				**$510**		**$12,300**					**$12,810**
Alamosa NWR Project I. Grand Total = $23,818											
Alamosa NWR Project II. Restore hydrology of Units C1, T, O, & P											
A: Install water control/diversion structures (numerous Units)	2021-2023	April-Dec									
Install water control/diversion structures					Contract	$18,000					
Remove various water control/diversion structures not used or needed					Contract	**$600**					
Administration (contract oversight)			BIO (15) WG (15)	$1,530							
A Total				**$1,530**		**$18,600**					**$20,130**
Alamosa NWR Project II. Grand Total = $20,130											
Alamosa NWR Project III. Restore hydrology and improve water inputs into riparian habitat											
A: Install water diversion structures in numerous ditches to facilitate water delivery to riparian habitats	2021-2023	April-Dec									
Purchase water diversion structures					Material	$20,000					
Install water diversion structures					Contract	$8,000					

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			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
Remove water control/diversion structures that are not used or needed					Contract	$600					
Administration (contract oversight)			BIO (15) WG (25)	$1,900							
A Total				**$1,900**		**$28,600**					**$30,500**
Alamosa NWR Project III. Grand Total = $30,500											
Alamosa NWR Project IV. Protect/Restore ~180 acres of riparian habitat											
A: Construct two ungulate proof exclosures adjacent the Rio Grande	2024	Sept-Dec									
Purchase materials for and install 8 strand electric fencing with a barrier to prevent beaver and porcupine from entering exclosure (17,350 linear feet)					Contract Labor/ Materials	$6.00/linear feet for a total of $104,100					
Administration (contract oversight)			BIO (15) WG (25)	$1,900							
A Total				**$1,900**		**$104,100**					**$106,000**
Alamosa NWR Project IV. Grand Total = $106,000											
Baca NWR Project I. Restore hydrology of the wet meadows in Crestone Creek, Willow Creek, Spanish Creek, Cottonwood Creek and Deadman Creek Drainages											
A: Install water control/diversion structures in Crestone Creek Drainage	2022	Sept-Dec									
Construct/install water control structures					Contract/ Materials	$80,000					
Administration (contract oversight)			RM (40)	2,800							
Construct and install drop-log boards and Fill Delivery			WG (100)	3,700	Materials	150					
A Total				**6,500**		**80,150**					**$86,650**
B: Willow Creek Drainage	2022	Sept-Dec									

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			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
Construct/install water control structures					Contract/ Materials	$80,000					
Administration (contract oversight)			RM (40)	2,800							
Construct and install drop-log boards and Fill Delivery			WG (100)	3,700	Materials	150					
B Total				**6,500**		**$80,150**					**$86,650**
C: Install water control/diversion structures in Spanish Creek Drainage	2022	Sept-Dec									
Construct/install water control structures					Contract/ Materials	$50,000					
Administration (contract oversight)			RM (30)	2,100							
Construct and install drop-log boards and Fill Delivery			WG (100)	3,700	Materials	150					
C Total				**5,800**		**$50,150**					**$55,950**
D: Install water control/diversion structures and remove ditches in Cottonwood Creek Drainage	2022	Sept-Dec									
Construct/install water control structures					Contract/ Materials	$125,410					
Administration (contract oversight)			RM (30)	2,100							
Construct and install drop-log boards and Fill Delivery			WG (100)	3,700	Materials	150					
D Total				**5,800**		**$125,560**					**$131,360**
E: Install water control/diversion structures in Deadman Creek Drainage	2022	Sept-Dec									
Construct/install water control structures					Contract/ Materials	$75,000					
Administration (contract oversight)			RM (40)	2,800							
Construct and install drop-log boards and Fill Delivery			WG (100)	3,700	Materials	150					

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			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
E Total				**6,500**		**$75,150**					**$81,650**
F: Remove water control/diversion structures in Crestone Creek Drainage	2022	Sept-Dec									
Remove water control structures					Contract	$20,000					
Administration (contract oversight)			RM (20)	1,400							
Fill Delivery			WG (20)	740	Materials	150					
F Total				**2,140**		**$20,150**					**$22,290**
G: Remove water control/diversion structures in Willow Creek Drainage	2022	Sept-Dec									
Remove water control structures					Contract	$5,000					
Administration (contract oversight)			RM (10)	700							
Fill Delivery			WG (5)	185	Materials	150					
G Total				**885**		**$5,150**					**$6,035**
H: Remove water control/diversion structures in Cottonwood Creek Drainage	2022	Sept-Dec									
Remove water control structures					Contract	$28,000					
Administration (contract oversight)			RM (10)	700							
Fill Delivery			WG (20)	740	Materials	150					
H Total				**1,440**		**$28,150**					**$29,590**
I: Remove water control/diversion structures in Deadman Creek Drainage	2022	Sept-Dec									
Remove water control structures					Contract	$16,000					
Administration (contract oversight)			RM (5)	350							
Fill Delivery			WG (20)	740	Materials	150					
I Total				**1,090**		**$16,150**					**$17,240**
Baca NWR Project I. Grand Total = $517,415											
Baca NWR Project II. Restore Riparian Stream Habitat by curtailing ungulate browse in											

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			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
Crestone Creek, Willow Creek, Cottonwood Creek and Deadman Creek Drainages											
A: Construct 31 Acre ungulate exclosure on Crestone Creek Drainage	2021	Sept-Dec									
Purchase materials for and install 7 x 9,150 feet fencing					Contract/ Materials	$36,600					
Administration (design, contract oversight)			RM (20)	1,400							
Surveying and Marking			WG (20)	740	Materials	150					
A Total				**2,140**		**$36,750**					**$38,890**
B: Construct 16 Acre ungulate exclosure on Crestone Creek Drainage	2022	Sept-Dec									
Purchase materials for and install 7 x 5,800 feet fencing					Contract/ Materials	$23,200					
Administration (design, contract oversight)			RM (20)	1,400							
Surveying and Marking			WG (20)	740	Materials	150					
B Total				**2,140**		**$23,350**					**$25,490**
C: Construct 34 Acre ungulate exclosure on Willow Creek Drainage	2022	Sept-Dec									
Purchase materials for and install 7 x 7,100 feet fencing					Contract/ Materials	$28,400					
Administration (design, contract oversight)			RM (20)	1,400							
Surveying and Marking			WG (20)	740	Materials	150					
C Total				**2,140**		**$28,550**					**$30,690**
D: Construct 67 Acre ungulate exclosure on Cottonwood Creek Drainage	2022	Sept-Dec									
Purchase materials for and install 7 x 12,051 feet fencing					Contract/ Materials	$48,204					
Administration (design, contract oversight)			RM (20)	1,400							
Surveying and Marking			WG (20)	740	Materials	150					

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			Station Staff[1]	*Station Other*[2]		*Refuge Sharing*		*Partners*		*Total*	
Projects and Sub-Activities (Sequential Order)	***Year***	***Month***	***Personnel (hours)***	***Cost ($)***	***Item (hours)***	***Cost ($)***	***Type (hours)***	***Cost ($)***	***Name***	***Cost ($)***	***Cost ($)***
D Total				**2,140**		**$48,354**					**$50,494**
E: Construct 50 Acre ungulate exclosure on Deadman Creek Drainage	2022	Sept-Dec									
Purchase materials for and install 7 x 9,860 feet fencing					Contract/ Materials	$39,440					
Administration (design, contract oversight)			RM (20)	1,400							
Surveying and Marking			WG (20)	740	Materials	150					
E Total				**2,140**		**$39,590**					**$41,730**
Baca NWR Project II. Grand Total = $187,294											

[1] Acronyms used for personnel include: wage grade (WG), project leader (PL), biologist (BIO), refuge manager (RM), and wildlife refuge specialist (WRS). Salary was calculated using current position grades at a step 6, plus benefits.

[2] Category includes equipment; material; and contract costs. Equipment costs are based on in-house equipment use (running costs) and standard maintenance costs.

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MONTE VISTA NWR

MONTE VISTA NWR PROJECT I. RESTORE HYDROLOGY OF SPRING CREEK CHANNEL

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Monte Vista Wetland Objective 1. From mid-February through March (spring migration), depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and pairing habitat for waterfowl as well as roosting habitat for sandhill cranes (*Grus canadensis*). Tolerance level of invasive plant species is ≤ 10 percent.

- Flood 25 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide foraging habitat for waterfowl.

Monte Vista Wetland Objective 2. From April through mid-June (nesting) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 50 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and nesting habitat for waterfowl, shorebirds, wading birds, and rails. Tolerance level of invasive plant species is ≤15 percent.

- Flood 60 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide habitat for nesting waterbirds such as colonial-nesting white-faced ibis (*Plegadis chihi*), black-crowned night-herons (*Nycticorax nycticorax*), and snowy egrets (*Egretta thula*) as well as grebes and black terns (*Chlidonias niger*).

- Flood 25 percent (+/- 10 percent) of the 1,095 estimated maximum potential acres of habitat dominated by inland saltgrass to depths of < 3 inches for short durations (< 60 days) to provide foraging and nesting areas for shorebirds.

Monte Vista Wetland Objective 3. From mid-June through August (brood rearing) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood about 250 (+/- 10 percent) acres annually of open water and tall-emergent habitat to provide brood rearing areas for waterfowl and waterbirds throughout the Refuge.

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Monte Vista Wetland Objective 4. In September and October (fall migration) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths <15 inches to provide foraging habitat for waterfowl as well as roosting habitat for sandhill cranes. Tolerance level of invasive plant species is ≤10 percent.

- Flood 25 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide foraging and pairing habitat for waterfowl.

Contribution to the CCP

Spring Creek and the adjacent wetland habitat provide important habitat for a variety of breeding and migrating waterbirds even though the majority of Spring Creek has been severely altered and degraded as a result of stream channelization, deepening of the channel, and even the complete elimination of the creek in many places. In the associated floodplain, contour terraces and ditches have also been constructed. Consequently, the overall hydrology of virtually the entire Spring Creek drainage has changed dramatically. For example, the deepening and channelization of the creek has affected the water holding capability of floodplain soils and has contributed to increased drainage of floodplain areas and adjacent wetland/wet meadow habitats. Contour terraces and ditches disrupt sheetflow within the floodplain. All of these alterations have altered the timing, depth, duration, and extent of surface and sub-surface hydrologic conditions.

Additionally, the ditch bank that was created as a result of the channelization of Spring Creek has interrupted and diverted the flow of water within the adjacent Rock Creek drainage. Historically, Rock Creek and Spring Creek drainages merged together on the eastern side of the Monte Vista NWR. However, ditch banks, contour terraces, and modifications to the channels themselves have resulted in water flowing within these areas not joining until they flow into a roadside ditch. Collectively, these alterations have contributed to declines in the extent and quality of short emergent wetland habitat and, certainly, a significant impact on hydrologic conditions and wetland function. This HMP Project will restore hydrologic characteristics that will improve the ecological conditions and function, as well as the extent and quality of wetland habitat.

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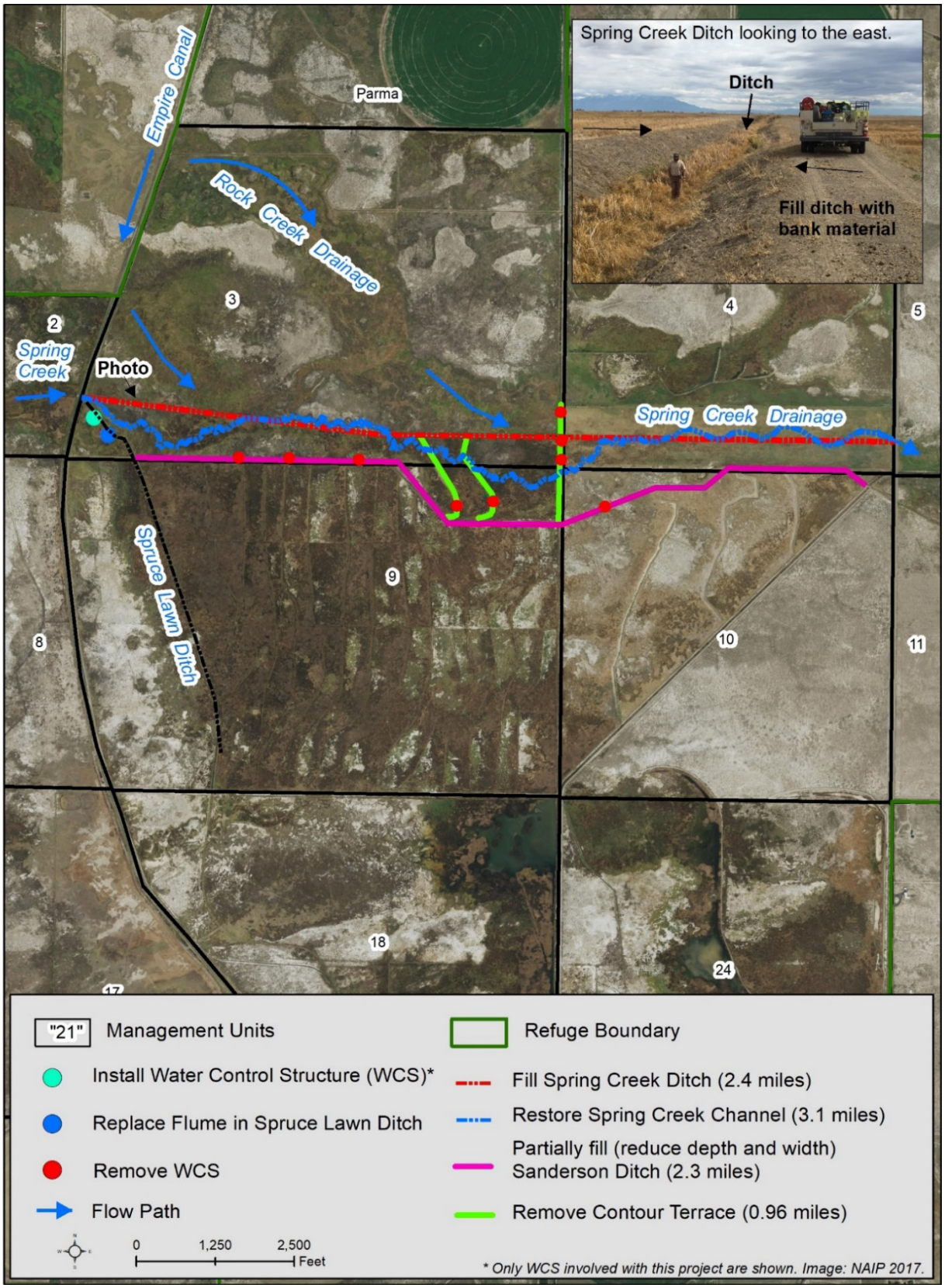

Figure 1: Restore Hydrology of Spring Creek Channel.

SUB-ACTIVITY A. REDUCE DRAINAGE AND IMPROVE WATER HOLDING CAPACITY IN FLOODPLAIN AND ADJACENT WETLAND AREAS

Summary – The historic channel of Spring Creek has been altered along virtually its entire length. Specifically, the channel has been straightened and deepened substantially. In some places the channel has been excavated to a depth of over two meters. As a result, the creek now functionally acts as a drainage ditch, draining surface and sub-surface water from within the floodplain and adjacent wetland areas. Additionally, another large ditch (Sanderson Ditch) also functions as a drainage ditch (due to its depth) and also contributes toward draining surface and sub-surface water from within the Spring Creek floodplain and adjacent wetland areas. Removing and/or modifying these ditches (i.e., filling them in or shallowing their depth) will greatly reduce the drainage of surface and sub-surface water in the entire area. Restoration of a meandering, shallow creek will reduce drainage and improve vegetative conditions within the Spring Creek floodplain (Figure 1).

Efficiencies Gained – Reduced drainage and improved water holding capability within the floodplain and adjacent wetland areas will improve water budget (i.e., amount of water entering the system vs. amount of water leaving) and efficiency of water use. The quality and extent of desirable short-emergent vegetation for nesting waterfowl and other waterbirds will also improve.

SUB-ACTIVITY B. REMOVE DITCH BANKS ALONG CHANNELIZED SPRING CREEK DITCH, NORTH-SOUTH CONTOUR TERRACES, ASSOCIATED WATER CONTROL STRUCTURES, AND PARTIALLY FILL THE SANDERSON DITCH IN UNIT 3

Summary – Historically, the Rock Creek system and Spring Creek system joined in the southeastern part of Unit 3. The existing ditch bank along Spring Creek ditch (i.e., channelized creek) restricts virtually all surface water flows from the Rock Creek drainage to the north from entering the Spring Creek drainage. The ditch bank (running east-west) intercepts surface water flows and forces the water to move east, eventually draining through a small water control structure and into the channelized Spring Creek ditch. Effectively, this water is never allowed to enter the Spring Creek floodplain. Within the Spring Creek floodplain, several contour terraces were constructed with the objective of creating shallow wetland basins in this area. Surface water inputs for these basins required that Refuge staff divert irrigation water into this area, which in recent years has been very limited as a result of reduced water supplies. By disrupting surface water flows, these ditch banks and contour terraces have altered the extent and quality of vegetative conditions within the floodplain. In particular, there has been a change in vegetation structure and type and has likely contributed to the prevalence of invasive plant species. These problems have been exacerbated due to the draining of surface and sub-surface water from Spring Creek ditch and Sanderson ditch.

Efficiencies Gained – Removal of ditch banks, contour terraces, and associated water control structures will reduce staff time related to water management activities (e.g., diverting surface water flows into wetland basins) and infrastructure maintenance. Restoration of the hydrology within the floodplain should result in a decrease in invasive plant extent and density, reducing staff time and material costs (i.e., herbicide) required to control these plant species. Restoring

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natural surface flows with the floodplain will result in increases extent and quality of desirable vegetation and proper wetland/floodplain function.

SUB-ACTIVITY C. INSTALLATION OF A CULVERT IN UNIT 14

Summary – The installation of a culvert in the northwest portion of Unit 14 is necessary to facilitate the movement of water from the restored Spring Creek channel and floodplain. Without the ability to adequately move water from Spring Creek to wetland habitat in Unit 7, water will "pond" up, creating undesirable habitat conditions in this area as well as impacting the availability of water for Unit 7 wetland habitat.

Efficiencies Gained – Installing a culvert will reduce the potential for wetland habitat conditions such as "ponding" of water in an area or habitat type that would be undesirable and may encourage growth of vegetative species that would not naturally occur in this wetland type. Installing a culvert will allow the direct flow of water into other wetland habitats (i.e., Unit 7).

SUB-ACTIVITY D. INSTALLATION OF WATER DIVERSION STRUCTURE AND PARSHALL FLUME

Summary – The installation of a new water diversion structure is necessary to maintain the ability to divert water toward wetland areas in Unit 9 when needed. Wetlands in Unit 9 are very productive in regard to waterfowl and other waterbird nesting and maintaining the ability to divert water into these wetland areas (via the Spruce Lawn ditch) is necessary. Installation of this water diversion structure gives Refuge staff the flexibility to direct water into Unit 9 or maintain water flows into Spring Creek and its associated floodplain. Any water diverted out of Spring Creek (such as into the Spruce Lawn ditch) must be measured pursuant to Colorado State Water Law. As such, a Parshall Flume must be installed to accurately measure the amount of water diverted into the Spruce Lawn ditch.

Efficiencies Gained – Installing this water diversion structure and Parshall Flume allows Refuge staff the maximum flexibility to make water management decisions while ensuring compliance with Colorado State Water Law.

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MONTE VISTA NWR PROJECT II. RESTORE HYDROLOGY OF UNITS 14, 15, AND 16

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Monte Vista Wetland Objective 1. From mid-February through March (spring migration), depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and pairing habitat for waterfowl as well as roosting habitat for sandhill cranes. Tolerance level of invasive plant species is ≤10 percent.

- Flood 25 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide foraging habitat for waterfowl.

Monte Vista Wetland Objective 2. From April through mid-June (nesting) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 50 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and nesting habitat for waterfowl, shorebirds, wading birds, and rails. Tolerance level of invasive plant species is ≤15 percent.

- Flood 60 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide habitat for nesting waterbirds such as colonial-nesting white-faced ibis, black-crowned night-herons, and snowy egrets as well as grebes and black terns.

- Flood 25 percent (+/- 10 percent) of the 1,095 estimated maximum potential acres of habitat dominated by inland saltgrass to depths of < 3 inches for short durations (<6 0 days) to provide foraging and nesting areas for shorebirds.

Monte Vista Wetland Objective 3. From mid-June through August (brood rearing) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood about 250 (+/- 10 percent) acres annually of open water and tall-emergent habitat to provide brood rearing areas for waterfowl and waterbirds throughout the Refuge.

Monte Vista Wetland Objective 4. In September and October (fall migration) and depending on the availability of irrigation water, provide water to accomplish the following:

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- Flood 25 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths < 15 inches to provide foraging habitat for waterfowl as well as roosting habitat for sandhill cranes. Tolerance level of invasive plant species is ≤ 10 percent.

- Flood 25 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide foraging and pairing habitat for waterfowl.

Contribution to the CCP

Management Units 14, 15, and 16 have been highly altered prior to and since the time of Refuge establishment. Prior to Refuge establishment, irrigation ditches were constructed to facilitate the delivery of water to irrigate lands within these areas. Early aerial photography indicates that as early as 1941, numerous areas within these Units had been converted from native upland habitats to irrigated meadows, presumably comprised of native and non-native wet meadow plant species. Since Refuge establishment, numerous large contour terraces, stretching up to a mile long, were constructed to facilitate further conversion of upland habitat into created wetlands, attempting to maximize the amount of breeding waterfowl habitat. Over the last 20 years, as water availability (e.g., volume and duration) has become limited, the Refuge's ability to apply adequate water to maintain wetland vegetation and habitat quality has diminished considerably. Many of these contour terraces are extremely large in size (> 3 feet in height and > 20 feet wide) with large, deep borrow areas immediately in front of the contour terraces. As water supplies continue to diminish, there is barely enough water to fill the borrow areas of the upper-most contour terraces, leaving no water available to sheetflow across the landscape. Within these areas, natural wetland flowpaths do exist, but make up less than 25% of the areas that were designed to be irrigated using the complex irrigation system (i.e., ditches, water control/diversion structures, and contour terraces). With current infrastructure design, it is impossible to maintain appropriate hydrologic conditions within these flowpaths while restricting water application on historic upland areas. Removal of this system of contour terraces (i.e., pushing the soil from the contour terraces back into the borrow areas) will remove these large, deep borrow areas (reducing the amount a water captured in a small area), eliminate the ability to flood former upland habitats, and restore the sheetflow and connectivity of natural wetland flowpaths. This modification of the water management infrastructure will help restore the natural hydrologic function to the area, allowing former upland habitats to revert back to upland vegetative conditions, improve the quality of vegetation and function in natural wetland areas, and promote connectivity of natural wetland flowpaths (Figure 2).

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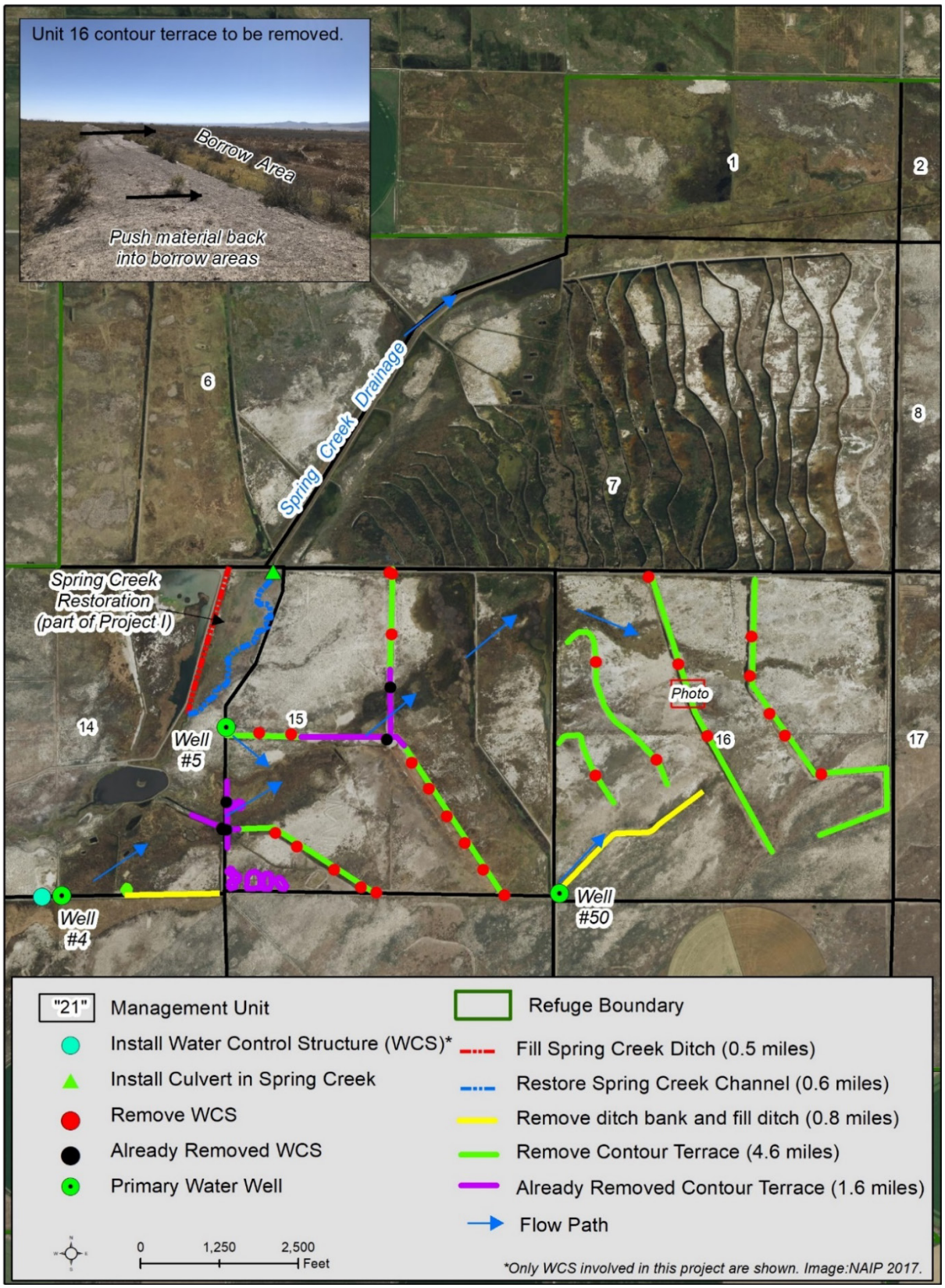

Figure 2: Restore Hydrology of Units 14, 15, and 16.

SUB-ACTIVITY A: REMOVE CONTOUR TERRACES, DITCHES, AND ASSOCIATED WATER CONTROL STRUCTURES IN UNITS 14, 15, AND 16

Summary – Numerous large contour terraces were constructed not long after Refuge establishment (most likely in the 1960's) in Units 15 and 16. The intent of these contour terraces were to create wetland basins and spread (i.e., back-up) water across as great of an area as possible. These contour terraces were constructed irrespective of soil types and other abiotic considerations. These long (up to a mile in length), straight contour terraces were constructed across natural wetland flowpaths as well as through upland shrub habitat. It is presumed that the intent was to flood natural wetland areas as well as convert upland habitats into wetland vegetation to enhance habitat waterfowl and other wetland dependent wildlife species. Over time, with adequate water supplies (e.g., timing, volume, and duration) there was a shift in typical upland vegetation to wetland vegetation. However, beginning in the 2000's, water supplies began to diminish and maintaining the required hydrology needed to maintain these converted areas in a wetland vegetative condition became difficult. As a consequence, wetland vegetation in these formerly converted upland areas diminished, being replaced by invasive plant species. Attempts were made to apply water to these areas for numerous years, however the timing, volume, and duration of water supplies were not adequate to maintain wetland vegetation health and kept upland vegetation from re-establishing.

Efficiencies Gained – Removal of contour terraces, ditches, and the associated water control structures will reduce staff time related to water management activities (e.g., diverting surface water flows into wetland basins) and infrastructure maintenance as well as eliminating the ability to continue to flood natural upland habitats. Restricting water inputs to the natural wetland flowpaths will allow formerly converted upland habitats to revert back to natural vegetative communities and will result in a decrease in invasive plant extent and density, reduced staff time and material costs (i.e., herbicide) required to control these plant species both in natural wetland and upland habitats. Restoring surface flows within the flowpaths will result in an increase in extent and quality of desirable vegetation and proper wetland function.

SUB-ACTIVITY B: REPLACE WATER CONTROL STRUCTURE IN UNIT 14

Summary – This water control structure facilitates the flow of water from Unit 20 into the natural wetland flowpath in Units 14, 15, and 16. Currently, the existing structure is old, dilapidated, and under-sized, resulting in inadequate flows of water within the flowpath. As a consequence, much of the water backs-up and flows into a ditch, by-passing the flowpath.

Efficiencies Gained – Replacing the existing water control structure with one that allows all of the water from Unit 20 to flow into the natural wetland flowpath in Units 14, 15, and 16 will result in greater efficiency of water use. The quality and extent of desirable short-emergent vegetation for nesting waterfowl and other waterbirds within the natural wetland flowpath will improve.

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MONTE VISTA NWR PROJECT III. RESTORE HYDROLOGY AND IMPROVE WATER FLOW IN UNITS 18 AND 24

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Monte Vista Wetland Objective 1. From mid-February through March (spring migration), depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and pairing habitat for waterfowl as well as roosting habitat for sandhill cranes. Tolerance level of invasive plant species is ≤10 percent.

- Flood 25 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide foraging habitat for waterfowl.

Monte Vista Wetland Objective 2. From April through mid-June (nesting) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 50 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and nesting habitat for waterfowl, shorebirds, wading birds, and rails. Tolerance level of invasive plant species is ≤15 percent.

- Flood 60 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide habitat for nesting waterbirds such as colonial-nesting white-faced ibis, black-crowned night-herons, and snowy egrets as well as grebes and black terns.

- Flood 25 percent (+/- 10 percent) of the 1,095 estimated maximum potential acres of habitat dominated by inland saltgrass to depths of < 3 inches for short durations (< 60 days) to provide foraging and nesting areas for shorebirds.

Monte Vista Wetland Objective 3. From mid-June through August (brood rearing) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood about 250 (+/- 10 percent) acres annually of open water and tall-emergent habitat to provide brood rearing areas for waterfowl and waterbirds throughout the Refuge.

Monte Vista Wetland Objective 4. In September and October (fall migration) and depending on the availability of irrigation water, provide water to accomplish the following:

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- Flood 25 percent (+/- 10 percent) of the 2,221 estimated maximum potential acres of short-emergent habitat to depths < 15 inches to provide foraging habitat for waterfowl as well as roosting habitat for sandhill cranes. Tolerance level of invasive plant species is ≤ 10 percent.

- Flood 25 percent (+/- 10 percent) of the 544 estimated maximum potential acres of tall emergent habitat to provide foraging and pairing habitat for waterfowl.

Contribution to the CCP

Similar to other Units on the Refuge, Units 18 and 24 have been highly altered within the last century. By the time of Refuge establishment, significant portions of these Units had been converted to farm fields/hay meadows, utilizing a flood irrigation system of ditches, diversions, and lands. After Refuge establishment, additional ditches, water control/diversion infrastructure, and numerous contour terraces and ditches have been constructed to create wetland habitat in these former agricultural fields as well as other areas within these Units. Similar to other areas on the Refuge, the creation of these wetland areas occurred irrespective of topography, natural hydrologic conditions, soil type and other abiotic considerations as well as natural vegetative communities. Also similar to other areas on the Refuge, numerous natural wetland flowpaths exist within these Units and are bisected by these contour terraces.

Additionally, a large drain ditch (Bowen Drain) had been constructed to drain surface and sub-surface water from not only the area within the current Refuge boundary, but areas to the south of the Refuge as well. In addition to the Bowen Drain, numerous smaller drains had been constructed around the perimeters of the farm fields in the southern portions of Units 18 and 24. Presumably, these drains were constructed with the purpose of lowering the water table on these agricultural fields to reduce over saturation of the crop's roots, reduce the accumulation of salts, and allow equipment such as tractors and other harvesting equipment to be used without getting stuck in saturated soils. Over the last 20 years, as groundwater tables have dropped and irrigation water availability has decreased, these drains are now having a severe negative impact on groundwater levels and resulting in the drainage of surface water flows in adjacent natural wetland areas. Consequently, it has become extremely difficult to maintain adequate surface and sub-surface hydrologic conditions within these wetland areas. Although removal of the Bowen Drain is not possible, the removal of the drains surrounding the former agricultural fields is feasible. Removal of these drains will eliminate the continued drainage of surface water flows in desired locations. Additionally, removal of sections of small water delivery ditches will eliminate the flooding of natural upland habitats, allowing these areas to revert back to historic vegetative communities (upland shrub). Interestingly, the west ditch bank of the Bowen Drain acts as an embankment, creating what is known as Bowen Pond in Unit 18. Although the majority of the pond is within a natural wetland flowpath, the "backing up" of water due to the ditch bank has changed the type of wetland that naturally occurred (from short emergent to a deeper open water/tall emergent wetland type). For more than 25 years, the bulrush patches within the pond provide one of the largest breeding areas for white-faced ibis in Colorado. Black-crowned night herons as well as snowy egrets also breed in these bulrush patches. As such, maintaining the integrity and productivity of Bowen Pond is a high priority for the Refuge. Part of this project involves adding additional material (pit-run/soil) to the existing ditch bank to ensure its integrity

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as well as replacing the dilapidated water control structure which controls water levels and discharge of the pond (Figure 3).

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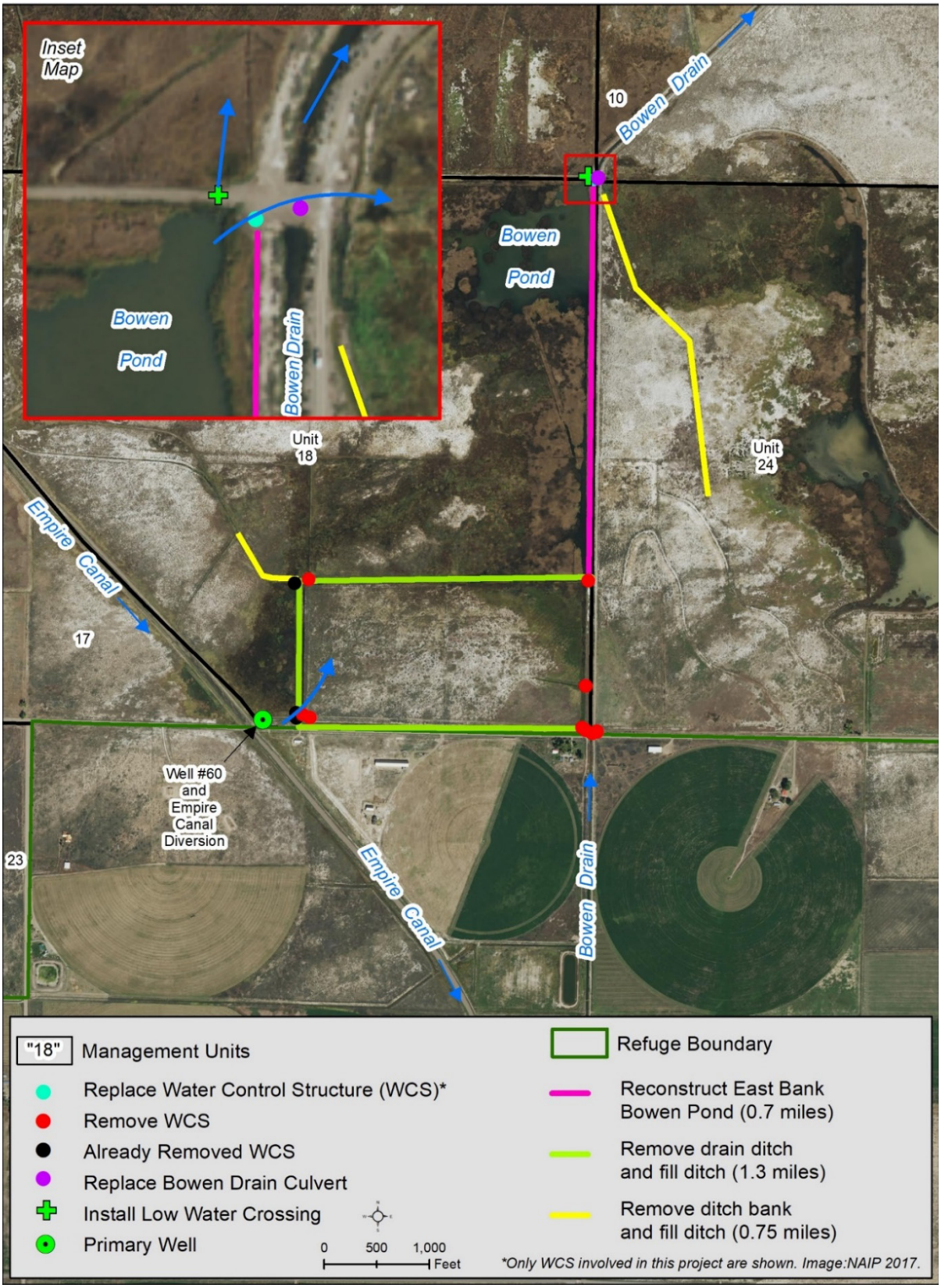

Figure 3: Restore Hydrology and Improve Water Flow in Units 18 and 24.

SUB-ACTIVITY A: REPLACE WATER CONTROL STRUCTURE OUT OF BOWEN POND AND BOWEN DRAIN CULVERT

Summary – Bowen Pond was created by backing water up within a natural wetland flowpath. Even though the pond and current vegetative community was not a natural component of the landscape (i.e., the natural wetland habitat was dominated by shallow water and short-emergent vegetation), maintaining the pond, associated habitat attributes, and the value to breeding colonial waterbirds is a high priority to Refuge staff. Typically, the bulrush patches within the pond host the largest breeding colony of white-faced ibis (> 400 breeding pairs) in Colorado, along with approximately 300 breeding pairs of black-crowned night herons and 200 breeding pairs of snowy egrets. Because these species can be sensitive to abrupt changes in water levels, especially early in the breeding season, it is important to maintain fairly consistent water levels throughout the breeding season. Currently, the primary water control structure which controls water levels as well as discharge is undersized and dilapidated. Because water inputs into the pond can be difficult to control, there are times when the amount of discharge is inadequate, resulting in the pond becoming too deep or full. In order to replace the Bowen Pond outlet structure, the large culvert in the Bowen Drain must be replaced as well due to its dilapidated condition.

Efficiencies Gained – Replacing the existing water control structure out of Bowen Pond will result in the ability to adequately discharge the necessary amount of water, allowing increased ability to maintain appropriate water levels in the pond. Improved water level management will reduce the likelihood of colonial waterbirds abandoning nests and will improved vegetation management in the pond. Additionally, replacement of the structure will facilitate suitable water in-flows into the natural wetland flowpath in Unit 24. Because the water control structure out of Bowen Pond rests on top of a large culvert in the Bowen Drain, as well as serving as a vehicle cross-over, this large culvert must be replaced due to its dilapidated condition.

SUB-ACTIVITY B: RE-CONSTRUCTION OF THE EAST EMBANKMENT OF BOWEN POND

Summary – Bowen Pond exists because the west ditch bank of the Bowen Drain acts as an embankment on the east side of the pond. Over time, the embankment has experienced severe erosion (due to settling of soil, wave action, etc.), causing the water in the pond to over-top the embankment at times where erosion is particularly severe. Due to the importance of Bowen Pond to nesting colonial waterbirds, maintaining the integrity of the pond is a high priority for the Refuge. This project would involve hauling in material (e.g., soil, pit-run, road base) to build up and widen the existing embankment to a height that would reduce erosion and ensure that water does not over-top the embankment.

Efficiencies Gained – Widening and elevating the height of the embankment will ensure that the integrity of Bowen Pond is maintained. Labor time and costs would be reduced as a result of eliminating the need for constant maintenance of the embankment.

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SUB-ACTIVITY C: INSTALL LOW WATER CROSSING IN ROAD IN THE NORTHEAST CORNER OF BOWEN POND

Summary – At times, the water inputs into Bowen Pond exceed the ability to discharge adequate water, resulting in the water levels in the pond becoming too high. There is an existing water control structure in the location of the proposed low water crossing, but it is old, dilapidated, and undersized. Because maintaining adequate water levels in Bowen Pond is extremely important to breeding colonial waterbirds and vegetation management, constructing a low water crossing, acting as an emergency spillway, will ensure that water levels can never become too deep, reducing the likelihood of colonial waterbird nest abandonment.

Efficiencies Gained – By acting as an emergency spillway, the low water crossing will ensure that water levels in Bowen Pond will never become too deep, causing colonial waterbird nest abandonment. Additionally, the low water crossing will also eliminate the likelihood of water over-topping the east embankment of Bowen Pond. Combined, construction of a low water crossing will ensure the integrity of Bowen Pond and the associated infrastructure (embankment, water discharge structure, etc.) and reduce the need for constant maintenance of this infrastructure.

SUB-ACTIVITY D: REMOVE DITCH IN UNIT 24

Summary – This ditch was originally designed to transport discharged water from Bowen Pond to high spots (i.e., upland habitat) on the western side of the unit. The original intent was to convert upland vegetation to wetland vegetation for the purpose of increasing the amount of waterfowl nesting habitat. The consequence of this is that water is directed away from natural wetland flowpaths, keeping a portion of this flowpath dry. Because of the intermittency of this water, coupled with non-hydric soils and other abiotic factors, the area where water was transported to is not, and never was, quality wetland habitat. Instead, this area was dominated by invasive plants. Removal of this ditch will result in ceasing water application on natural upland habitats and allowing these areas to revert back to an upland vegetation community, allow the discharge water stay in the natural wetland flowpath, improving the quality of wetland vegetation, and an overall reduction in invasive plant distribution and density.

Efficiencies Gained – By ceasing the water application to the high ground (i.e., upland habitat), it is expected that the distribution and density of invasive plants would decrease, and even be eradicated, resulting in less labor and costs associated with controlling these plants (i.e., reduced or no herbicide application). Allowing water to flow directly into the natural wetland flowpath will improve the quality and extent of wetland vegetation and allow the formerly irrigated upland habitat to revert back to upland vegetation and restore hydrologic conditions.

SUB-ACTIVITY E: REMOVE DITCH/DITCH BANK IN UNIT 18

Summary – An existing water delivery ditch was constructed in a location that bisects a natural wetland flowpath, restricting the ability to sheetflow water down the flowpath. The ditch banks act as a levee, resulting in un-intentional ponding of water and redirecting surface water flows

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away from the flowpath. A small portion of this ditch has already been removed, but more removal will result in completely unrestricted sheetflow of water throughout the flowpath.

Efficiencies Gained – Removal of this ditch, and its ditch banks, will result in unrestricted sheetflow of water throughout the natural wetland flowpath, improving overall quality of wetland vegetation and wetland connectivity.

SUB-ACTIVITY F: REMOVE DRAIN DITCHES AND ASSOCIATED WATER CONTROL STRUCTURES SURROUNDING OLD FARM FIELD IN UNIT 18

Summary – A large drain ditch surrounds an old (abandoned) farm field. Presumably, the drain ditch was constructed to drain sub-surface water levels to facilitate farming practices in the field and reducing the build-up of surface salts. The farm field is no longer farmed and, consequently, the drain ditch is no longer needed to facilitate farming. However, the existing drain ditch still functions as a drain, draining surface and sub-surface water from adjacent wetland areas, making it difficult to maintain adequate hydrologic conditions within the wetlands. Additionally, the drain ditch bisects part of a natural wetland flowpath. Removal of the drain ditch will eliminate drainage of surface and sub-surface water from within the wetland areas and will allow the restoration of a portion of a natural wetland flowpath.

Efficiencies Gained – Removal of the drain ditch and associated water control structures will help maintain adequate surface and sub-surface hydrologic conditions in adjacent wetland areas as well as restore surface water sheetflow across a portion of a natural wetland flowpath.

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ALAMOSA NWR

ALAMOSA NWR PROJECT I. RESTORE HYDROLOGY OF MUMM WELL AREA

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Alamosa Wetland Objective 1. From mid-February through March (spring migration), provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and pairing habitat for waterfowl. Tolerance level of invasive plant species is ≤ 10 percent.

- Flood 25 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide foraging and pairing habitat for waterfowl.

Alamosa Wetland Objective 2. From April through mid-June (nesting) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 50 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and nesting habitat for waterfowl, shorebirds, wading birds, and rails. Tolerance level for invasive plant species is ≤10 percent.

- Flood 60 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide habitat for nesting waterbirds.

- Flood 25 percent (+/- 10 percent) of the 216 estimated maximum potential acres of transition habitat (dominated by inland saltgrass) to depths of <3 inches for short durations (< 60 days) to provide foraging and nesting areas for shorebirds.

Alamosa Wetland Objective 3. From mid-June through August (brood rearing) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood about 300 acres (+/- 10 percent) annually of open water and tall-emergent habitat to provide brood-rearing areas for waterfowl and waterbirds.

Alamosa Wetland Objective 4. In September and October (fall migration) and depending on the availability of irrigation water, provide water to accomplish the following:

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- Flood 25 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging habitat for waterfowl. Tolerance level for invasive plant species is ≤ 10 percent.

- Flood 25 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall emergent habitat to provide foraging habitat for waterfowl.

Contribution to the CCP

The area around the Mumm Well has been highly altered since the time of Refuge establishment. Numerous areas within these Units have been converted from native upland habitats to irrigated meadows, presumably comprised of native and non-native wet meadow plant species. Since Refuge establishment, one large contour terrace, stretching up to three-quarters of a mile long, was constructed to facilitate further conversion of upland habitat into created wetlands and convert existing seasonal wetland habitat into deeper, more perennial wetlands to maximize the amount of breeding waterfowl habitat. Additionally, a large ditch was constructed to facilitate the delivery of water to upland habitats in attempts to convert these upland areas into wet meadows. The ditch banks from this ditch impede the sheetflow of water within natural wetland flowpaths.

Over the last 20 years, as water availability (e.g., volume and duration) has become limited, the Refuge's ability to apply adequate water to maintain wetland vegetation and habitat quality has diminished considerably. As water supplies continue to diminish, the contour terrace and ditch banks inhibit the ability to provide enough water to sheetflow across the natural wetland habitat. With current infrastructure design, it is impossible to maintain appropriate hydrologic conditions within these flowpaths while restricting water application on historic upland areas. Removal of this contour terrace (i.e., pushing the soil from the contour terrace back into the borrow area) will eliminate the ability to flood former upland habitats, and restore the sheetflow and connectivity of natural wetland flowpaths. Similarly, removal of the large irrigation ditch and ditch banks will allow unimpeded overland flow of water within natural wetland flowpaths and eliminate the ability to apply water to natural upland habitats. This modification of the water management infrastructure will help restore the natural hydrologic function to the area, allowing former upland habitats to revert back to upland vegetative conditions, improve the quality of vegetation and function in natural wetland areas, and promote connectivity of natural wetland flowpaths (Figure 4).

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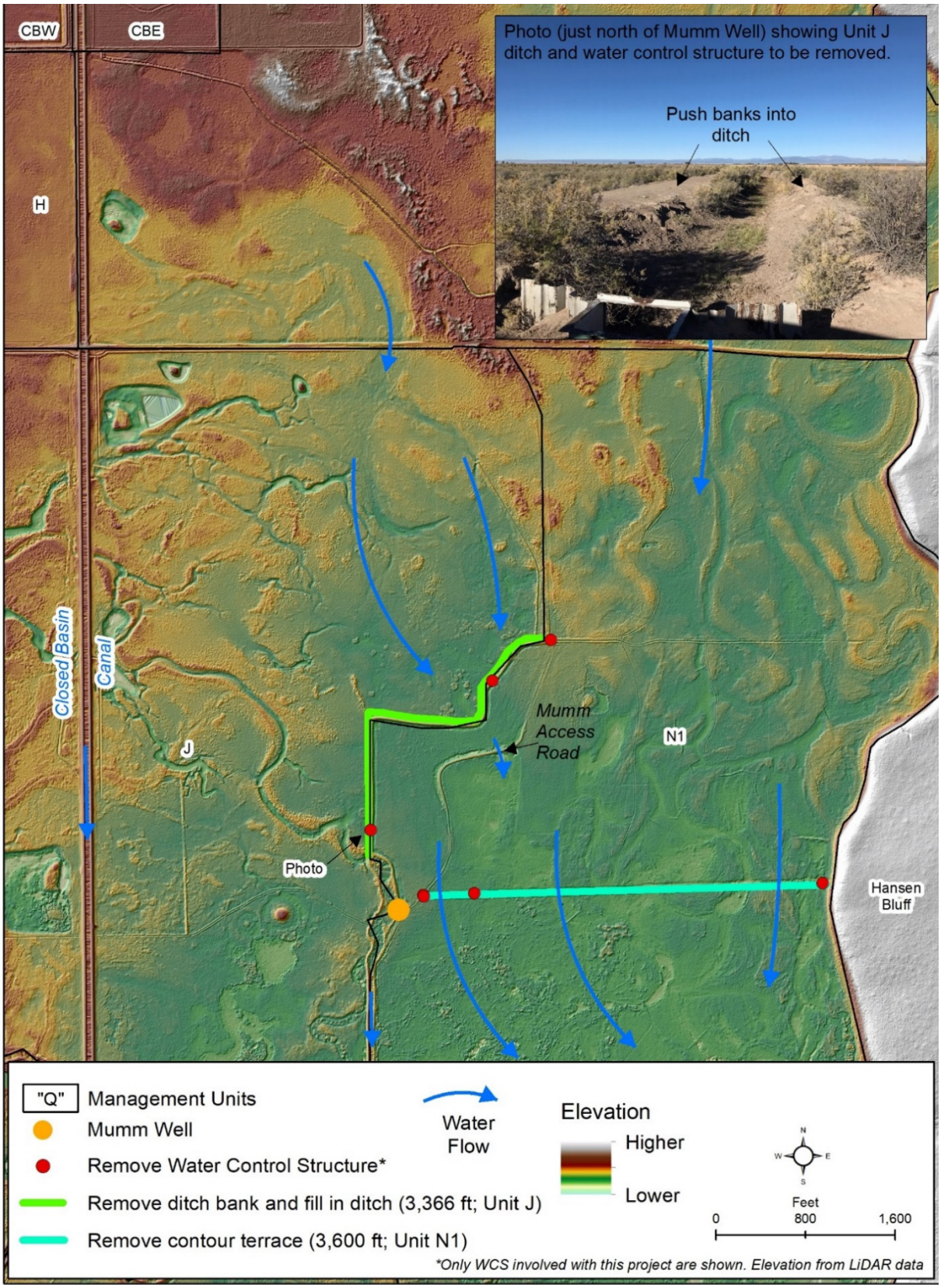

Figure 4: Restore Hydrology and Munn Well Area.

SUB-ACTIVITY A: REMOVE DITCH/DITCH BANK AND ASSOCIATED WATER CONTROL STRUCTURES IN UNIT J

Summary – Sometime after Refuge establishment, a water delivery ditch was constructed to facilitate moving water north from the Mumm Well to irrigate lands in the middle of Unit N1 north. This ditch was constructed across natural wetland flowpaths coming from the west (Unit J) as well as through areas of upland habitat. As a result of ditch construction, large ditch banks were established on the western side of the ditch, effectively blocking any flow of water through natural wetland flowpaths coming from the west (Unit J). For over a decade, it has been determined that use of this ditch is not necessary and has not been used. Removal of this ditch and ditch banks will not impact long-term water management plans and will allow the uninterrupted flow of surface water in natural wetland flowpaths. Additionally, the ditch bank acts as a levee, resulting in undesired ponding of water and inundating upland habitat areas on the west side of the ditch.

Efficiencies Gained – Removal of this ditch, ditch banks, and associated water control/diversion structures will result in unrestricted sheetflow of water throughout the natural wetland flowpath, improving overall quality of wetland vegetation and wetland connectivity and allow the reestablishment of upland vegetation on natural upland habitat areas. In the long term, there will be a reduction in labor and financial resources needed for invasive and undesirable plant control.

SUB-ACTIVITY B: REMOVE UNIT N CONTOUR TERRACE AND ASSOCIATED WATER CONTROL STRUCTURES EAST OF MUMM WELL

Summary – During either the 1970's or 1980's a contour terrace was constructed beginning just east of the Mumm Well extending straight east to the base of the bluff (about ¾ mile long). It is assumed that the purpose of this contour terrace was to intercept any water flows from the north (including water from the Mumm Well) in attempts to pond water across as broad of an area as possible, irrespective of soil type, vegetation type, or other biotic and abiotic considerations. As a result, native upland vegetation was replaced by wetland vegetation and in natural wetland areas, the vegetative community shifted from vegetative species typically found in seasonal wetlands to those found in more perennial wetlands. Additionally, as a result of this change in the timing, duration, and volume of water, soil chemistry and forage production changed as well. Another consequence of changing the hydrologic conditions of this area was the encroachment and spread of phragmites. Depending on water availability, there were times when over 200 acres were occupied by a monoculture of phragmites. Removal of this contour terrace will eliminate the ability to pond water on former upland habitats, allowing upland vegetation to reestablish, as well as eliminating the ability to pond water at undesired depths. Removal of the contour terrace, combined with only seasonal water application, will restore wetland vegetation types appropriate for the soil types, and other abiotic factors, while at the same time reduce invasive and undesirable plant species such as perennial pepperweed and phragmites.

Efficiencies Gained – Removal of this contour terrace and associated water control structures will reduce labor involved to maintain this contour terrace and eliminate the time involved with managing water levels. In the long term, there will be a reduction in labor and financial resources needed relating to invasive and undesirable plant control. Removal of this contour terrace will

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result in unrestricted sheetflow of water throughout the natural wetland flowpath, improving overall quality of wetland vegetation and wetland connectivity and allow the reestablishment of upland vegetation on natural upland habitat areas.

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ALAMOSA NWR PROJECT II. RESTORE HYDROLOGY OF UNITS C1, T, O, AND P

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Alamosa Wetland Objective 1. From mid-February through March (spring migration), provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and pairing habitat for waterfowl. Tolerance level of invasive plant species is ≤ 10 percent.

- Flood 25 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide foraging and pairing habitat for waterfowl.

Alamosa Wetland Objective 2. From April through mid-June (nesting) and depending on the availability
of irrigation water, provide water to accomplish the following:

- Flood 50 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and nesting habitat for waterfowl, shorebirds, wading birds, and rails. Tolerance level for invasive plant species is ≤ 10 percent.

- Flood 60 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide habitat for nesting waterbirds.

- Flood 25 percent (+/- 10 percent) of the 216 estimated maximum potential acres of transition habitat (dominated by inland saltgrass) to depths of < 3 inches for short durations (< 60 days) to provide foraging and nesting areas for shorebirds.

Alamosa Wetland Objective 3. From mid-June through August (brood rearing) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood about 300 acres (+/- 10 percent) annually of open water and tall-emergent habitat to provide brood-rearing areas for waterfowl and waterbirds.

Alamosa Wetland Objective 4. In September and October (fall migration) and depending on the availability of irrigation water, provide water to accomplish the following:

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- Flood 25 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging habitat for waterfowl. Tolerance level for invasive plant species is ≤ 10 percent.

- Flood 25 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide foraging habitat for waterfowl.

Contribution to the CCP

Similar to other places on Alamosa NWR, the hydrology in Units C1, T, O, and P have been highly altered prior to and after Refuge establishment. Numerous roads, contour terraces, and irrigation ditches were constructed to establish travel routes and create maximum water management flexibility. This infrastructure was built with the purpose of irrigating the maximum amount of land as possible, irrespective of natural habitat types or abiotic considerations. As with other locations on Alamosa NWR, the goal of water management was to grow as much livestock forage (prior to Refuge establishment) or waterfowl nesting habitat (after Refuge establishment). This resulted in a considerable amount of infrastructure designed to flood natural upland habitats. Most of the water control/diversion structures were installed on "high ground", with the purpose of converting upland vegetation communities to those typified by wetland plants. Once the high ground was flooded, the water would eventually reach the "low areas", which were typically the natural wetland flowpaths, oxbows, and depressions. During times of sufficient water availability (e.g., duration, volume) it was possible to maintain wetland plant communities on these high ground areas. However, in recent decades, water availability has diminished, combined with a lowering of the groundwater table. As a result, the quality and quantity of wetland plants on much of these former upland habitat areas has declined and the plant community has transitioned into a condition dominated by invasive plants. Additionally, the amount of water available has declined, resulting in significantly less water reaching the natural wetland flowpaths, oxbows, and depressions. Installing new water control structures in appropriate locations (i.e., within the natural wetland flowpaths) in existing water delivery ditches will increase the efficiency of providing water to these natural wetland areas, resulting in improved quantity and quality of wetland vegetation (Figure 5). Additionally, water control/diversion structures on the high ground will be removed, allowing upland vegetative communities to reestablish on natural upland habitat areas.

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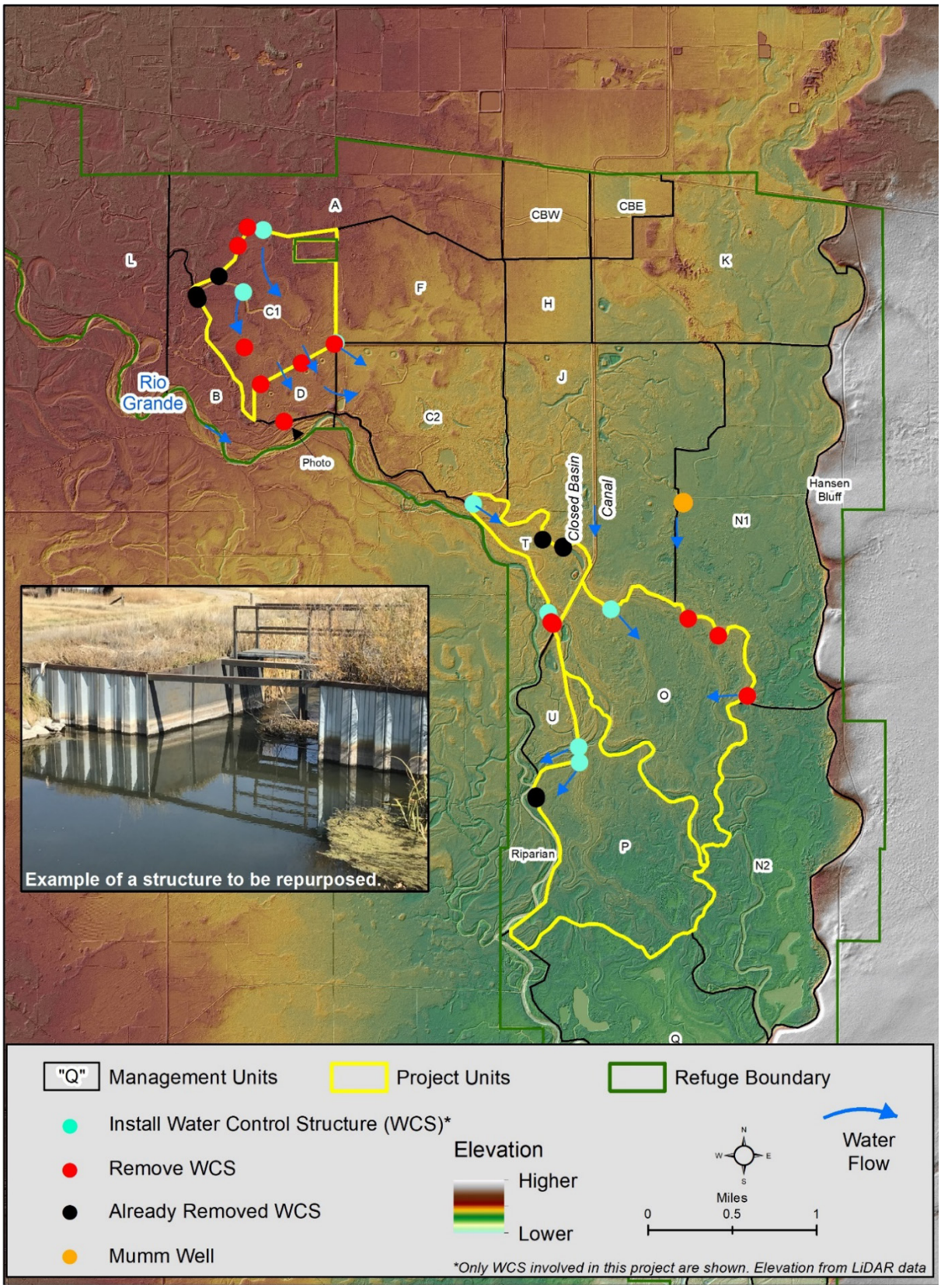

Figure 5: Restore Hydrology of Units C1, T, O, and P.

SUB-ACTIVITY A: INSTALL NEW WATER CONTROL/DIVERSION STRUCTURES AND REMOVE VARIOUS WATER CONTROL/DIVERSION STRUCTURES NOT USED OR NEEDED

Summary – Water management goals prior to and after Refuge establishment was geared towards maximizing either forage production for livestock (prior to Refuge establishment) or maximizing the amount of waterfowl nesting habitat (after Refuge establishment). Because of these goals, water management infrastructure was designed to irrigate the high ground (upland habitats) first, with the knowledge that the excess water would eventually reach the low ground (i.e., natural wetland flowpaths, oxbows, and depressions). During years when sufficient water was available, this method worked fairly well. However, in recent decades, groundwater levels have dropped substantially and water availability has diminished. As a result, it is extremely difficult to maintain adequate water supplies on the high ground to maintain quality wetland vegetation and invasive plant species have become established and in many locations is the dominant vegetative species. Additionally, a reduction in the volume of excess water now reaches the natural wetland areas. The installation of new water control/diversion structures within the natural wetland areas (low areas) will substantially improve the ability to provide water directly to natural wetland areas and improve the quantity and quality of wetland vegetative conditions within these areas. Ceasing use of the control/diversion structures on the high ground will allow upland vegetation to reestablish and it is anticipated that invasive plant density and distribution will decline.

Efficiencies Gained – Removal of unneeded water control/diversion structures or structures in inappropriate locations and installation of new water control/diversion structures at locations which deliver water directly to natural wetland flowpaths will increase the volume and duration of water inputs into these areas, resulting in an increase in the quantity and quality of wetland vegetation communities. Eliminating the practice of irrigating the high ground (natural upland habitats) will result in the reestablishment of upland vegetation communities and a long-term decrease in invasive plants, reducing labor and financial resources devoted to invasive plant control. To reduce costs, water control/diversion structures will be moved and repurposed to the greatest extent possible.

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ALAMOSA NWR PROJECT III. RESTORE HYDROLOGY AND IMPROVE WATER INPUTS INTO RIPARIAN HABITAT

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Alamosa Wetland Objective 1. From mid-February through March (spring migration), provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of <15 inches to provide foraging and pairing habitat for waterfowl. Tolerance level of invasive plant species is ≤ 10 percent.

- Flood 25 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide foraging and pairing habitat for waterfowl.

Alamosa Wetland Objective 2. From April through mid-June (nesting) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 50 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging and nesting habitat for waterfowl, shorebirds, wading birds, and rails. Tolerance level for invasive plant species is ≤10 percent.

- Flood 60 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide habitat for nesting waterbirds.

- Flood 25 percent (+/- 10 percent) of the 216 estimated maximum potential acres of transition habitat (dominated by inland saltgrass) to depths of < 3 inches for short durations (< 60 days) to provide foraging and nesting areas for shorebirds.

Alamosa Wetland Objective 3. From mid-June through August (brood rearing) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood about 300 acres (+/- 10 percent) annually of open water and tall-emergent habitat to provide brood-rearing areas for waterfowl and waterbirds.

Alamosa Wetland Objective 4. In September and October (fall migration) and depending on the availability of irrigation water, provide water to accomplish the following:

- Flood 25 percent (+/- 10 percent) of the 5,528 estimated maximum potential acres of short-emergent habitat to depths of < 15 inches to provide foraging habitat for waterfowl. Tolerance level for invasive plant species is ≤ 10 percent.

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- Flood 25 percent (+/- 10 percent) of the 1,109 estimated maximum potential acres of tall-emergent habitat to provide foraging habitat for waterfowl.

Riparian Objective 1. On the Alamosa NWR, maintain and enhance a minimum of 50 acres of existing willow and cottonwood riparian habitat along the Rio Grande to help riparian species, with an emphasis on breeding songbirds.

Riparian Objective 2. By year 15, on off-channel sites, restore or establish a minimum of 50 acres of moderate to dense (> 35 percent canopy cover) willow and cottonwood riparian habitat in locations where site conditions, including soil and available water (see Figure 38 in Chapter 3 of CCP), will ensure long-term health, sustainability, and ecological function.

Contribution to the CCP

Like many areas across the Intermountain West, riparian habitat on Alamosa NWR is in a degraded condition due to hydrologic alterations, past livestock grazing, and current browsing by native ungulates such as elk and deer. Upstream reservoirs and water diversions on the Rio Grande have a significant effect on the hydroperiods within the river on the reaches through Alamosa NWR. Specifically, annual high flow events in late spring and early summer occur haphazardly and even when annual high flows do occur during this time period, they are unnaturally low. As a result, natural regeneration of willows and cottonwoods has been severely impacted. Additionally, lower mountain snowpack over the last few decades has reduced flow rates to the extent that the river acts as a drain, rather than a source for maintaining sub-surface water levels. As a consequence, it is suspected that groundwater levels are insufficient in most years to maintain adequate hydrological conditions within the root zones of willows and cottonwoods. The restoration, enhancement, and maintenance of willow and cottonwood is one of the Refuge's highest priorities because of its importance to neo-tropical migratory songbirds, including the federally endangered southwestern willow flycatcher. Installing water diversion structures out of various water delivery ditches will provide sufficient water to riparian habitats, maintaining adequate hydrologic conditions within the root zone of willow and cottonwood, promoting their growth, spread, and persistence (Figure 6).

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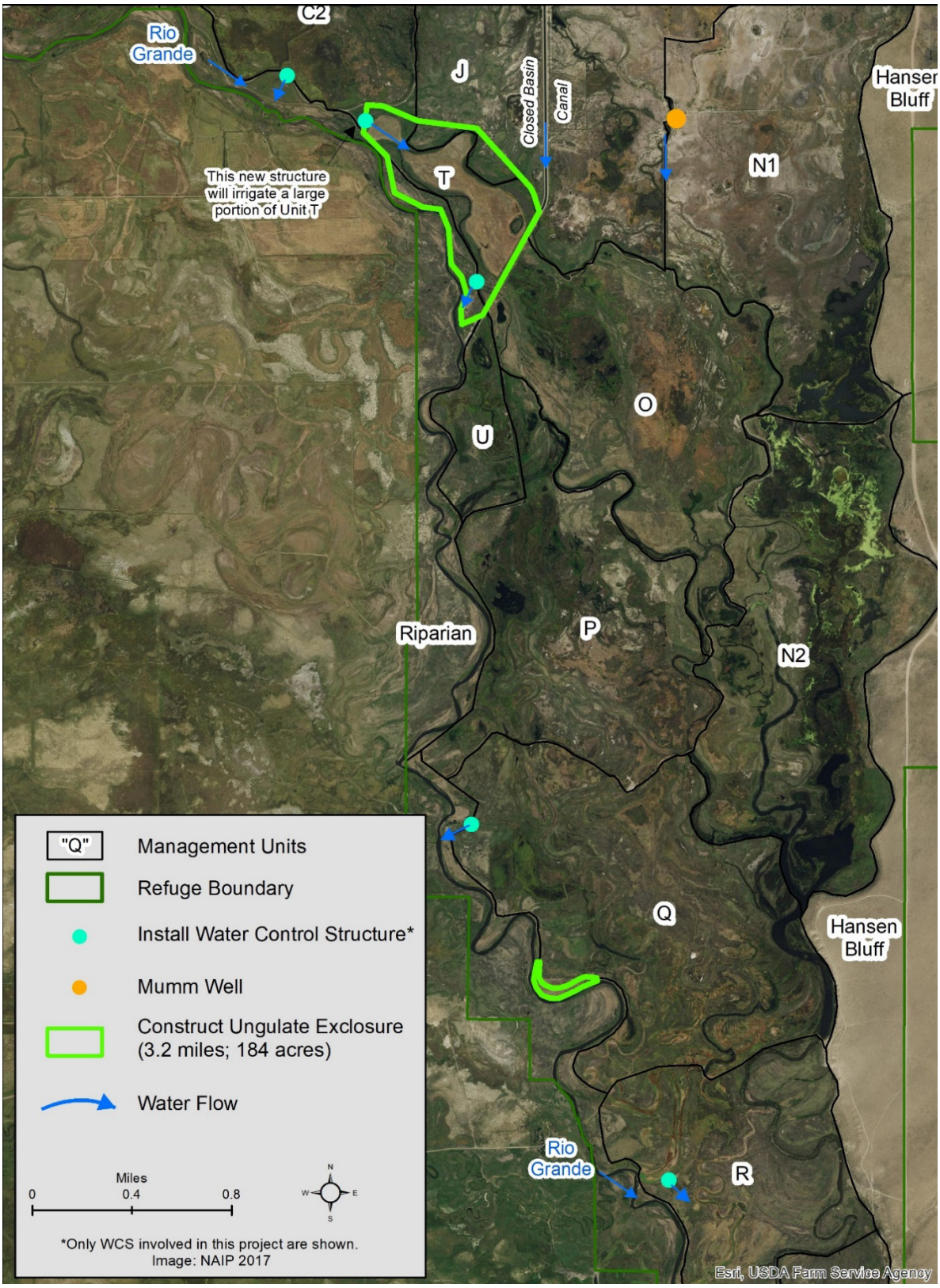

Figure 6: Restore Hydrology and Improve Water Inputs into Riparian Habitat and Construct Ungulate Proof Fencing.

SUB-ACTIVITY A: INSTALL NEW WATER DIVERSION STRUCTURES TO FACILITATE WATER DELIVERY TO RIPARIAN HABITATS

Summary – Riparian habitat occupies a small part of the overall landscape of Alamosa NWR. However, it is disproportionately important for wildlife in general and birds in particular, especially the federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*). Although there are portions of riparian habitat on the Refuge that is healthy with fairly tall, dense stands of willow, the majority of riparian habitat consists of small, sparse patches of willow or the occasional individual plant. There appears to be an overall lack of recruitment and survival of young willows and cottonwoods. Refuge staff surmise that altered hydrologic conditions is the driving factor in lack of willow and cottonwood establishment, growth, and survival. Due to upstream reservoirs and water diversion, the flows on the Rio Grande through the Refuge are, in general, not sufficient for adequate seed dispersal and germination. On occasion, seed establishment does occur when flows are suitable; however, subsequent year's flows are too low to supply adequate water supplies to the root zones of young plants, resulting in these young plants dying. Because the flows and hydroperiods of the river are out of the Refuge's control, it has been determined that in order to sustain and expand existing willow stands and promote the regeneration and survival of new stands (either through root suckering or planting) irrigation water must be applied to these areas in order to provide adequate hydrological conditions within the root zone. As such, installation of water diversion structures in the Chicago Ditch will facilitate the delivery of water into these areas.

Efficiencies Gained – Removal of unneeded water control/diversion structures or structures in inappropriate locations and installation of new water diversion structures will allow greater control of hydrologic conditions within the riparian area. Maintaining adequate hydrologic conditions within the root zone of willows and cottonwoods will aid in the regeneration, growth, expansion, and survival of these species. Promoting and sustaining high quality willow and cottonwood stands in these areas will provide suitable migration, foraging, and breeding habitat for a wide array of riparian dependent wildlife species including the southwestern willow flycatcher. To reduce costs, water control/diversion structures will be moved and repurposed to the greatest extent possible.

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ALAMOSA NWR PROJECT IV. CONSTRUCT UNGULATE PROOF EXCLOSURES ADJACENT TO THE RIO GRANDE

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Riparian Objective 1. On the Alamosa NWR, maintain and enhance a minimum of 50 acres of existing willow and cottonwood riparian habitat along the Rio Grande to help riparian species, with an emphasis on breeding songbirds.

Riparian Objective 2. By year 15, on off-channel sites, restore or establish a minimum of 50 acres of moderate to dense (>35 percent canopy cover) willow and cottonwood riparian habitat in locations where site conditions, including soil and available water (see Figure 38 in Chapter 3 of CCP), will ensure long-term health, sustainability, and ecological function.

Southwestern Willow Flycatcher Objective 1. Contribute to the recovery goals as described in the southwestern willow flycatcher recovery plan of 2002.

Southwestern Willow Flycatcher Objective 2. By year 5, maintain and enhance a minimum of 50 acres of existing suitable habitat (dense patches of willow of a minimum. acre within or adjacent to standing or flowing water) on the Alamosa NWR, and by year 10-15, restore or establish a minimum of 25-50 acres of suitable habitat at locations off the main channel of the Rio Grande.

Contribution to the CCP

Maximizing the establishment, growth, and extent of woody riparian vegetation (willows and cottonwoods) is one of the Refuge's highest priorities. Riparian habitat provides necessary resources for a wide array of wildlife species, especially neo-tropical migratory songbirds such as the federally endangered southwestern willow flycatcher. Hydrologic alterations on the Rio Grande, such as upstream reservoirs and water diversion, have had significant effects on the recruitment, establishment, growth, and extent of riparian habitat on Alamosa NWR. However, excessive browsing pressure by elk and deer is also having a negative impact on willow and cottonwood establishment, growth, and survival. The combination of hydrologic alterations and excessive browsing pressure by elk and deer have resulted in severely degraded riparian habitat on many portions of the riparian area. Establishment and restoration of willow and cottonwood communities can be accomplished by reducing the number of stressors affecting these communities. As stated earlier, the hydrology of the Rio Grande (timing and volume of water flows) is out of the control of the Refuge. However, installing water diversion structures throughout various water delivery ditches (see Project III) will help provide adequate hydrologic inputs to sustain willow and cottonwood growth, reducing the stressor of lack of water. To reduce the stress of elk and deer browsing on these plants, we propose to construct ungulate proof exclosures (Figure 6). Although attempts have been made to manage the distribution and

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size of the elk population (through harassment, culling, and public hunting), significant browsing pressure still exists. Combined with improved hydrologic conditions, eliminating browsing pressure by elk will aid in the establishment, growth, and survival of willow and cottonwood communities, providing improved migration, foraging, and nesting habitat for a wide array of wildlife species, especially neo-tropical migratory songbirds such as southwestern willow flycatchers.

SUB-ACTIVITY A: CONSTRUCT UNGULATE PROOF FENCING

Summary - Numerous ungulate exclosures have been constructed on Crestone Creek on Baca NWR in recent years and have proved successful at keeping ungulates (especially elk) out of the riparian habitat. Inside the exclosures, data collected by Refuge staff demonstrates that there is an immediate growth response with many willow and cottonwood plants growing beyond the browse zone within a few years with patch sizes expanding. Outside the existing exclosures, browse pressure remains heavy with willow and cottonwood plants continuing to either die completely or are dying back to a lower lateral bud or even to the plant base. Under this current heavy browsing pressure, protection and restoration of riparian habitat is impossible.

Efficiencies Gained – Constructing ungulate proof exclosures in the appropriate locations (e.g., where hydrologic conditions can sustain willow growth), will help achieve riparian and southwestern willow flycatcher objectives identified in the CCP by eliminating browsing pressure by elk and deer. Additionally, protecting willow and cottonwood communities in these areas may reduce labor necessary to harass elk out of these areas and the need to conduct lethal removal of elk (conducted by Colorado Parks and Wildlife).

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BACA NWR

BACA NWR PROJECT I. RESTORE HYDROLOGY OF WET MEADOWS IN CRESTONE, SPANISH, WILLOW, COTTONWOOD, AND DEADMAN CREEK DRAINAGES

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Short Emergent Objective 1. Over 15 years, use flood and sub-irrigation on 70–80 percent of irrigable acreage, of which about 8,329 acres fluctuates annually based on snowpack levels in the Sangre de Cristo Mountains, to maintain and improve graminoid (grasses) health. Where degradation is occurring or is anticipated to occur such as from invasive species, low live-to-dead ratios, or low-stem density levels, take proactive or corrective actions.

Short Emergent Objective 2. Use flood irrigation to inundate 50–70 percent of the potential irrigable acreage to a depth of ≤ 6 inches to promote conditions suitable for nesting shorebirds, such as Wilson's phalarope (*Phalaropus tricolor*). For example, if the surface water supply will allow for flood irrigation on 8,000 acres, then 4,000–5,600 acres will be shallowly flooded.

Short Emergent Objective 3. Maintain dry conditions on 10–20 percent (832–1,666 acres) of this habitat type to help upland ground-nesting passerines such as horned larks (*Eremophila alpestris*), savannah sparrows (*Passerculus sandwichensis*), vesper sparrows (*Pooecetes gramineus*), and western meadowlarks (*Sturnella neglecta*).

Contribution to the CCP

Approximately 14,000 acres of wet meadow habitat exists on the Baca NWR. Hydrologic inputs come from six creek systems originating in the Sangre de Cristo mountains to the east. Prior to Refuge establishment, when the property was a working cattle ranch, the goal of water management was to grow the highest quality grass across the greatest extent as possible. To accomplish this, many miles of irrigation ditch were dug and water control/diversion structures were installed. As a consequence, many areas of native upland habitat were converted to wet meadow vegetation, sustained by constant irrigation. However, with decreased water availability, the focus of water management is on applying irrigation water effectively and efficiently where wet meadow habitat naturally occurs. Similar to the other refuges, the modification of water control infrastructure is necessary to reduce irrigation of natural upland habitats and focus water inputs into natural wetland flowpaths (Figure 7).

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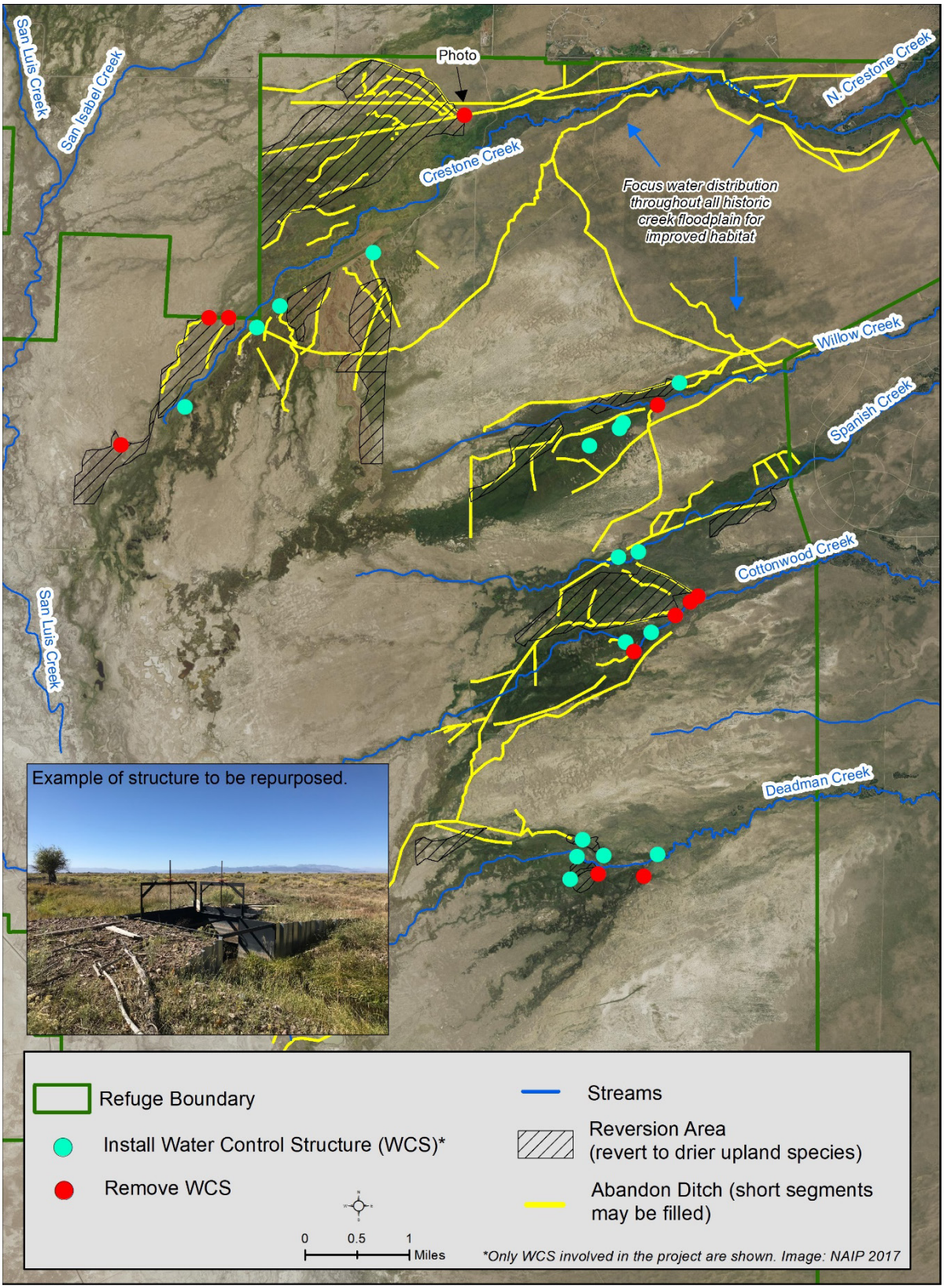

Figure 7: Restore Hydrology of Wet Meadows in Crestone, Spanish, Willow, Cottonwood, and Deadman Creek Drainages.

Installation of new water control/diversion structures in appropriate locations will facilitate the delivery of water directly into the upper areas of natural wetland flowpaths. Delivery of water directly into the upper areas of these flowpaths (allowing water to naturally flow through the flowpath) will result in greater efficiency of water use (more water being delivered to natural wetland areas) and improve the quality of desired vegetative species and other habitat conditions for migrating, foraging, and breeding for a wide array of native wildlife species, especially ground nesting birds. Removal of water control/diversion structures and ditches located on the higher ground (natural upland habitat) will allow these areas to revert back to a vegetation community typified by upland habitat in this area, benefitting upland wildlife species such as Brewer's sparrow (*Spizella breweri*), loggerhead shrike (*Lanius ludovicianus*), and sage thrasher (*Oreoscoptes montanus*).

SUB-ACTIVITY A: INSTALL WATER CONTROL/DIVERSION STRUCTURES WITHIN CREEKS AND LATERALS

Summary – Prior to Refuge establishment when the property was a working cattle ranch, many miles of ditch had been constructed and numerous water control/diversion structures have been installed in these ditches as well as the creeks. The goal of water management was to grow the most cattle forage as possible. As such, ditches and structures were placed on the highest ground possible, with the objective of maximizing the extent of wet meadow grasses and rushes. This resulted in a conversion of upland vegetation to wet meadow vegetation in many places. In recent years, the availability (volume and duration) of irrigation water has diminished and it has become difficult to efficiently distribute water using the existing infrastructure. Additionally, the annual maintenance required to maintain the integrity of these ditches and diversions is extremely difficult due to soil types (i.e., unstable soils) and sediment deposits. Similar to other upland sites that have been converted to wet meadow vegetation, when adequate water is not available to sustain healthy growth of vegetation, invasive plants begin to encroach and become established. As stated in the CCP, one of the Refuge's goals is to focus available refuge resources on applying irrigation water effectively and efficiently to areas where wetland habitat occurred historically.

Efficiencies Gained – Installing water control/diversion structures in more appropriate locations that deliver water as directly as possible to natural wetland flowpaths and meadows, avoiding irrigation of natural upland habitat, will improve water management efficiency, reduce labor and costs needed to maintain infrastructure integrity and invasive species control, and result in higher quality and quantity of desired vegetation in natural wetland flowpaths and wet meadows. To reduce costs, water control/diversion structures will be moved and repurposed to the greatest extent possible.

SUB-ACTIVITY B: REMOVE WATER CONTROL/DIVERSION STRUCTURES AND ABANDON DITCHES

Summary – As stated above, prior to Refuge establishment many miles of irrigation ditch and water control/diversion structures were constructed and installed to maximize the extent of quality cattle forage (typically wet meadow grasses). Many of these ditches and structured were designed to convert upland habitats to a vegetative condition characterized by wet meadow

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species. To sustain this vegetative community on upland soils requires consistent water application with the appropriate timing, volume, and duration of water. In recent years, water supplies have diminished and it has become difficult to provide adequate water to these areas. As a consequence, the quality of vegetation has diminished as well and invasive plants have begun to encroach and establish. Installing water control/diversion structures in locations that efficiently deliver water directly to natural wetland flowpaths and wet meadows (described above) combined with the abandonment of ditches and removal of structures that exist on high ground (natural upland habitat), will restore natural hydrologic conditions, allowing upland vegetation to reestablish in these areas.

Efficiencies Gained – Abandonment of ditches and removal of water control/diversion structures from natural upland areas will allow upland vegetation to reestablish, benefitting a wide array of wildlife species such as Brewer's sparrow, loggerhead shrike, and sage thrasher. Restoring native upland vegetation and appropriate hydrologic conditions will reduce invasive plant encroachment and establishment. Additionally, the need to provide labor and financial resources to maintain the integrity of this infrastructure will be eliminated.

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BACA NWR PROJECT II. PROTECT/RESTORE RIPARIAN/STREAM HABITAT BY CONSTRUCTING UNGULATE PROOF EXCLOSURES ON CRESTONE, WILLOW, COTTONWOOD, AND DEADMAN CREEK DRAINAGES.

Associated CCP Goals & Objectives

Habitat and Wildlife Goal: Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.

Riparian Objective 1. On the Baca NWR, by year 15, maintain existing reaches of healthy riparian habitats, which are defined as those with dense and multilayered woody vegetation. Restore the reaches of riparian habitat along about 21 miles of the Crestone, Willow, Cottonwood, and Deadman Creek drainages that are considered to be in poor condition with scattered mature plants and small patches of very small (< 2 feet tall) young willows and narrowleaf cottonwoods. Restoration potential will be based on hydrology, seedling regeneration, and other factors. On average, achieve > 35 percent canopy cover of about 15–30 feet wide to help riparian species, with an emphasis on breeding songbirds (see Table 16 in CCP for the focal birds that use riparian habitats).

Riparian Objective 2. On the Baca NWR, by year 15, achieve or maintain low browse levels (height of new growth each year exceeds browse height) by elk on > 25 percent or 5 miles out of 21 miles of riparian corridors.

Riparian Objective 3. On the Baca NWR, maintain hydrologic conditions (not dewatering streams; maintaining meanders; allowing sediment transport and position and allowing sufficient water to remain in creeks to support riparian vegetation growth and stream function) in creek channels and off-channel locations along 21 miles within the 4 creek drainages.

Contribution to the CCP

As on Alamosa NWR, maximizing the establishment, growth, and extent of woody riparian vegetation (willows and cottonwoods) is one of the Refuge's highest priorities. Riparian habitat provides necessary resources for a wide array of wildlife species, especially neo-tropical migratory songbirds. As stated in the CCP, the maintenance, enhancement, and restoration efforts will focus on providing a riparian community that has a diversity of plant species, age classes, and structure, and that is resilient and sustainable over the long term. Prior to Refuge establishment when the property was a working cattle ranch, the riparian habitat along the creeks on Baca NWR were heavily grazed, and likely had a significant negative effect on the extent and quality of woody (willow and cottonwood) habitat. Since Refuge establishment, cattle were removed from riparian habitats, however, there is a large elk population on the Refuge that exerts a tremendous amount of browsing pressure on the willow and cottonwood. Consequently, willow and cottonwood establishment, growth, and extent continues to be severely impacted. Although other actions have been undertaken to redistribute or reduce the elk herd size, these actions have resulted in little success. Construction of ungulate proof exclosures have proved successful in

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minimizing elk browse, allowing willows and cottonwoods to grow and spread. Construction of ungulate exclosures will result in protecting and restoring additional acres of willow and cottonwood habitat (Figure 8).

SUB-ACTIVITY A: CONSTRUCT UNGULATE FENCING ON CRESTONE, WILLOW, COTTONWOOD, AND DEADMAN CREEKS

Summary – Numerous ungulate exclosures have been constructed on Crestone Creek in recent years and have proved successful at keeping ungulates, especially elk, out of the riparian habitat. Inside the exclosures, data collected by Refuge staff demonstrate that there is an immediate growth response with many willow and cottonwood plants growing beyond the browse zone within a few years with patch sizes expanding. Outside the existing exclosures, browse pressure remains heavy with willow and cottonwood plants and plants continue to either die completely or are dying back to a lower lateral bud or even to the plant base. Under this current heavy browsing pressure, protection and restoration of riparian habitat is impossible.

Efficiencies Gained – Constructing ungulate exclosures on Crestone, Willow, Cottonwood, and Deadman Creeks will help achieve riparian and focal species objectives identified in the CCP by eliminating browsing pressure by ungulates, especially elk. Additionally, protecting willow and cottonwood communities in these areas may reduce labor necessary to harass elk out of these areas and the need to conduct lethal removal of elk (conducted by Colorado Parks and Wildlife).

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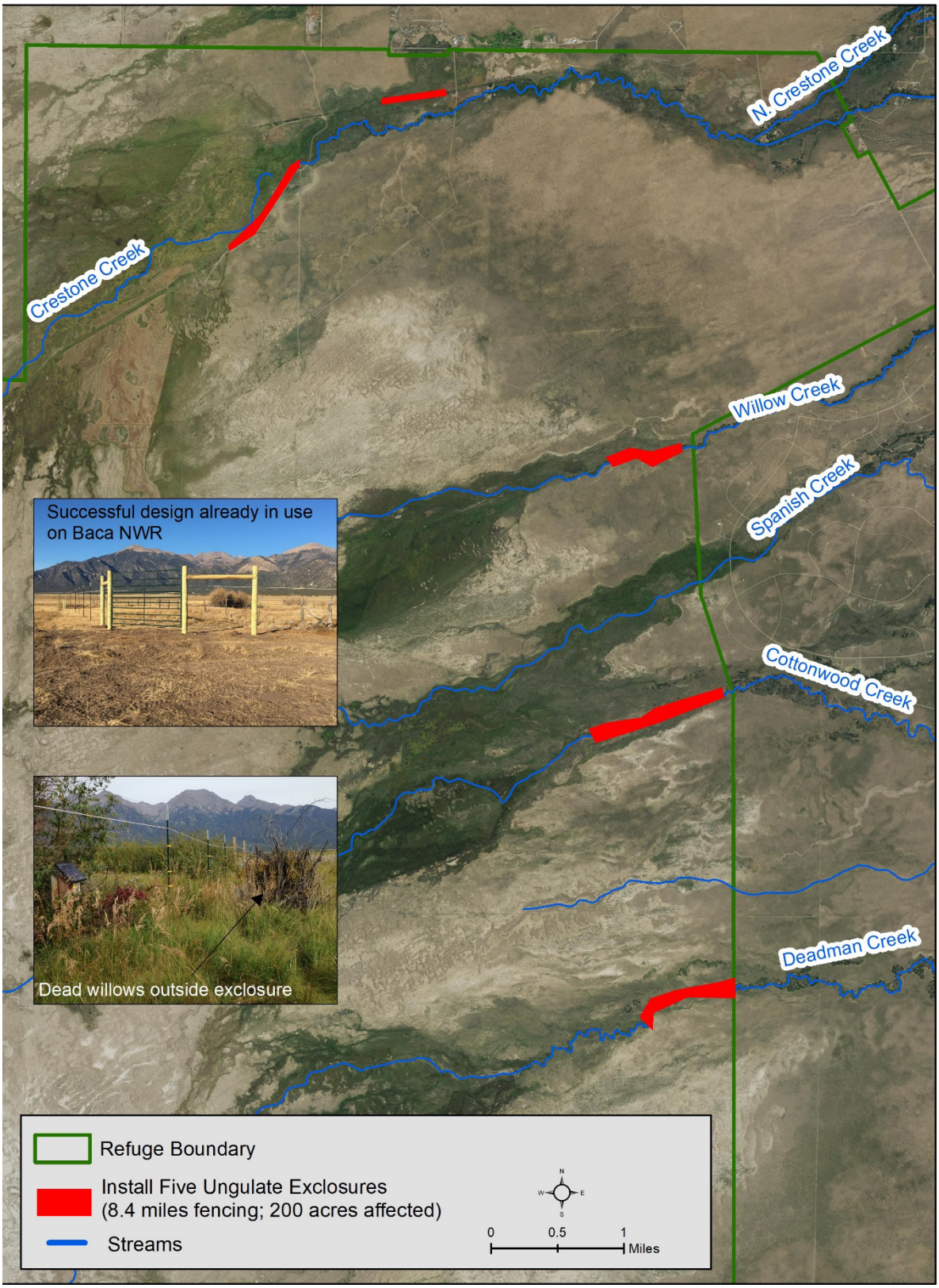

Figure 8: Protect/Restore Riparian/Stream Habitat by Constructing Ungulate Proof Exclosures on Crestone, Willow, Cottonwood, and Deadman Creek Drainages.

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APPENDIX A. KEY BACKGROUND AND GUIDANCE INFORMATION

WHAT IS THE HABITAT MANAGEMENT PLAN?

The definition provided in the HMP Policy 620FW 1 states: "A dynamic working document that provides the refuge managers a decision-making process; guidance for the management of refuge habitat; and long-term vision, continuity, and consistency for habitat management on refuge lands. Each plan incorporates the role of refuge habitat in international, national, regional, tribal, state, ecosystem, and refuge goals and objectives; guides analysis and selection of specific habitat management strategies to achieve those habitat goals and objectives; and utilizes key data, scientific literature, expert opinion, and staff expertise".

ESTABLISHING LEGISLATION AND PURPOSE

The 14,834-acre Monte Vista NWR was established in 1952 as the first national wildlife refuge in Colorado. Alamosa NWR was established in 1962 and encompasses about 12,026 acres. Both Refuges were established under the authority of the 1929 Migratory Bird Conservation Act (45 Stat. 1222; 16 U.S.C. §715d) "…for use as inviolate sanctuaries, or for any other management purposes, for migratory birds."

Baca NWR was authorized with passage of Public Law 106-530 (16 U.S.C. 410hhh-4), as part of the Great Sand Dunes National Park and Preserve Act of 2000, and its authorized boundary is about 92,500 acres. The Refuge was established by Secretarial Order in 2003 with the acquisition of the first parcel. The authorizing legislation was amended in part by the Omnibus Public Land Management Act of 2009, Public Law No. 111-11, resulting in the following purpose:

> *The purpose of the Baca National Wildlife Refuge shall be to restore, enhance, and maintain wetland, upland, riparian, and other habitats for native wildlife, plant, and fish species in the San Luis Valley. In administering the Baca National Wildlife Refuge, the Secretary shall, to the maximum extent practicable - (A) emphasize migratory bird conservation; and (B) take into consideration the role of the Refuge in broader landscape conservation efforts; and (C) subject to any agreement in existence as of the date of enactment of this paragraph, and to the extent consistent with the purposes of the Refuge, use decreed water rights on the Refuge in approximately the same manner that the water rights have been used historically.*

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REFUGE GOALS

The long-term management goals of the San Luis Valley National Wildlife Refuge Complex as stated in the 2015 Comprehensive Conservation Plan (CCP) are:

- **Goal 1.** Conserve, restore, and enhance the ecological diversity and function of the San Luis Valley ecosystem to support healthy populations of native fish and wildlife, with an emphasis on migratory birds.
- **Goal 2.** As climate patterns change, we will protect, acquire, and manage surface and ground water resources to maintain and support management objectives.
- **Goal 3.** Provide safe, accessible, and quality wildlife-dependent recreation and perform outreach to visitors and local communities to nurture an appreciation and understanding of the unique natural and cultural resources of the Refuge complex and the San Luis Valley.
- **Goal 4.** Secure and effectively use funding, staffing, and partnerships for the benefit of all resources in support of the Refuge complex purposes and the mission of the Refuge System. Actively pursue and continue to foster partnerships with other agencies, organizations, the water community, and private landowners to conserve, manage, and provide for the long-term sustainability of working landscapes within the San Luis Valley ecosystem.
- **Goal 5.** Protect significant cultural resources within the San Luis Valley National Wildlife Refuge Complex.
- **Goal 6.** Use sound science, applied research, monitoring, and evaluation to advance the understanding of natural resource functions, changing climate conditions, and wilderness values in the management of the habitats within the San Luis Valley ecosystem.

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SIGNATURE PAGE

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