RECLAMATION

Managing Water in the West

Pecos River Channel Restoration at the Bitter Lake National Wildlife Refuge, Chaves County, New Mexico

Environmental Assessment

U. S. Department of the Interior
Bureau of Reclamation
Albuquerque Area Office
Environment Division
Albuquerque, New Mexico

January 2009

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

The mission of the U.S. Fish & Wildlife Service is working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.

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Environmental Assessment

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Bureau of Reclamation
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FINDING OF NO SIGNIFICANT IMPACT

Pecos River Channel Restoration at the Bitter Lake National Wildlife Refuge
Chaves County, New Mexico

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BACKGROUND

Historically the Middle Pecos River was a wide, sediment-ladened braided river with a diversity of habitats, ranging from low-velocity backwaters to swift main channel settings. Under the natural river regime, flood flows periodically changed the river course within the floodplain. Various species, especially fish, adapted to this type of dynamic river channel and the variety of habitat that it provided. Since 1942, the ecological conditions within the Bitter Lake National Wildlife Refuge (NWR) section of the Pecos River have been degraded by excavating straight channels, encroaching nonnative vegetation, and controlling reservoir flows. As part of the Endangered Species Act consultation process associated with the Carlsbad Project Water Operations and Water Supply Conservation Final Environmental Impact Statement, the Bureau of Reclamation agreed to "partner with Federal, state, and private entities to participate and assist in the completion of ongoing habitat improvement projects on the Pecos River."

SUMMARY OF THE PROPOSED ACTION

The environmental assessment (EA) addresses phased proposals over the next ten years to improve the riparian and in-channel habitat along approximately seven river miles of the Pecos River in the Middle Tract of the Bitter Lake NWR by restoring the river flows to dynamic conditions. A combination of restoration techniques would be used that include removing vegetation, lowering banks, changing the channel morphology, restoring flow into historic oxbows, and revegetating. The preferred plan involves two phases of habitat improvement projects within the refuge, which are discussed in detail and that reflect the current level of planning and proposed design. The preferred plan projects also reflect future actions on other river segments, which are analyzed more generically, commensurate with the level of available information.

Reclamation would conduct the restoration activities for Phase I in Reach 4 in collaboration with the US Fish and Wildlife Service (the Service). Proposed restoration techniques include plugging and diverting the river into a historic oxbow (Oxbow 4) in Reach 4, excavating a meandering channel within the oxbow (12 feet wide at the base and 44 feet wide at the top), removing nonnative vegetation, lowering banks, and revegetating. The reconnected channel would replace approximately 3,000 feet of the current channel with approximately 8,200 feet of channel in the historic oxbow. The anticipated amount of reconnected floodplain is expected to total 179 acres. The new channel would total approximately 1,018 acres.

Phase II restoration would be conducted in Reaches 2 and 3 by a collaborative partnership consisting of the Service, the World Wildlife Fund and the New Mexico Interstate Stream Commission (NMISC), with funding from the State of New Mexico. Proposed restoration actions include removing nonnative vegetation from bank levees and active bars to deter the development of armored levees. Following this removal, additional restoration would be undertaken as needed, including lowering the banks, reconnecting a small oxbow lake with the northern part of Reach 2, and revegetating. The combined width of the channel and floodplain could be restored up to 350 feet, providing room for the existing 150-foot-wide channel and adequate floodplain. The Phase I and Phase II restorations are planned to begin in the winter of 2009.

Over the next ten years, the Service would continue to pursue partnerships and funding to conduct additional restoration in Reaches 1, 2, 3, and 4. The proposed combination of restoration

activities would be tailored to the specific characteristics of each reach, complementary to Phases I and II, and similar in scope. The Proposed Action is inclusive of the Phase I and Phase II work, as well as additional restoration actions that may be conducted at Reaches 1 through 4 as funding becomes available.

ENVIRONMENTAL IMPACTS RELATED TO THE RESOURCES OF CONCERN

The effects of the proposed action and reasons for a Finding of No Significant Impacts are addressed in detail in the EA and are summarized below.

Land Use—The Bitter Lake NWR is bordered by private land, Bureau of Land Management-(BLM-) administered land, and state trust lands. Surrounding land uses include residential, farming and ranching, recreational, mining, and oil and gas development. Special management areas in the Middle Tract of the Bitter Lake NWR include the 300-acre Bitter Lake Research Natural Area (RNA) and the 700-acre Lake St. Francis RNA. There would be no change or effects on surrounding land uses, no anticipated effects on refuge facilities and infrastructure, and no effects on the refuge research natural areas or the Salt Creek Wilderness in the North Tract of Bitter Lake NWR.

Geology and Soils—There are no prime or unique farmlands in the proposed project area. The proposed restoration techniques for Phases I and II would disturb soil along the banks, floodplain, and terraces in the project area, access routes, on-site disposal areas, and staging areas. Mechanical clearing methods would remove soil and vegetative cover, leaving soils exposed and subject to wind and water erosion. Abatement measures would be used to reduce dust. Soils would be subject to minor short-term compaction from heavy equipment use. There would be long-term minor improvement in soil quality, primarily by removing salt caused by saltcedar. No loss of prime and unique farmlands or mineral resources is expected.

Air Quality—The Salt Creek Wilderness is designated as a Class I area. The rest of the Bitter Lake NWR, including the proposed project area, is considered a Class II air quality area. Air quality at the Bitter Lake NWR is good, with blowing dust being the most immediate air pollution problem. Implementing the Proposed Action would result in short-term increases in fine particulate matter (PM_{10}) and other pollutants due to construction. Visibility impacts due to dust and smoke from burning woody debris would be temporarily visible within the Class II air quality area, which allows for moderate amounts of air quality degradation. The Salt Creek Wilderness Class I airshed would not likely be impacted due to distance and the southwesterly prevailing winds. Effects are anticipated to be negligible.

Water Resources—The Bitter Lake NWR includes a large variety of surface water types, including arroyos, spring-fed streams, isolated oxbow lakes, large and small playa lakes, developed impoundments, artesian springs, and approximately sixty sinkholes throughout the refuge. The Proposed Action is designed to minimize risks of damage or loss of other surface water features. It is designed to have a major long-term positive effect on channel morphology, sinuosity, and river function within the physical context of current conditions and river operations. Bank lowering and grading of vertical cut banks, along with the changes in channel morphology, would reduce the current bank cutting and improve sediment transport. Care would be taken to minimize any detrimental effects of sediments and debris, as outlined in Chapter 5, Environmental Commitments. The lead agencies would ensure the implementation of the

conditions regarding soil, sediments, and debris, as required by the Section 404 Nationwide Permit 27 from the US Army Corps of Engineers (USACE) and the New Mexico Environment Department (NMED) Surface Water Quality Bureau (SWQG) Section 401 water quality certification.

The effects of the Proposed Action on flood control would be moderate and beneficial. Reconnecting the channel with the floodplain and returning sinuosity to its length would improve flood peak attenuation and flood flow storage. There would be a loss of oxbow lake habitat, but these features are not unique on the refuge. Effects on other surface water features should be negligible or minor and positive.

The two major aquifers that provide the largest supplies of water are the Permian artesian aquifer and the shallow-water aquifer in the alluvium deposits and terraces. While the Proposed Action would increase the area subject to evaporation loss, full implementation of Phase I and Phase II may result in increased flow in the Pecos River channel due to greater connectivity with the local aquifer. Removing nonnative phreatophytes from the channel banks may also initially increase water to the system, although the NMISC does not recognize any credit for water salvage activities. Surface water features that are connected to the shallow aquifer may benefit from higher water tables. Effects on the deeper artesian aquifer are unknown.

Potential contaminant sources in the area include natural salinity, irrigated agriculture, grazing, feedlots, oil and gas production wells and pipelines, septic tanks, and historic municipal wastewater discharges to Hunter Marsh, a natural wetland at the south end of the Middle Tract. The Proposed Action would cause short-term increases in sedimentation in the river from ground disturbance, exposed soils, and erosion and could result in minor risk of inadvertent discharge of pollutants into surface waters from construction equipment. Water from the oxbow lake would be added to the main stem of the river, temporarily increasing organic matter immediately after reconnecting the oxbow. These short-term impacts and risks would be minimized by implementing control measures. Negligible and short-term effects on water quality are anticipated during restoration work. As beneficial vegetative cover returns, long-term water quality in this section would improve in the long term to a better balance between flows and sediment loads, thereby restoring the sand beds and floodplain and reducing salt deposited by saltcedar. Better river function can also improve the ability of the river to contend with pollutants from other sources.

The Proposed Action would not exceed water rights held by the Bitter Lake NWR or affect the water rights of other parties. Based on conservative estimates of water usage—that is, higher than would likely occur—the NMISC anticipates that Phase I restoration may consume 1.9 ac ft/yr, and Phase II may consume 7.6 ac ft/yr, for a total of 9.5 ac ft/yr (Appendix C). The Service will monitor long-term effects and will work with the NMISC to address any depletions.

Biological Resources—Areas adjacent to the water courses contain riparian vegetation composed primarily of coyote willow, seepwillow, common reed, and exotic saltcedar. Common reed, Russian thistle, kochia, and saltcedar are the major invasive plant species on the refuge. Removing the saltcedar would allow the development and expansion of more diverse riparian vegetation and habitat capable of supporting a greater variety of wildlife. Other species, such as

willows, cottonwoods, grasses, and cattails on the banks, may be affected by mechanical removal. There would be a short-term loss of natural cover provided by vegetation.

Refuge wetlands, ranging from relatively freshwater flowing streams and oxbow lakes to brackish impoundments and natural sinkholes to hypersaline playa lakes, support a variety of plant and animal species and are vital to migratory birds. The isolated gypsum springs, seeps, and associated wetlands protected by the refuge have been recognized as providing the last known habitats in the world for several unique species. Long-term positive effects for wetland vegetation and function are anticipated by removing saltcedar, reconnecting the river and the floodplain, and creating the new meanders. These actions are anticipated to result in a higher water table, more diverse plant communities, and more areas where self-sustaining wetlands would develop. No adverse effects are anticipated on refuge impounded wetlands or other wetlands outside of the immediate vicinity of the Pecos River.

To date, over 360 bird species have been documented on the refuge, including 44 nesting species. In addition, 59 mammal species, 40 reptile species, 12 amphibian species, and 24 fish species have been identified on the refuge and surrounding area. The refuge also supports one of the most diverse populations of dragonflies and damselflies in North America. Long-term positive effects are anticipated for wildlife species. Restored channels, floodplains, wetlands, and riparian vegetation are expected to increase the abundance of birds, mammals, reptiles, amphibians, and fish relative to expanded habitat availability and quality. During restoration, some wildlife species may be killed and their dens or nests destroyed by heavy equipment. Noise associated with restoration could also affect nesting or reproductive behavior of some species. However, work would be conducted outside of nesting seasons and locations, and expected wildlife loss would be very limited. These minor short-term adverse impacts in areas of poor habitat would be outweighed by the overall benefits to wildlife and habitat that would result from the Proposed Action during the life span of the project.

Chaves County includes over 75 special status species, including New Mexico species of concern, many of which are found on the refuge. The Bitter Lake NWR provides a critical role in maintaining a sanctuary for at least 27 state or federal threatened, endangered, or candidate species. Because the Bitter Lake NWR has been identified as important core conservation and recovery area for the Pecos sunflower, restoration actions will be coordinated with the current review of water and wetlands management at the refuge. The Pecos sunflower should benefit from the removal of saltcedar through less competition and gradually reduced soil salinities. The one population of Pecos sunflowers in the critical habitat that could be negatively affected by the proposed action would be protected by rock vane revetment structures.

Protected aquatic invertebrates include the Roswell springsnail, Koster’s springsnail, Noel’s amphipod, and Pecos assiminea. Restoration is not expected to negatively impact their habitats, which are located far from the Proposed Action and the river, although negligible or minor beneficial effects could occur if a higher water table were to improve spring flows or to support suitable habitat.

Migratory and nesting birds were the primary reason that the refuge was chartered. Special status migrant or wintering bird species include the bald eagle, American peregrine falcon, Baird’s sparrow, mountain plover, southwestern willow flycatcher, Bell’s vireo, brown pelican, and the

neotropical cormorant. A small population of interior least terns has nested at the Bitter Lake NWR consistently for over 50 years. Depending on the season, the Proposed Action may have minor short-term negative effects on some special status migratory birds due to noise and removal of vegetation used for cover, perches, or possibly nesting. There are no negative impacts on the interior least tern expected from this action. The restoration is not expected to create any additional nesting areas along the river but may provide additional feeding and loafing areas in backwaters and small sandbars. Removal of saltcedar would remove habitat used potential predators of nesting terns. The action should also enhance the abundance and accessibility of tern prey (fish and invertebrates).

Fish species include the Arkansas River shiner, Pecos gambusia, Pecos pupfish, Mexican tetra, greenthroat darter, and the Pecos bluntnose shiner. The proposed restoration is expected to have long-term minor to moderate beneficial effects on shiner reproduction, recruitment rates, and survival at all of its life stages. The Proposed Action would result in negative effects on the shiner during restoration from the use of construction equipment in the channel and disturbance of sediments. Impacts would be short term but could result in take of a small number of the species. Through its Intra-Service Section 7 consultation, the Service has determined that the Pecos River Restoration at Bitter Lake National Wildlife Refuge, Chaves County, New Mexico may affect, but is not likely to adversely affect, the Pecos bluntnose shiner. The restoration is expected to improve habitat for other riverine fishes. The Pecos gambusia is not found in the Pecos River but lives in spring heads and sinkholes at off-channel sites and would not be negatively affected by the restoration.

Cultural Resources—With the exception of the staging and river access locations, work would be conducted in active or recently active floodplains, channels, or oxbows, which are a highly disturbed setting. No cultural resources have been recorded or are expected to be present in the proposed restoration project area. The New Mexico Office of Historic Preservation has concurred that the Proposed Action is not expected to have any effects on cultural resources. No concerns or traditional cultural properties were identified by the parties consulted.

Recreation—Principal recreation at the Bitter Lake NWR include wildlife observation, hiking, photography, environmental education, and limited hunting and camping. Implementing the Proposed Action would result in long-term beneficial recreation impacts with an increase in the abundance and variety of wildlife and more recreation and interpretive opportunities in the restored areas near the Pecos River. Minor short-term negative effects on wildlife-based recreation in the refuge would result from construction.

Visual Resources—In the long term, visitors may experience improved visual quality of the site and its surroundings consistent with natural riparian function and vegetation. The viewing platform at the Phase I restoration site would create a new viewpoint and afford the public a new opportunity to observe the Pecos River in the restored oxbow. Short-term minor negative effects on visual resources in the refuge would result from construction vehicles and equipment, dust, and the loss of vegetative cover.

Noise—Noise levels at Bitter Lake NWR are very low. As a wildlife refuge and a location for wildlife observation there is a higher degree of sensitivity to increases in noise levels. The noise from construction would be short term, variable, and minor but may exceed 80 dBA in the

immediate vicinity of the activity. With the exception of the Phase I construction, most actions would be half a mile or more from the auto loop and other popular visitor facilities.

Socioeconomics—The Proposed Action would result in minor temporary increases in federal spending in Chaves County for construction support materials, fuels, and labor. In the long term, there would be indirect positive impacts on local and regional economies that may result from the restoration. New recreation opportunities in the restored areas may lead to increased refuge visits and visitor spending in the local economy.

Environmental Justice—Implementing the Proposed Action would not result in any disproportionate impacts on minority or low-income communities, so there would be no environmental justice impacts.

Indian Trust Assets—Twelve tribes and Native American pueblos have been solicited for their interest in government-to-government consultation on Indian Trust Assets and cultural resource concerns. No Indian Trust Assets have been identified in the project area, and no Indian Trust Assets are believed to be affected by restoration. There are no reservations or ceded lands present. Reclamation will provide tribes and pueblos with the draft EA and again afford them the opportunity to comment and enter into government-to-government consultation. Because resources are not believed to be present, no impacts are anticipated to result.

ENVIRONMENTAL COMMITMENTS

The environmental commitments to minimize potential adverse effects listed in detail in Chapter 5 of the EA will be implemented during construction and as part of the post-construction site restoration activities. All applicable permits have been obtained and all required consultations will be completed before each phase of the project begins. Specific lead agency responsibilities are addressed in agreement documents provided in Appendix A of the EA. These permits include or may include the following:

- Clean Water Act, Section 404, Nationwide Permit 27;
- Clean Water Act, Section 401, State Water Quality Certification;
- National Pollutant Discharge Elimination System permit; and
- Stormwater Pollution Prevention Plan.

Environmental commitments include the following:

- Establishing a monitoring program (outlined in Appendix B of the EA) to determine the river's response to restoration, including surface flows, groundwater levels, channel morphology, water budget, sediment, debris, and the effects of restoration on vegetative, avian, and fish communities;
- Implementing specific mitigation measures to avoid impacts on threatened and endangered species and their habitats, as identified in the Intra-Service 7 Consultation (Appendix E);
- Implementing specific permit conditions outlined in the Clean Water Act, Section 404, Nationwide Permit 27 and Section 401, State Water Quality Certification (Appendix E);
- Armoring the eastern extent of the historic oxbow channel with rock vane revetments to decrease the risk to the refuge ponds, refuge road, and Pecos sunflower habitat;

- Controlling soil erosion and sediment during construction;
- Scheduling work within the river during periods of low flow or no flow;
- Minimizing airborne soil transport and PM_{10} through dust suppression;
- Minimizing impacts on seed germination, plants, water quality, and air quality during burning of woody debris through procedures outlined in site-specific burn plans;
- Maintaining channel capacity to pass normal and high flows;
- Complying with approved state or local floodplain management standards;
- Prohibiting the use of unsuitable materials in the river;
- Avoiding the potential for discharge of toxic pollutants into the river;
- Minimizing adverse effects on aquatic ecosystems from impoundments, flow acceleration, or flow restrictions during construction;
- Flagging and avoiding Pecos sunflowers and their habitats;
- Seining and relocating Pecos bluntnose shiners upstream from isolated pools and the portion of the Pecos River that will be filled with sediment;
- Conducting preconstruction surveys and preparing guidelines to avoid impacts on birds;
- Ensuring that there is no activity in the vicinity of least tern nesting colonies or populations of Koster's springsnails, Noel's amphipods, Roswell springsnails, and Pecos assimineas;
- Washing construction equipment before use to identify any leaks and to reduce the potential for introducing additional invasive species to the refuge;
- Briefing workers and implementing measures to stop work immediately and notify the Service archaeologist if archaeological resources or human remains are discovered or suspected during construction, restoration, or monitoring;
- Selectively revegetating disturbed areas with desirable species as funding and staffing permit; and
- Assessing and reducing noise impacts on wildlife, workers, and refuge visitors.

COORDINATION

All required consultations will be completed before each phase of the project begins.

Required consultations	Agency	Phase I	Phase II
Clean Water Act, Section 404 Permit	US Army Corps of Engineers	Complete	Complete
State Water Quality Certification under CWA, Section 401	New Mexico Environment Department, Surface Water Quality Bureau	Complete	Complete
Section 106, National Historic Preservation Act	New Mexico Office of Historic Preservation, Interested Tribes and Stakeholders	Complete	Complete
Section 7, Endangered Species Act	US Fish and Wildlife Service	Complete	Complete
National Pollutant Discharge Elimination System (NPDES) Permit and Storm Water Pollution Prevention Plan	Environmental Protection Agency	If needed, to be addressed before construction	If needed, to be addressed before construction

Agencies, government entities, and tribal groups contacted or contributing to the development of the restoration project or the EA or those consulted during its preparation include the following:

- US Bureau of Reclamation;
- US Army Corps of Engineers;
- US Fish and Wildlife Service, Bitter Lake National Wildlife Refuge;
- US Fish and Wildlife Service, New Mexico Ecological Services;
- US Fish and Wildlife Service, New Mexico Fishery Resources;
- New Mexico Department of Game and Fish;
- New Mexico Interstate Stream Commission;
- New Mexico State Historic Preservation Division;
- New Mexico Environment Department;
- Carlsbad Irrigation District;
- Chaves County;
- Chaves County Flood Control District;
- DeBaca County;
- Eddy County;
- Guadalupe County;
- Pecos Valley Artesian Conservancy District;
- Pueblo of Jemez;
- Kiowa Tribe of Oklahoma;
- Fort Sill Apache Tribe of Oklahoma;
- Apache Tribe of Oklahoma;
- Hopi Tribe;
- Navajo Nation;
- Jicarilla Apache Nation;
- Comanche Indian Tribe;
- Pueblo of Ysleta del Sur;
- Pueblo of Isleta; and
- Mescalero Apache Tribe.

CONCLUSION

In accordance with the National Environmental Policy Act of 1969 and based on the analysis in the EA, coordination with agencies, stakeholders and tribes, public comments, and environmental commitments, the Bureau of Reclamation and the US fish and Wildlife Service have determined that implementing the preferred plan presented in the EA for Pecos River Channel Restoration at the Bitter Lake National Wildlife Refuge, Chaves County, New Mexico, would not result in a significant impact on the human environment and does not require preparation of an environmental impact statement.

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List of Acronyms and Abbreviations

AF	Acre-foot or acre-feet
AFY	Acre-feet per year or annum
APE	Area of potential effects
BMPs	Best Management Practices
BO	Biological Opinion
CCP	Comprehensive Conservation Plan
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CID	Carlsbad Irrigation District
Compact	Pecos River Compact
CWA	Clean Water Act
EA	Environmental Assessment
ET	Evapotranspiration
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FSID	Ft. Sumner Irrigation District
HPZ	Habitat protection zone
ITAs	Indian Trust Assets
mg/kg	milligrams per kilogram
mts	Mean topographic surface
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMDA	New Mexico Department of Agriculture
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMISC	New Mexico Interstate Stream Commission
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWR	National Wildlife Refuge
OSE	New Mexico Office of the State Engineer
PCB	Polychlorinated biphenyls
ppm	parts per million
PVACD	Pecos Valley Artesian Conservancy District
Reclamation	Bureau of Reclamation
ROD	Record of Decision
RPM	Reasonable and Prudent Measure
shiner	Pecos bluntnose shiner
SHPO	State Historic Preservation Office
SWPPP	Stormwater Pollution Prevention Plan
USACE	US Army Corps of Engineers
USDI	US Department of the Interior
TCPs	Traditional Cultural Properties

TDS	Total Dissolved Solids
Service	US Fish and Wildlife Service
WWF	World Wildlife Fund

1. Purpose of and Need for the Proposed Action

1.1 Introduction

This Environmental Assessment (EA) has been prepared by the US Department of the Interior (USDI), Bureau of Reclamation (Reclamation) and the USDI, Fish and Wildlife Service (Service) to evaluate the environmental, cultural, and socioeconomic impacts of Pecos River Channel Restoration within the Bitter Lake National Wildlife Refuge (NWR) in Chaves County, New Mexico. This analysis was carried out to meet requirements of the National Environmental Policy Act of 1969 (NEPA)[1] and the Endangered Species Act of 1973, as amended (ESA).

Reclamation's mission is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public. In July 2006, Reclamation issued a Record of Decision (ROD) for the Carlsbad Project Water Operations and Water Supply Conservation Final Environmental Impact Statement (EIS) (Reclamation 2006a). The ROD mandated changes in water operations within the Pecos River in order to conserve the federally threatened Pecos bluntnose shiner (*Notropis simus pecosensis*) (shiner) and its designated critical habitat, while conserving the Carlsbad Project water supply. As part of the consultation process under the ESA, the Service issued a Biological Opinion (2006 – 2016) on the selected alternative from the EIS (US Fish and Wildlife Service 2006; Reclamation 2006a). Under Reasonable and Prudent Measure 1 (RPM #1) of the Biological Opinion, Reclamation agreed to "partner with Federal, state, and private entities to participate and assist in the completion of ongoing habitat improvement projects on the Pecos River and to restore 1-1.5 miles of quality habitat within the Farmlands reach by 2009 and another 1-1.5 miles by 2014." Reclamation is proposing to conduct the first of these habitat improvement projects under RPM #1 with the Service at Bitter Lake NWR. These actions would be done in conjunction with other restoration activities within the wildlife refuge.

> A reach is an extended portion of a stream or river usually between two defined points. The Farmlands reach is that section of the Pecos River between the Acme Gage and the Brantley Dam. Within the Bitter Lake NWR, the Pecos River is discussed in terms of five reaches, Reach 1 through Reach 5 (see Sections 1.1.1, 1.1.2, and 2.1.1 for more detail).

[1] 42 USC § 4321 et seq., the Council on Environmental Quality (CEQ) regulations for implementing NEPA, 40 CFR Parts 1500-1508, and the final revised procedures for implementing NEPA for actions by Reclamation (Chapter 14) and the Service (Chapter 8) in the Department of the Interior, Departmental Manual, 516 DM 6.

The Service is the principal agency responsible for conserving, protecting, and enhancing fish and wildlife and their habitats. As part of this responsibility, the Service manages a diverse network of more than 500 National Wildlife Refuges. The Bitter Lake NWR in Chaves County, New Mexico, is part of this network. Current management of the Bitter Lake NWR is guided by the Bitter Lake NWR Comprehensive Conservation Plan (CCP) (Research Management Consultants 1998). One of the goals of the CCP for the Bitter Lake NWR is the "maintenance and restoration of a hydrological system that mimics to the extent possible the natural processes along the Pecos River drainage (within the Refuge)." An objective under that goal is to "restore a more natural stream morphology and floodplain geometry to the reach of the Pecos River within the refuge in order to benefit native aquatic and riparian plant and animal communities."

Reclamation and the Service are proposing to restore portions of the river channel at the Bitter Lake NWR in phases. Because the actions evaluated in this document would occur on federal property, would receive federal funding, and would require federal permits and approvals, environmental documentation under NEPA is required. In accordance with NEPA, Reclamation and the Service have prepared this EA to address the environmental effects of the proposed river channel restoration. The EA addresses direct, indirect, and cumulative effects of the proposed channel restoration and habitat enhancement activities.

Two habitat improvement projects within the refuge are discussed in greater detail, reflecting the current level of planning and proposed design. Actions on other river segments are analyzed more generically, commensurate with the level of available information.

Reclamation and the Service are joint lead federal agencies for this action. Reclamation is proposing to fund, design, and conduct channel habitat restoration only at Reach 4. The Service would be the responsible federal agency for other proposed restoration actions and any related refuge improvements. Reclamation is leading the team preparing the EA and is responsible for day-to-day NEPA project management. Reclamation is also responsible for ensuring compliance with the applicable federal environmental statutes and for maintaining the quality of the content of the EA. Reclamation will assist in developing and funding the monitoring program.

The Service is participating in all aspects of the NEPA process and analysis. The Service has prepared the internal Section 7 documentation and the 401/404 permit application and will facilitate access to the refuge. The Service, in collaboration with the World Wildlife Fund-Chihuahuan Desert Program (WWF) and the New Mexico Interstate Stream Commission (NMISC), is proposing to manage, fund, and conduct the Phase II restoration at Reaches 2 and 3. Additional restoration actions may be conducted by the Service at Reaches 1 through 4 as funding becomes available. A detailed description of the components of the Proposed Action is found in Section 2.2.

1.1.1 Location

The Bitter Lake NWR is approximately nine miles northeast of Roswell, New Mexico, in Chaves County (Figure 1-1, Location Map). The Bitter Lake NWR consists of 24,536 acres in three noncontiguous units along the Pecos River. The North Tract occupies approximately 12,160 acres and includes the 9,620-acre Salt Creek Wilderness. The Middle Tract is composed of approximately 11,000 acres and contains the refuge headquarters, auto-tour loop, Bitter Lake, several sinkholes and natural wetlands, desert uplands, riparian areas, and impoundments. The South Tract, or Farm Unit, consists of approximately 1,000 acres primarily used for agricultural croplands. The South Tract is closed to most public access, although special youth pheasant hunts are conducted. Access to the North Tract is limited to hikers and horseback riders. Hunting is permitted in accordance with state seasons and regulations. The Pecos River passes through all three of the refuge units.

1.1.2 Background

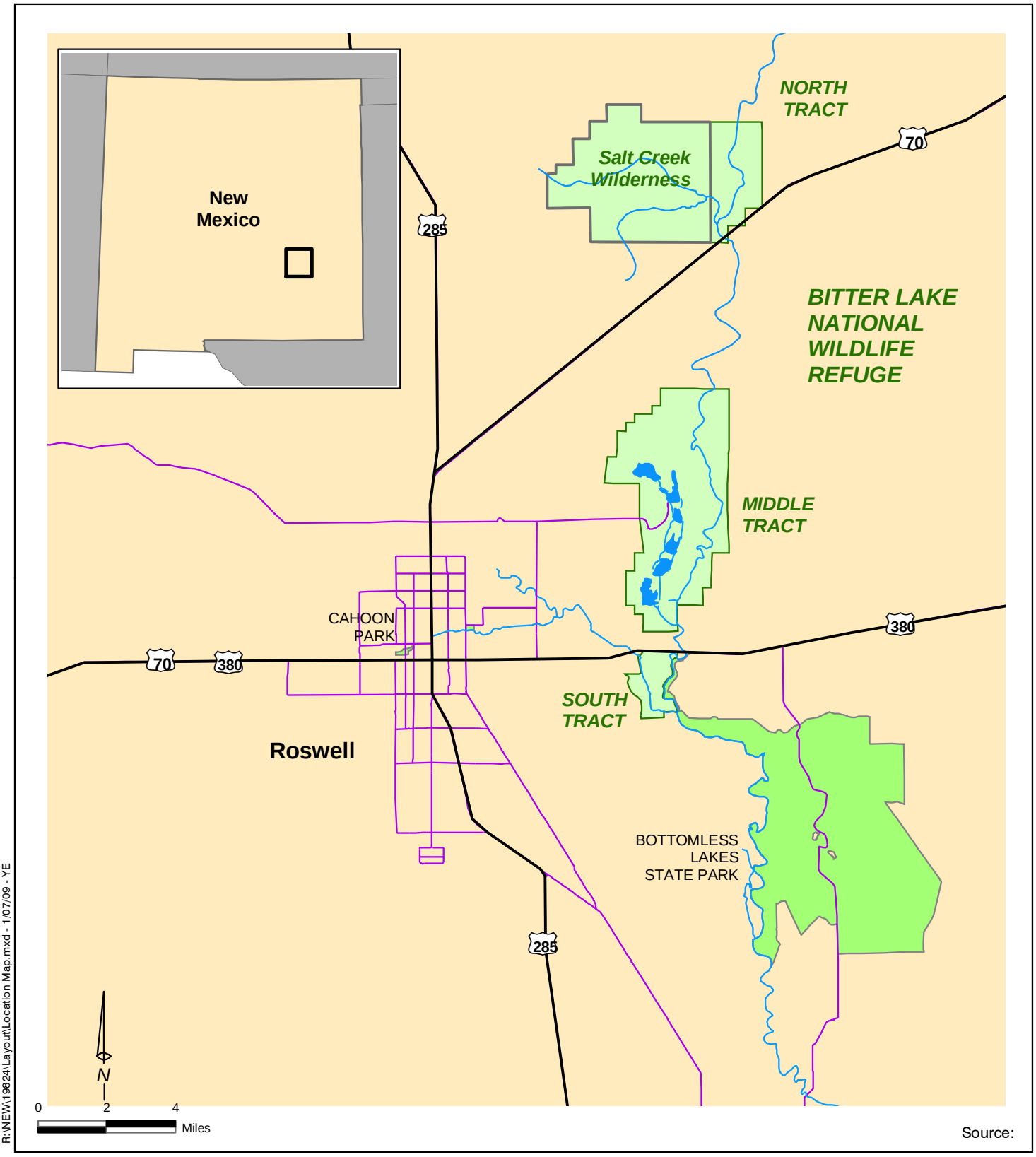
Historic Changes to the Pecos River and Riparian Habitat

The Pecos River spans roughly 920 river miles, from its headwaters in the Sangre de Cristo Mountains of northern New Mexico to its confluence with the Rio Grande near Langtry, Texas. Under the natural river regime, periodic flooding changes the river course within the floodplain. Various species, especially fish, adapted to this type of dynamic river channel and the variety of habitat that it provided. Water development and reclamation projects, including channelization, dam and levee construction, bank protection, diversions, and stream flow regulation, have altered the riparian system and contributed to vegetation loss. Native riparian vegetation along the Pecos River and its tributaries has been greatly reduced in the last 100 to 120 years. Riparian habitat is critically important for various threatened and endangered species, migratory birds, fish, native wildlife, and plants.

Important resources for both humans and wildlife in the semiarid western United States are connected with river systems and their associated wetland and riparian communities. The diversion of water and use of water management features along the Pecos River preceded Euroamerican settlement of the region. Beginning in the nineteenth century and continuing through the twentieth century, an extensive system of water retention and conveyance infrastructure, including diversion structures, dams, levees, drains, and ditches, was constructed for irrigation, flood, and sediment control. Supplemented by wells, this system allowed the growth of an agricultural-based economy and the expansion of cities along the river.

Middle Pecos River

The Middle Pecos River is the reach from Sumner Reservoir to Brantley Reservoir. It consists of 220 river miles of range and farmland on the plains of eastern New Mexico along with Bitter Lake NWR. Historically the Middle Pecos River was a wide, sediment-laden, braided river with a diversity of habitats, ranging from low-velocity backwaters to swift main channel settings. These habitats were maintained by flooding, which moved



Location Map
Bitter Lake National Wildlife Refuge

Chaves County, New Mexico

Tetra Tech, Inc

Figure 1-1

sediments between the channel and the floodplain. This dynamic relationship sculpted a wide channel, moved sediment from the floodplain back into the channel, and formed new floodplains with channel sediment (FLO Engineering 1999).

For purposes of fish surveys and habitat considerations, the Middle Pecos River has been divided into three reaches (Hoagstrom 2003). The first is the Tailwater reach, which extends from Sumner Dam to near the confluence of the Pecos River and Taiban Creek. The second is the Rangelands reach, which extends from Taiban Creek to the Middle Tract of the Bitter Lake NWR. The third reach, the Farmlands, extends from the project area in the Bitter Lake NWR to Brantley Reservoir. The "stronghold" for the shiner occurs in the Rangelands reach (Hoagstrom 2003). Habitat availability and suitability are the best within this reach of the river, all size classes of shiner are found, and population numbers are relatively stable (Hoagstrom 2003).

The encroachment of saltcedar in the region has resulted in the growth of thick stands of these trees that stabilize river banks and induce sediment deposit, resulting in the formation of natural levees. The stable banks decrease the ability of the river to rework the floodplain, while the natural levees reduce the occurrence of overbank flows. Both of these conditions result in a more channelized river (FLO Engineering 1999).

The construction of Sumner Dam in 1937 allowed greater control of natural upstream flows to meet agricultural storage and irrigation delivery needs and to prevent flooding. Since that time, water has been typically released into the Pecos River from Sumner Dam in large block releases to minimize losses due to evaporation. Reservoir operations have dramatically altered flows in this reach of the Pecos River by reducing both the base flows and flood peak flows. The control of the natural flows alters the physical channel shape, the amount of sediment in the river and floodplain, and the associated riparian habitat (FLO Engineering 1999).

Today the most intact remaining riparian habitat on the river exists in the Rangelands reach above the Acme Gauge, where the channel is wide and relatively dynamic. This stretch of the river is hydrologically characterized as a losing reach. Surface water is lost primarily through seepage and evaporation, but can additionally be affected by climatic conditions such as wind, low humidity, high temperatures, and lack of storm inflows; transpiration by vegetation; river and ground water pumping; and the geomorphology (river slope) of the area. Thus, this area has been subject to drying and flow intermittence during the summer months. Downstream of Acme in the Farmlands reach, the river gains water from artesian aquifer inflows and irrigation returns in the Roswell Basin (FLO Engineering 1999; US Fish and Wildlife Service 2006).

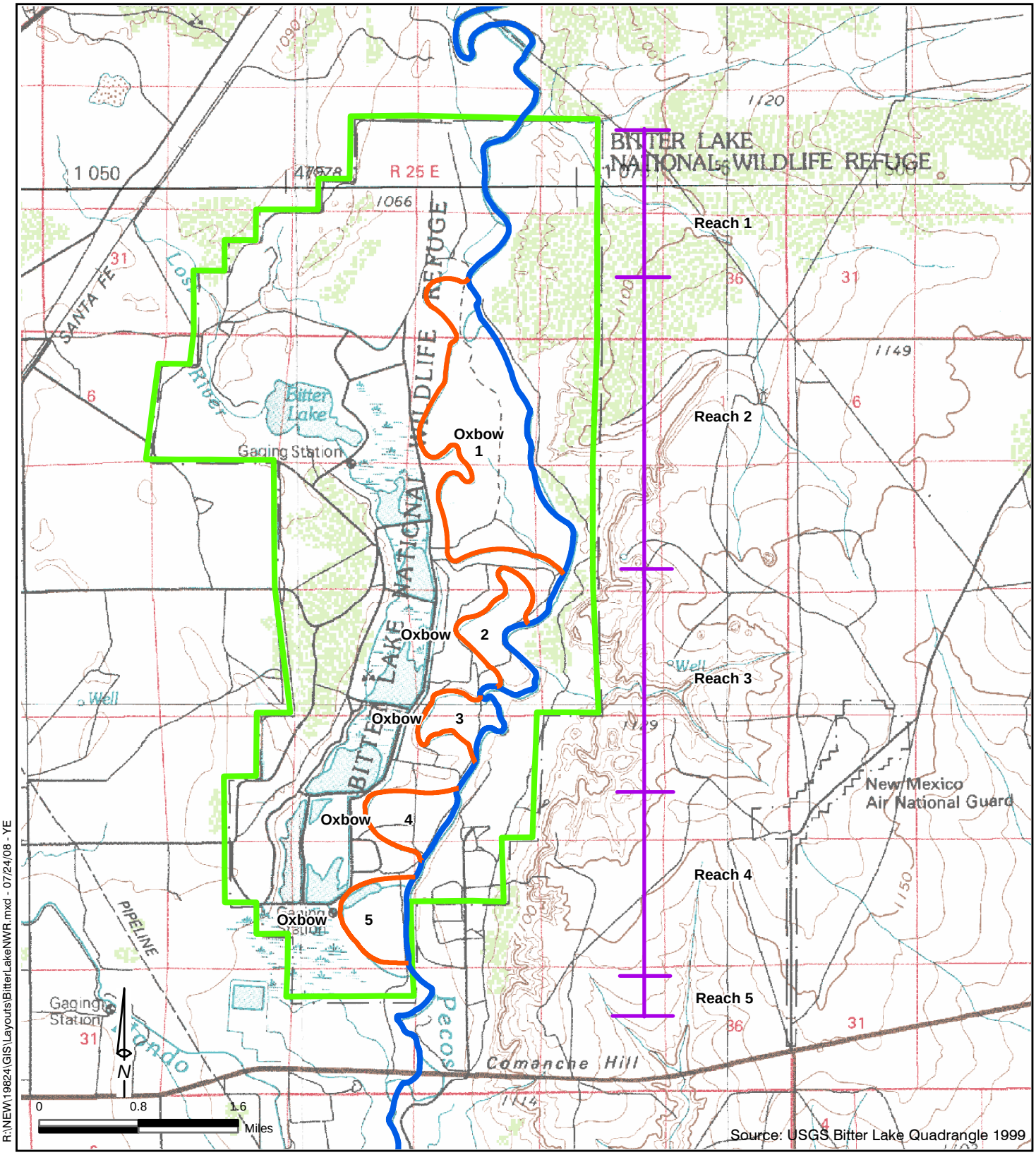
The good quality habitat of the Rangelands reach contains some of the most diverse native fish communities within the southwestern United States. The Rangelands reach has been the focus of detailed fish community and habitat studies as part of a research and management program for the shiner. Investigations of the native fishery within the Rangelands reach show that the native fishes prefer a wide, sand substrate and an active channel bed that creates a variety of favorable small instream features (Hoagstrom 1999;

Kehmeier et al. 2004a; Tashjian 1997). Such habitats are common north of the Bitter Lake NWR but are rare south of the refuge, where the river is generally incised and channelized. The investigations strongly suggest the restoration of poor quality habitats back into quality habitats is critical to the long-term survivability of these native fishes.

Pecos River in the Bitter Lake NWR

The Bitter Lake NWR occupies the central portion of the Middle Pecos River, much of it within the historic floodplain. Before 1942, the Pecos River in the Middle Tract of the Bitter Lake NWR was a dynamic river, with large oxbows that were constantly eroding banks and changing course. Two channels were excavated to straighten the river to decrease damage to the bordering agricultural lands from flooding and bank erosion (Figure 1-2, Project Area). The following is a history of the channel alterations, compiled by John Magera, former Assistant Refuge Manager:

> "The river diversion project began in 1940 with initial design and surveying, and was planned in two segments, north and south of the current Scout camp. The south segment design was approved in November of 1941, and became the highest priority on the refuge. Work actually began on the southernmost point of the south segment just two days before the September, 1941 flood and resulted in several pieces of stranded equipment. Between September, 1941 and September, 1943, bulldozers were used to excavate a channel from the outlet of Oxbow 5 to somewhere along the reach of Oxbow 2. It is not clear when, but Oxbow 2 was apparently cut off by the river around 1942 with little or no help from the refuge staff. Following the dozers were draglines, since it had become too soft to operate within the channel. The south diversion channel was completed to plan in 1947, and afterward tripod strings (water control structures) were placed at the entrance to each of the four south oxbows. Considerable effort was required to maintain these tripod strings, as they were replaced in part or in full after each flood event. The north segment design was approved in March of 1941, and was eventually completed in January of 1957. This segment was much less involved than the south segment, as the river was diverted into an ancient river channel after only 3500 feet of excavation.
>
> Since the completion of the river diversion, several sinuous bends have developed between the inlet to Oxbow 2 and the outlet to Oxbow 3. These naturally occurring modern oxbows have increased the length of the river to nearly its pre-channel length and provide some of the finest shiner habitat on the refuge. Here the channelization was cut into Pecos River deposits and is quite erosive in nature. In fact, another oxbow cut-off has recently been created and was probably cut off during the May, 1999 "flood." Also, the river bend at the inlet to Oxbow 4 continues to cut into the old oxbow channel, and is very close to creating a natural connection to the historical oxbow. Despite the natural changes upstream, the reach of the Pecos between Oxbow 4 and 5 remains a deeply incised, straight channel, almost completely unchanged since 1947. Here the channel was excavated into sedimentary bedrock, which is immobile and hard to erode (Magera 2002)."



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Bitter Lake NWR
Middle Tract

Pecos River

Oxbows

Chaves County, New Mexico

Tetra Tech, Inc

Figure 1-2

The south channel cut off Oxbows 4 and 5, while the north channel bypassed Oxbow 1, cutting off the natural oxbows from the main stream of the Pecos River. The ecological functioning of the river through this section has been degraded by the excavation of these channels, the reduced magnitude of peak flows since the construction of Summer Dam, and the encroachment by saltcedar (see Section 2.1.1 for correlation between defined reaches and historic oxbows). The river channel is deeply incised and capable of containing very large flood flows.

The Pecos River is currently functioning within a physical context that is different from the pre-reservoir conditions that formed the now disassociated oxbow lakes of the Bitter Lake NWR. The Middle Tract of the Bitter Lake NWR is an optimal location for restoration because it is on land that has water rights administered by the Service (see Section 3.5.3 for details). The action is consistent with the mission of the Service and the refuge system. The restoration is proposed to be entirely on federal land and is not next to downstream infrastructure or private lands. The location is a "gaining reach," where inflows to the river exceed losses to evaporation. The proposed restoration would extend the reach of connected good quality habitat into these historic channels and would partially compensate for past actions that contributed to the degraded ecological function of this portion of the river.

1.2 Proposed Action

This EA addresses phased proposals over the next ten years to improve the riparian and in-channel habitat along approximately seven river miles of the Pecos River in the Middle Tract of the Bitter Lake NWR by restoring the river flows to dynamic conditions. The Proposed Action is a combination of restoration techniques that include removing vegetation, lowering banks, changing the channel morphology, restoring flow into historic oxbows, and revegetation. These techniques would be designed to work within the changed physical context of the river that includes lower peak flood flows, irrigation withdrawals, channelized river segments, nonnative plant incursions, and protection of farmland and floodplain infrastructure.

At this time, Reclamation is proposing to fund, plan, design, and conduct channel habitat restoration only at Reach 4. The Service, in collaboration with the WWF and the NMISC, is proposing to manage, fund, and conduct work at Reaches 2 and 3. Additional restoration actions may be conducted at Reaches 1 through 4 as funding becomes available. A detailed description of the components of the Proposed Action is found in Section 2.2.

1.2.1 Decisions to be Made

This EA is an evaluation of the environmental impacts of the Proposed Action and the No Action Alternative and provides information to help Reclamation and the Service fully consider environmental impacts and any proposed mitigations. Using the analysis in this EA, Reclamation and the Service will decide whether there would be any significant

impacts associated with the Proposed Action that would require the preparation of an environmental impact statement or whether the Proposed Action can proceed when funding is secured and other requirements are met. Reclamation and the Service are anticipated to record their decisions on the federal actions they control in separate or joint decision documents.

1.3 Need for the Action

The need for restoration action at this time is to satisfy federal requirements under the Biological Opinion to restore quality habitat on the Pecos River and to participate and assist in the completion of ongoing habitat improvement projects (US Fish and Wildlife Service 2006). Under RPM #1, Reclamation agreed to "assist in the completion of ongoing habitat improvement projects on the Pecos River and to restore 1-1.5 miles of quality habitat within the Farmlands reach by 2009 and another 1-1.5 miles by 2014." The project would also support the need of the Service to implement the Bitter Lake NWR Comprehensive Conservation Plan goals and objectives and would support broad Service mandates to restore, preserve, and enhance riparian habitat and the overall mission of the National Wildlife Refuge System.

1.4 Purpose of the Action

The ecological conditions within the Bitter Lake NWR section of the Pecos River have been degraded by excavating straight channels, encroaching nonnative vegetation, and reservoir control of flows. The purpose of the proposed restoration is to correct or improve these degraded ecological conditions by improving riparian and in-channel habitat and by extending the reach of connected good quality habitat for the benefit of native aquatic and riparian plant and animal communities. The restoration would improve habitat by restoring parts of the river to more natural flow conditions within the context of the modern hydrologic regime, including reconnecting the river to the floodplain. According to the Biological Opinion, activities that restore and optimize the interaction of river channel and floodplain habitats with available flows will be most successful in mitigating the observed displacement of shiner eggs and in providing a variety of channel conditions favorable to the shiner. The reach that would provide the most benefit for the shiner is from the Bitter Lake NWR south to Hagerman where flows are perennial due to inflow from the Roswell Basin and habitat is degraded (US Fish and Wildlife Service 2006). Improving riparian and in-channel habitat and removing invasive species would also provide benefits for the diverse plant, animal, and fish species that use the refuge and would enhance visitor experience.

1.5 Relevant Statutes, Regulations, and Relationship to Other Projects, Plans, Agreements, and Agency Actions

In addition to NEPA, actions of Reclamation and the Service on the Pecos River are guided by a number of statutes, regulations, and agreements. These are described in detail in the Carlsbad Project Water Operations and Water Supply Conservation EIS (Reclamation 2006a). The most relevant regulatory requirements and plans to the Proposed Action are summarized here.

1.5.1 Required Compliance Actions and Permits

The following compliance actions and permits are expected to be required for the Proposed Action. Mitigation measures and best management practices will be incorporated into the Proposed Action or detailed in Chapter 5, Environmental Commitments. Additional permitting and consultation prior to implementation may be required as actions become better defined.

Consultation under Section 7 of the ESA is required to determine if the project will adversely affect threatened or endangered species or designated critical habitat. The Service conducted an Intra-Service Section 7 consultation for the proposed restoration projects at the Bitter Lake NWR.

Compliance and permitting under Section 404 of the Clean Water Act (CWA) is required, in consultation with US Army Corps of Engineers (USACE) and Surface Water Quality Bureau (SWQB) of the New Mexico Environment Department (NMED). The reason for this is because much of the work would be within aquatic areas. Section 401 of the CWA requires anyone applying for a federal license or permit for any activity that could discharge a pollutant into waters of the United States to obtain a certification from the state. A National Pollutant Discharge Elimination System Section 402 permit may be required if it is determined that construction or discharge of material into wetlands and other waters of the US would occur. The Service is coordinating efforts with the USACE and the NMED SWQB for these requirements.

Reclamation and the Service are required to consult with the State Historic Preservation Office regarding the effects of the project on historic properties (sites eligible for listing on the National Register of Historic Places) and to mitigate any adverse effects on these sites. The Section 106 process also requires the agency to provide the Advisory Council on Historic Preservation the opportunity to comment on any adverse effects on historic properties.

1.5.2 Relationship to Other Projects, Plans, Agreements, and Agency Actions

National Wildlife Refuge System. The Proposed Action would be implemented within a nationwide system of federal refuges and in accordance with the overall mission of the National Wildlife Refuge System. The broad goals of the refuge system are as follows:

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered;
- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges;
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts;
- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation); and
- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats (601 FW 1).

Bitter Lake NWR Comprehensive Conservation Plan. Under the National Wildlife Refuge System Improvement Act of 1997, the Service is required to prepare a CCP for each refuge. The CCP outlines the desired future conditions and provides long-range guidance and management direction to achieve the purposes of the refuge. As stated in the Bitter Lake NWR Comprehensive Conservation Plan, one of the major goals for the Bitter Lake NWR is as follows:

> "To restore and maintain a hydrological system that mimics the natural processes along the Pecos River drainage by: (1) restoration of the channel, as well as restoration of threatened, endangered, and special concern species; and (2) control of exotic species and manage trust responsibilities for maintenance of plant communities and to satisfy traditional recreational demands."

Actions proposed in this EA implement many of the strategies designed to meet this goal and its supporting objectives, as described in the CCP (Research Management Consultants 1998). The planning direction of the CCP was evaluated in an EA that resulted in a signed finding of no significant impact (FONSI) (Federal Register 1998; US Fish and Wildlife Service 1998).

Biological Opinion. In May of 2006, the Service issued a final Biological Opinion on the effects on the Interior least tern, and on the shiner and its designated critical habitat[2] of

[2]In accordance with Section 7 of the Endangered Species Act of 1973, as amended (16 USC 1531 et seq.)

Reclamation's Proposed Carlsbad Project water operations, 2006-2016. Among the reasonable and prudent measures specified is the requirement that:

> "Reclamation will partner with Federal, state, and private entities to participate and assist in the completion of ongoing habitat improvement projects on the Pecos River and to restore 1-1.5 miles of quality habitat within the Farmlands reach by 2009 and another 1-1.5 miles by 2014."

The following implements RPM #1:

> 1.1) Reclamation will attend meetings and work with federal, state, and private entities as a cooperating agency to support and enhance shiner habitat restoration at the Bitter Lake National Wildlife Refuge.
>
> 1.2) Reclamation will attend meetings and work with federal, state, and private entities as a cooperating agency to support and enhance related hydrogeomorphic process improvements to the reach of the Pecos River north of Dexter Bridge and adjacent to the Bureau of Land Management waterfowl area.
>
> 1.3) Reclamation will partner with federal, state, and private entities to complete habitat improvement projects totaling two oxbow sequences 0.5-1 mile in length between Dexter and Hagerman. (Note: This refers to a suggested option and location for conducting the second required restoration project in two noncontiguous reaches.)
>
> 1.4) Reclamation will partner with federal, state, and private entities to monitor the success of habitat restoration projects in terms of winter and summer habitat conditions through the use of color infrared videography, at least 4 cross sections within the site, and fish population and habitat use data. Videography should be used to map riparian habitat within each restoration site, including in-channel and riparian habitats (US Fish and Wildlife Service 2006).

Carlsbad Project Water Operations and Water Supply Conservation Project EIS. In July of 2006, Reclamation signed a Record of Decision implementing the preferred alternative identified in the Carlsbad Project Water Operations and Water Supply Conservation EIS and the 10-year Biological Opinion on Carlsbad Project operations. The goal of the preferred alternative is to conserve the shiner and its designated critical habitat, while conserving the Carlsbad Project water supply. The EIS addressed changes in the operation of Sumner Dam, target flows at the Taiban gage, and implementation of a water acquisition program. The preferred alternative includes conservation actions such as removing nonnative riparian vegetation and implementing channel restoration projects (US Bureau of Reclamation 2006a). The restoration actions considered in this EA are consistent with the EIS purpose and need to conserve the shiner. The changes in operations may change the frequency and timing of block releases and base flows, which could affect long-term channel formation processes at the Bitter Lake NWR.

EA for Pecos River Supplemental Water. Reclamation is assessing the potential impacts of obtaining supplemental water so it will have the operational ability to release

approximately 2,500 acre-feet of water out of Sumner Lake per year. This would keep the Pecos River flow continuous in order to conserve the federally protected Pecos bluntnose shiner, while ensuring that there would be enough water at Brantley Reservoir to meet the contracted irrigation needs of the Carlsbad Project. The project is needed to comply with the 2006-2016 Biological Opinion for the Carlsbad Project Water Operations and Water Supply Conservation EIS, June 2006. Potential supplemental water sources evaluated in the EA include the following:

- Transfer any unused water rights from Reclamation's river pumper offset program to Seven Rivers to be pumped into Brantley Reservoir in exchange for storing and withdrawing water from Santa Rosa Reservoir or Sumner Lake;
- Commit up to 360 acres of groundwater rights owned by Reclamation at the Seven Rivers Farm to be pumped into Brantley Reservoir in exchange for storing and withdrawing up to 1,000 acre-feet of water from Sumner Lake. This exchange would maintain the currently permitted 1,000 acre-foot fish conservation pool at Sumner Lake;
- Transfer any available water rights at Karr Farms near Artesia to Seven Rivers, to be pumped into Brantley Reservoir in exchange for storing and withdrawing water from Santa Rosa Reservoir or Sumner Lake, or to directly use these rights for habitat improvement projects; and
- Pursue any other lease or water transfer opportunities from willing sellers.

EA For Biological Control of the Invasive Tree Saltcedar (*Tamarix chinensis*) on Bitter Lake NWR. In July of 2007, the Service released an EA that assessed the potential impacts of the release of saltcedar leaf beetles (*Diorhabda elongata*) on selected areas of the refuge as a biological control for Saltcedar. The EA is tiered from a programmatic EA prepared by the US Department of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS). The programmatic EA resulted in a FONSI, and the USDA-APHIS has issued a permit to New Mexico State University to release beetles along the entire Pecos River.

The Service has prepared its own EA to address the specific release at Bitter Lake NWR. While the use of biological controls is not part of the Proposed Action of this EA, the removal of saltcedar is one of the goals. Use of biological controls is complementary to the proposed channel restoration and would allow saltcedar control in areas where mechanical methods would be difficult. The initial release would take place near the edge of a high-density patch of saltcedar on the west side of the Pecos River, near the south boundary of the refuge's north tract. If the release is successful, this population should travel across the river and downstream from the release site into the proposed restoration project area. A decision on the proposed action is pending.

Restoration of Wetland Habitat at Bottomless Lakes State Park. The US Army Corps of Engineers, Albuquerque District, in cooperation with the New Mexico Energy, Minerals, and Natural Resources Department - State Parks Division (State Parks) is restoring approximately 43 acres of wetland habitat at Bottomless Lakes

State Park, just south of the Bitter Lake NWR in Chaves County. The restoration consists of increasing the Lea Lake outlet channel capacity, removing all saltcedar and solid waste debris from the project area, constructing three open water habitats, planting supplemental wetland vegetation, and constructing a gravel parking lot, gravel loop trail, a 517-foot raised boardwalk trail, and four wildlife viewing blinds. An EA and FONSI were completed in December of 2006 and construction started in January of 2009 (USACE 2006). The proposed restoration actions in this EA complement the efforts by the USACE and the State Parks to restore wetland habitat and provide wildlife-based recreational amenities in Chaves County.

New Mexico Saltcedar Control Project. The New Mexico Department of Agriculture (NMDA) coordinates state-funded nonnative phreatophyte control programs through local soil and water conservation districts along the Pecos River. This project primarily has used aerial spraying to kill saltcedar along the river banks in the hope of reducing the water loss associated with this invasive species through transpiration. The New Mexico Non-Native Phreatophyte/Watershed Management Plan (NMDA 2005) includes recommendations for saltcedar control, revegetation, rehabilitation, monitoring, and long-term maintenance throughout the state and specifically in the Pecos River Basin. The proposed restoration actions in this EA are compatible with the management plan and past efforts by the state to remove nonnative riparian species.

Pecos River Basin Water Salvage Project is a Reclamation-funded project to control saltcedar growth from the Sumner Dam area to the New Mexico-Texas state line. Reclamation began clearing saltcedar in 1967 and continued until 1971, during which time about 53,950 acres were cleared at various locations between Sumner Lake, New Mexico, and Pecos, Texas, a distance of about 370 miles. The clearing program began again in 1995 without the participation of Texas, and since then, the program has been limited to maintaining 33,000 cleared acres in New Mexico in cooperation with the Carlsbad Irrigation District (CID).

Lower Pecos Valley Regional Water Plan. There are ongoing regional planning efforts overseen by the NMISC to develop information, analysis, and documentation to address the region's available water supply and its means of meeting future demand. This planning is done at the regional level, bringing together such stakeholders as elected officials, public agencies, private citizens, and representatives of private industry. A part of the regional water planning effort is to compile and analyze information on water quantity and quality in their regions and to project population growth for 40 years. The objectives of the regional water plans are to answer questions about the water supply and the projected water requirements and to present a plan for meeting regional water requirements. Regional planning is intended to reflect the water-related goals and the knowledge of the public and the governing bodies of the region. The Lower Pecos Valley Water Planning Region includes Chaves County, Eddy County, and portions of De Baca, Lincoln, and Otero Counties. The plan encourages the study and implementation of riparian management, watershed management, and conservation programs in the Pecos River Basin.

Pecos River Compact. Interstate compacts are agreements developed and ratified by states and Congress and signed by the President that apportion surface waters of selected streams that cross state borders. Interstate compacts are governed by both state and federal requirements. The Pecos River Compact (entered into by New Mexico and Texas on December 3, 1948, and approved by Congress, effective June 9, 1949) requires delivery of water from the Pecos River into Texas. Compacts both protect each state's use of its waters and prescribe the amount of water that New Mexico must pass downstream to Texas. Compliance with the Pecos River Compact and the 1988 Supreme Court Amended Decree to the Pecos River Compact prohibits New Mexico from allowing a net shortfall in its deliveries to Texas. The NMISC has legal authority and a strong interest in ensuring that restoration actions do not reduce compact deliveries to Texas.

Settlement Agreement. The NMISC, CID, Reclamation, and the Pecos Valley Artesian Conservancy District (PVACD) executed a settlement agreement on March 25, 2003. Among other provisions, the settlement agreement is designed to ensure that New Mexico meets its interstate delivery obligation to Texas under the Pecos River Compact. The settlement agreement includes an acquisition program that authorizes the NMISC to purchase up to 6,000 acres of land and water rights in the CID and up to 12,000 acres of land and water rights upstream of Brantley Dam, which includes the PVACD and the Fort Sumner Irrigation District (FSID). Land retirement is anticipated to increase base flows in the river (and through the refuge) to help state line deliveries to Texas.

1.6 Issues Identification

1.6.1 Stakeholder Involvement

Reclamation and the Service are providing opportunities for the public and agencies to participate in the NEPA process to promote open communication and better decision making. All persons, agencies, and organizations having a potential interest in the Proposed Action and the No Action Alternative, including minority, low-income, and Native American groups, are urged to participate in the NEPA environmental analysis process.

Reclamation and the Service have been considering plans for Pecos River restoration at Bitter Lake NWR for at least a decade. In 1999, FLO Engineering (now Tetra Tech Surface Water Group), under contract to Reclamation, prepared a conceptual restoration plan and screened restoration alternatives for five reaches of the river (FLO Engineering 1999). At that time and in several subsequent meetings continuing through 2008, the Service, Reclamation, and the WWF have met, discussed, and presented information to potential stakeholders. Participants have included several units of the Service, including Fishery Resources, Water Resources, Bitter Lake NWR, and Ecological Services, the NMISC, the New Mexico Department of Game and Fish, Reclamation, Chavez County, Chaves County Flood Control District, USACE, and the Carlsbad Irrigation District.

Formal project scoping was conducted from late June through July of 2007. Letters were sent to agencies, Native American Tribes, and other stakeholders (see Chapter 6, Consultation and Coordination). Additional opportunities to comment are the 30-day period for public review of the draft EA and a second public review period for the final EA. If Reclamation and the Service determine that significant adverse impacts would not result from the Proposed Action, they would issue and publish separate or joint FONSIs.

1.6.2 Issues Raised During Project Planning

The issues and questions presented below were raised during scoping, agency planning, and previous reviews of the potential restoration actions. These are addressed in the appropriate sections of the EA.

Water Budget and River Flows:

- Questions were raised about the water consumption budget of the existing channel and riparian system and what effects restoration would have on this budget.
- Concerns were expressed that new water costs or losses may be incurred.
- The Pecos River experiences periods of intermittent flow during the summer. The EA preparers should discuss the effect of the action on the intermittent flows, their duration, and requirements for supplemental water releases.
- Although the removal of saltcedar is generally believed to reduce some water loss, restoration would increase open water surface area and may increase water losses at the Bitter Lake NWR. What impact will restoring oxbows have on water loss?
- The EA should carefully examine the effects of the project on water supply and the potential for depletions to downstream users and state line water delivery.

Flood Control and Sediments:

- Concerns were expressed about the effects of the proposed restoration on flood control for the Pecos River, downstream of the Bitter Lake NWR. Would flood control be improved or hindered by restoration?
- Will this project impact private property downstream through sedimentation and bank sloughing?
- Would restoration affect the integrity of the Highway 380 Bridge?
- In areas south of the Bitter Lake NWR, the river is establishing floodplain, and there is a considerable amount of erosion and widening in key places. There may also be changes in flood wave attenuation on the floodplain. The EA should examine flood control issues both within the Bitter Lake NWR and downstream.
- What impact would flash floods have on the restoration?

- The EA preparers should discuss how the changes to the Pecos River in the project area could destabilize the river banks downstream of the project area and cause potential environmental and habitat impacts.
- The EA preparers should discuss the effect on sediment transport within the project area and downstream. Sediment transport is an important factor in restoring and degrading river systems.

Extent of Channel Work:

- The EA preparers should consider the extent of channel work that would be needed. Would work on Oxbows 4 and 5 require the sculpting of a new channel that reflects the modern hydrology better or would we simply reflood existing oxbows and expect that a new channel would establish new geometry within the old configuration?
- Should there be an attempt to reflood the small modern oxbow associated with the north end of Oxbow 1, or would this action encourage erosion and potential damage to refuge infrastructure?
- Is there a large elevation difference between the modern Pecos River and the Oxbow 1 inlet?
- The EA should address the potential for changes in groundwater gradient resulting from the restoration of Oxbow 4 and whether these changes would have an effect on the ability to manage Impoundment 7.
- How would the river be reconnected to the floodplain?
- Would the goal be to connect the river to the hydrologic floodplain or the topographic floodplain?
- How would banks be lowered? Would they be bulldozed into the river?
- What is a modern hydrologic regime?

Monitoring Program:

- There should be a program to monitor effects on fish populations prior to, during, and after restoration to determine impacts on shiner populations.
- Are there ongoing fish population studies on the Pecos River that include sites within the Bitter Lake NWR?
- A detailed description of the proposed monitoring program should be included in the EA. The monitoring program should include water quality, quantity, and sediment transport.

Impacts on Existing Habitats:

- The EA preparers should address the benefits of the existing oxbow habitats that developed after the Pecos River was diverted and whether restoration would have a significant impact on these habitats or on the species that use them.
- Numerous species inhabit the Bitter Lake NWR, and the EA should include a discussion of the effect of the proposed restoration on these species.
- The proposed removal of nonnative vegetation along the banks would change the balance of plants and cover along the banks. The EA preparers should discuss the impacts on nesting and refuge habitat as a result of these changes.
- How will this work impact shiner habitat down to Hagerman?

Stakeholder Outreach:

- The EA should inform and involve the stakeholders in this process.
- The EA preparers should address other permits needed for this type of project, such as those associated with the USACE's (404), Section 7, and New Mexico Environment Department requirements.
- Tribes need to be notified if cultural surveys identify any prehistoric cultural resources that would be affected by this project and provided with documentation for review and comment.

Appropriate Data:

- There is substantial data on habitat, water flow, and water budget for this area of the Pecos River. The EA preparers should use these data instead of generic models and generalized data.

1.7 Scope of the Document

This EA identifies, evaluates, and documents the environmental effects of the Proposed Action and the No Action Alternative. Chapter 1 is a description of the purpose of and need for the proposed federal action, project background, applicable law and regulations, related plans, and issues raised by stakeholders.

Chapter 2 is a description of the Proposed Action and the No Action Alternative. The proposed types of restoration actions and their locations are also described in detail.

Chapter 3 is a description of the current condition of resources within the project area that would be affected by the Proposed Action if implemented. Along with information presented for the No Action Alternative, these conditions constitute the baseline for analyzing the effects of the Proposed Action and No Action Alternative. Only those

resources that could be affected by the Proposed Action or the No Action Alternative are addressed in detail.

Chapter 4 is a description and analysis of the environmental impacts of each alternative on the natural, physical, and human environment. Direct impacts (those caused by an action and occurring at the same time and place) and indirect impacts (those caused by an action but occurring later or farther away but at a reasonably foreseeable time or place) are considered. The cumulative impacts of the Proposed Action are also addressed. These are the impacts of an action when added to other past, present, and reasonably foreseeable future actions, regardless of whether the actions are federal or nonfederal. Actions or mitigations that could reduce identified impacts are discussed, where appropriate.

Chapter 5 details the environmental commitments. Chapter 6 is a description of the stakeholder consultation and coordination that was conducted. Chapter 7 is a list of preparers, and Chapter 8 is the references used in preparing this EA. Appendices include relevant supporting information, copies of correspondence, the water budget, and monitoring plan.

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2. Description of the Proposed Action and Alternatives

This section is a description of river reaches or segments, restoration techniques, timing, and phasing of the Proposed Action (Section 2.3) and the No Action Alternative (Section 2.2). Inclusion of the No Action Alternative is prescribed by the Council on Environmental Quality and serves as a benchmark against which project alternatives can be evaluated.

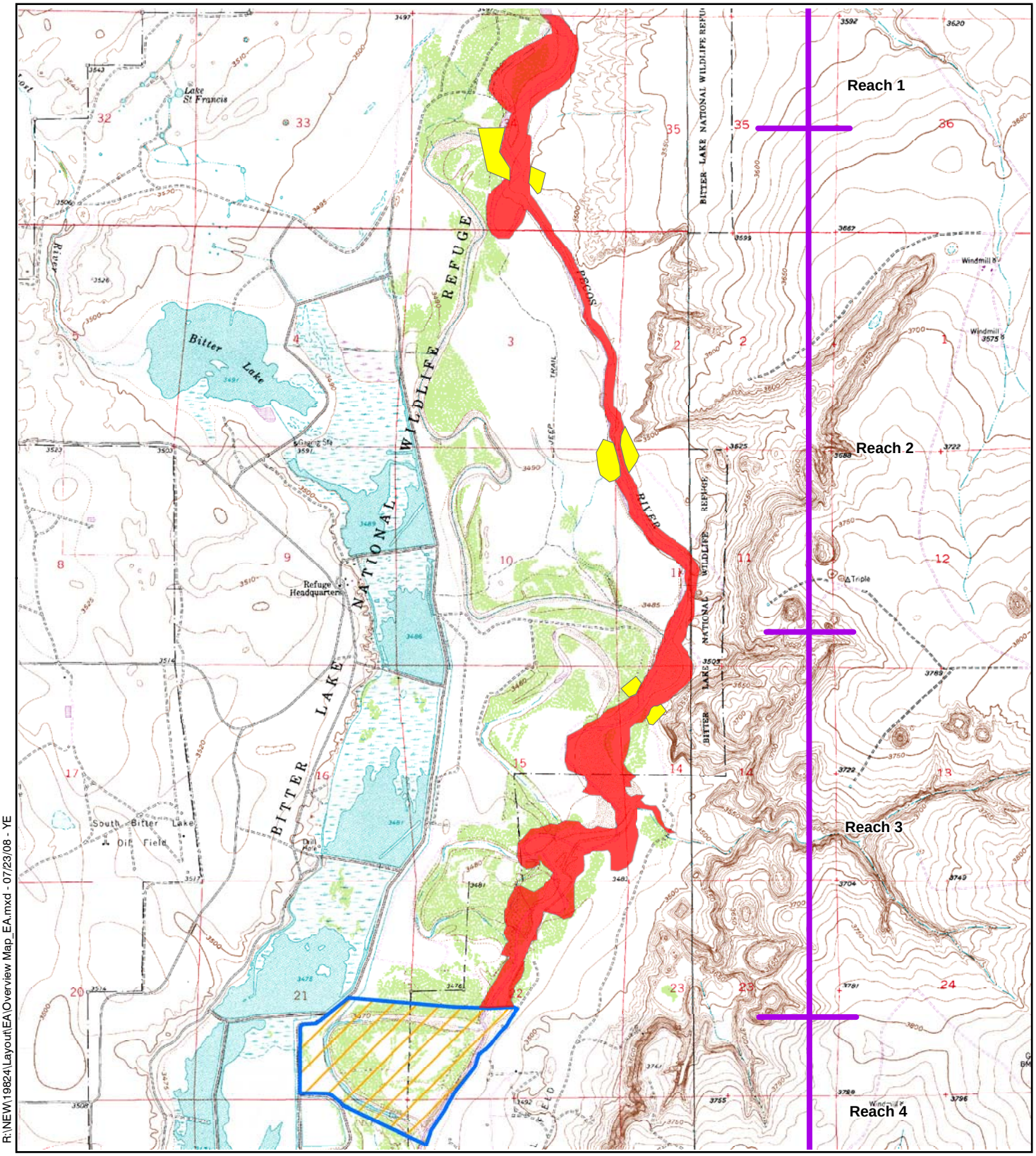
2.1 Background

Reclamation prepared a conceptual restoration plan and screened restoration alternatives for five reaches of the river, inclusive of the Bitter Lake NWR (FLO Engineering 1999). The Proposed Action analyzed in this EA incorporates much of that work but narrows the scope of the proposed project area and includes more specific proposals on how the restoration would be conducted. The Proposed Action is limited to federal lands entirely within the Middle Tract of the Bitter Lake NWR in Chaves County, southeastern New Mexico (Figure 2-1). Thus, the northern portion of Reach 1 and the southern portion of Reach 5 are outside the area associated with the Proposed Action. The portions of these reaches that are within the project area are referred to as Reach 1 and Reach 5.

2.1.1 Site Description

Reach 1. Reach 1 is bounded upstream by the refuge boundary and extends south to the point where a straight bypass channel begins (Figure 2-1). Reach 1 has not been disturbed by the excavation of channels and has several sections with suitable shiner habitat characteristics. There are wide sections and several bends that are eroding their banks. The main issue for channel function in this segment is the growth of saltcedar, which have stabilized the banks, decreasing the erosion at the bends and locking the straight sections in place.

Saltcedar grow on both banks of this reach in most locations. Where the vegetation is grass, the river is eroding into the terrace. The growths of saltcedar vary from thick stands of mature trees lining the banks with thinner stands or grasslands behind them, to stands of young saltcedar, which have not yet become well established.



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Source: USGS Bitter Lake Quadrangle, 1999

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Legend

- Phase II - Construction Staging and River Access
- Phase II - River Channel/Floodplain Project Area
- Phase I - Project Area

Project Area - Overview Map
Bitter Lake National Wildlife Refuge

Chaves County, New Mexico

Figure 2-1

Natural levees have formed due to the thick saltcedar growth. These levees are two to five feet higher than the 1,200-cubic-feet-per-second (cfs) water surface elevation and are 50 to 200 feet wide. Behind these levees are old floodplains that are less than two feet above the 1,200-cfs water surface elevation. In bends where the river is eroding into the terrace, the terrace is ten feet or more above the 1,200-cfs water surface elevation.

Reach 2. Reach 2 consists of the northern channel, which was excavated to bypass Oxbow 1 (Figure 2-1). The man-made channel is 100 feet wide, with 10-foot vertical banks. This channel runs for less than a mile, at which point the river is discharged into a runoff creek bed that connects with the old river at the outlet of Oxbow 1. This lower section is a more natural river, with wider cross sections and lower banks. Saltcedar growth is stabilizing the banks in the lower section.

The northern half-mile of this reach is an excavated channel with a thin row of saltcedar, mixed with upland vegetation. The rest of the reach has remained essentially straight since the river was diverted to it, with small amounts of new floodplain being created. Saltcedar have grown along the banks of the river and on the new floodplain, but in general the saltcedar are less than two hundred feet deep with upland vegetation behind them.

Reach 3. Reach 3 was not directly altered by excavating channels, but straightening the river downstream increased the energy through this section, causing it to cut off Oxbows 2 and 3. The river has been reworking its new course since the late 1940s and has created new, smaller oxbows, with large areas of accessible floodplain. For example, the outlet of Oxbow 2 is approximately ten feet above the current channel bed. In this reach there is a heavy growth of thick mature saltcedar on the low-lying floodplains created by the reworking of the banks. This reach is still dynamic, and the river continues to erode banks and has cut off an oxbow. Natural levees, ranging from three to six feet above the 1,200-cfs water surface elevation and approximately 80 feet wide, have formed between the river and the floodplains throughout this reach. Large areas of the floodplain are lower than the 1,200-cfs water surface elevation.

Reach 4. Reach 4 is a straight channel, measuring approximately a mile and a half and excavated to bypass Oxbows 4 and 5 (Figure 2-1). It has 10- to 15-foot vertical banks, and the river has not created any floodplain in this reach. At flows greater than 35 cfs, there is no low-flow shiner habitat. The scattered saltcedar, which have grown on the banks of the excavated channel, are too far above the riverbed to provide bank stability. The original oxbow channel bed is 300 to 400 feet wide with the thalweg, or lowest point within the channel, on the outside edge and a gradual six-foot rise to the inside bank and old floodplain. The first half-mile of Oxbow 4 has a dry bed, which has thick growths of mature saltcedar along the old banks and scattered smaller saltcedar growing on the bed. The width of the saltcedar growth is approximately 500 feet. The center section of the oxbow is an oxbow lake with thick saltcedar growth on the banks. At the outlet to the Pecos River, a thick stand of saltcedar has grown in the original channel bed from the outlet to the river to approximately 300 feet upstream in the oxbow.

Reach 5. The truncated Reach 5 continues south to the refuge boundary as a generally narrow channel.

2.1.2 Restoration Techniques

The following habitat restoration techniques were considered in developing the specific details of the Proposed Action (Section 2.3). These techniques were screened individually and collectively for Reaches 1 through 4 in the project area in the original conceptual restoration plan (FLO Engineering 1999). Due to concerns about the channel stability at the Highway 380 Bridge, no restoration is planned for Reach 5, but downstream effects of other restoration actions on this reach would be monitored. The effectiveness of each technique was evaluated for its ability to alter the characteristics for each reach of the Pecos River channel. The evaluation of changes to the river was based on five criteria: effect on channel habitat, connecting the river to the floodplain, the river's ability to rework the floodplain, and the short-term and long-term effects on channel morphology (FLO Engineering 1999). Revegetation has been added as a technique that will be further developed and integrated into restoration proposals at selected locations, as required and as funding becomes available.

Vegetation Removal. Vegetation along the river and reestablished channels would be removed to decrease the stability of the banks and to enhance interaction with the floodplain. The thick growth of vegetation along the banks not only stabilizes the banks but also induces sediment deposition, resulting in the buildup of natural levees, which reduce the frequency of overbank flows (Leopold et al. 1964). While saltcedar are the main source of bank stability, there are also willows, cottonwoods, grasses, and cattails on the banks. The removal of the thick stands of saltcedar is the goal because the other vegetation provides natural cover. In general, the saltcedar stands have crowded out most of the other types of vegetation (Kerpez et al. 1987).

The recommended procedure for mechanically removing the saltcedar has been developed and used successfully at the Bosque del Apache NWR near Socorro, New Mexico (Taylor and McDaniel 1998). The removal consists of the following steps: bulldozing the area, eliminating the trunks, cutting off the roots below the root crowns, and removing and destroying the root crowns. A mechanical excavator with a special bucket is used to extract the plants from the soil with as much root mass intact as possible and with little soil attached to the root system.

With this method the saltcedar are destroyed during a single growing season. Refuge staff would monitor the restored areas to ensure that the saltcedar and other undesirable species do not reestablish themselves. The width of the area of vegetation removal along the river would be up to 2,500 feet, sufficient to allow the river to create oxbows with the restricted flows of the current hydrology. Some saltcedar may be left in place as transitional habitat for bird species. Plant debris would be removed and stacked and burned on-site. Service fire crews would conduct these burns when weather conditions are favorable. The procedures for these prescribed fires would be outlined in site-specific

Burn Plans based on the Service's New Mexico Programmatic Piles, Ditches, and Debris Prescribed Fire Burn Plan (US Fish and Wildlife Service 2004).

Bank Lowering. The banks of the river would be lowered to increase the frequency of overbank flows, which improves the river's ability to rework the floodplain. Bulldozers and other heavy equipment would be used to lower the natural levees that have built up along the edges of the channel and to lower the floodplain between these levees and the terrace. The banks would be lowered to the elevation corresponding to a water surface elevation of 1,200 cfs.

The widths of the floodplains throughout the Bitter Lake NWR vary from zero to several thousand feet. The combined width of the channel and floodplain would be excavated to be at least 350 feet. This minimum width provides room for a 150-foot-wide channel and adequate floodplain. The terrace may need to be excavated in some spots to create a 350-foot-wide floodplain.

When implemented in combination with vegetation removal, lowering the bank elevation and removing a 2,500-foot-wide strip of saltcedar would improve the ability of the river to shift course across the floodplain and to create more floodplain by eroding into the terrace. Where the banks need to be lowered by more than two feet, the bank excavation would also remove the saltcedar root crowns at the same time. Where the banks need to be lowered by less than two feet, the saltcedar would be removed mechanically by bulldozing the trunks, cutting off the roots, and removing the root crowns.

Reworking Channel Morphology. Lowering the bank and removing vegetation would result in a less stable floodplain, but it would take the river time to create natural meanders and oxbows out of the straight sections. Reworking the channel into a pattern of meanders and oxbows would help form a more dynamic river immediately. When implemented in combination with vegetation removal and bank lowering, the river would have room to move laterally. Other modifications of instream features would be considered based on site-specific channel morphology.

Diverting the River into Historic Oxbows or New Oxbows. Returning the river to the historic oxbows would increase the length of the river, thereby decreasing the slope and increasing the sinuosity. However, the historic oxbows have been abandoned for 45 years, and river conditions and other refuge priorities have changed over that time. For example, small lakes fed by spring flows were formed in the historic oxbows and created another habitat type in the refuge. While this type of habitat exists at several locations in the refuge, it needs to be considered in restoration planning. Also, at some locations the historic oxbows are close to the levees impounding refuge ponds or are near Pecos Sunflower habitat. Protecting these areas from erosion would be important considerations in restoring river flows into historic oxbows. Therefore, two options were considered for this restoration technique: diverting the flow into the historic oxbow or excavating a new oxbow.

Under the first option, the river would be diverted into the historic oxbow. The thick growths of saltcedar along the banks, in the historic channel bed, and in the outlets from the oxbows would be removed. The banks would be lowered to facilitate river interaction with the floodplain. The present channel would be blocked completely using materials excavated on-site so that all flows would be diverted into the historic oxbow and the interaction between river and floodplain would be increased. By blocking the present channel completely there would be less chance of the river reestablishing flow. Also, by blocking the channel downstream from the entrance, new backwater habitat would be formed in the river.

Under the second option, the entrance and exit channels from the historic oxbows would be used, but a new channel would be excavated on the east side of the oxbow lakes, creating a buffer between the new channel and the refuge ponds. Some of the habitat provided by the oxbow lakes could be retained.

Revegetation. Where saltcedar has been removed outside of the active floodplain at Bitter Lake NWR, native grasses have reestablished within a few years. Some areas where strips of saltcedar were removed in the early 1960s still retain the distinctive stripped pattern today, with generally little encroachment into the restored areas. Because much of this work would be conducted in active floodplains, resprouting of invasives is likely to occur and follow-up vegetation control by the refuge would be needed. Planting native perennial species after saltcedar removal or land disturbance would also improve the success and speed of restoring riparian species and habitat, would reduce erosion, and would help keep the area free of noxious species. Revegetation success appears to be associated with mechanical removal of saltcedar, lower soil salinity and pH, and coarser soil texture as well as proximity to permanent water, sufficient precipitation, and good drainage (Bay and Sher 2006). Because of high salinity, some methods of revegetation that have been effective elsewhere may need to be modified. Native plant establishment methods and species appropriate to the restoration sites such as coyote willow, seepwillow, and mesquite would be tested and monitored. Revegetation strategies would be developed for restored areas, adapting and using methods that are most effective, as determined by testing and monitoring. Revegetation would also be important for restoring and stabilizing soils outside the floodplain that would disturbed by construction equipment and staging areas.

2.2 No Action Alternative

In accordance with CEQ regulations implementing NEPA (40 CFR 1502.14), a No Action Alternative must be evaluated. This is the basis for comparison with other alternatives and is a description of the most likely future condition that could occur if the Proposed Action is not implemented.

Under the No Action Alternative, Reclamation and the Service would not improve the riparian habitat in the Middle Tract of the Bitter Lake NWR using the specific actions

discussed in Section 2.3 for each reach of the Pecos River. The purpose and need for the Proposed Action would not be met by either agency. Ongoing actions under other authorities to improve habitat would continue. Other activities that could improve the riparian and in-channel habitat in the Bitter Lake NWR or elsewhere on the Pecos River may be proposed and analyzed.

Under the No Action Alternative, in Reach 1 the growth of saltcedar would continue, further stabilizing the banks, decreasing the erosion at the bends, and locking the straight sections in place. The straight sections would become increasingly entrenched, reducing interaction with the floodplain. It is likely that this reach would continue to lose desirable habitat characteristics under existing conditions. In Reach 2, saltcedar growth would continue to stabilize the banks in the lower section. In Reach 3, the river would continue to rework its course, creating meanders within large areas of accessible floodplain. The heavy growth of saltcedar on the floodplain would contribute to stabilized banks, which could degrade the dynamic nature of this reach by reducing the ability of the river to continue to erode banks and to shift course. In Reach 4, the river would continue to become more entrenched, with no ability to connect to the floodplain. The oxbow lakes habitat would not be disturbed. The levees for the refuge ponds would not be in danger of being eroded, and the proposed river interpretive site would not be constructed. In Reach 5, current hydrological conditions would persist. The potential for downstream erosion would remain the same as current conditions.

2.3 Proposed Action

This EA addresses phased proposals over the next ten years to improve the riparian and in-channel habitat along approximately seven river miles of the Pecos River in the Middle Tract of the Bitter Lake NWR using a combination of restoration techniques to change the river to more dynamic conditions and restore floodplain connectivity. The Proposed Action is a combination of restoration techniques, including removing vegetation, lowering banks, changing the channel morphology, restoring flow into historic oxbows, and revegetation. These techniques would be designed to work within the changed physical context of the river that includes lower peak flood flows, irrigation withdrawals, channelized river segments, nonnative plant incursions, and protection of farmland and floodplain infrastructure.

Goals of the Proposed Action include providing better habitat in these reaches to support the shiner through its life stages, improving habitat for other aquatic and riparian species, reducing the potential for downstream flooding, reducing the danger from fire, and enhancing refuge visitor experience.

Two phases of the restoration have been defined in detail. Phase I would be conducted in Reach 4 by Reclamation in collaboration with the Service. Phase II would be conducted in Reaches 2 and 3 by a collaborative partnership consisting of the Service, the WWF, and the NMISC, with funding from the state of New Mexico. Additional restoration

techniques may be applied in the future in the refuge portions of Reaches 1 through 4. No work is planned at this time in Reach 5 in order to avoid any concerns about the channel stability at the Highway 380 Bridge. Monitoring of upstream restoration effects, however, would be conducted in this reach. Some or all of these actions may eventually be implemented, and the individual actions are expected to be implemented at different times. It is assumed for the purpose of this analysis that all of the restoration actions described in this EA would be implemented to allow for evaluation of the total impact on the environment. Additional planning documents, permits, approvals, and funding would be needed for full implementation. Monitoring of the effectiveness of river restoration efforts and adaptive management are part of this Proposed Action and are described in Appendix B.

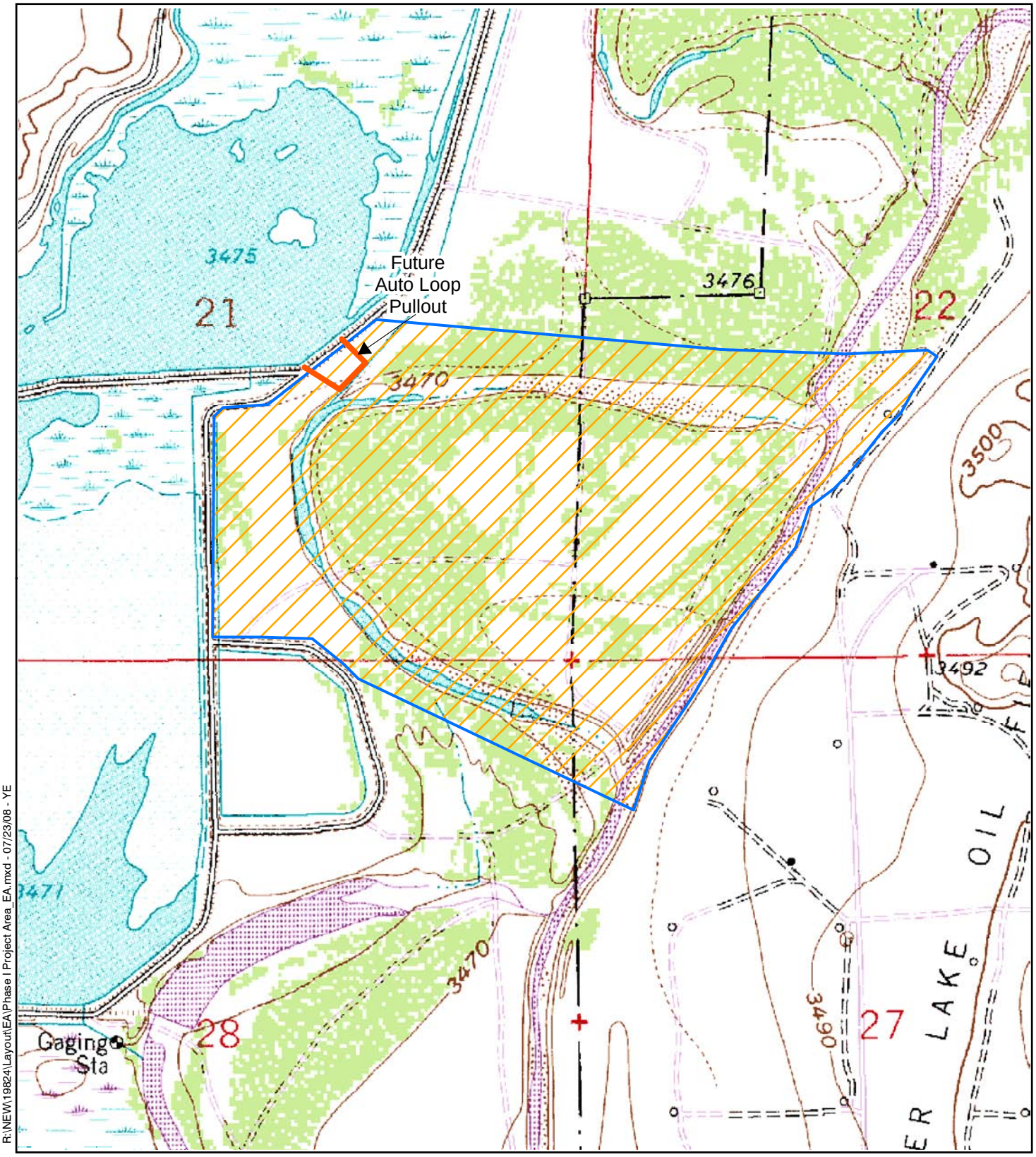
2.3.1 Phase I Restoration

Reclamation is funding, planning, designing, and conducting the restoration of habitat in Reach 4 in partial fulfillment of its obligations under RPM #1 of the Biological Opinion (US Fish and Wildlife Service 2006). Reclamation agreed to "partner with federal, state, and private entities to participate and assist in the completion of ongoing habitat improvement projects on the Pecos River and to restore 1-1.5 miles of quality habitat within the Farmlands reach by 2009 and another 1-1.5 miles by 2014." In Phase I, the Service is assisting Reclamation with permitting, refuge access, technical expertise, some labor and materials, and monitoring of restoration effects. Agency roles and responsibilities of the respective agencies are outlined in a memorandum of agreement (see Appendix A). The Service is also proposing to develop an auto loop pullout, viewing platform, and interpretive site in Reach 4 for the restored area when funding becomes available.

Restoration Techniques

Restoration techniques proposed for Phase I include plugging and diverting the river into a historic oxbow, excavating a meandering channel within the oxbow, removing nonnative vegetation, lowering banks, and revegetation.

Reach 4 includes the southern excavated channel bypassing Oxbows 4 and 5. Extensive excavation through bedrock would be required to create floodplain along this channel. Instead, the river would be plugged and diverted back into historic Oxbow 4 to restore the river through this reach (see Figure 2-2, Phase I Project Area). All flows would be diverted into the new channel, and the interaction between river and floodplain would be increased. A sinuous channel approximately 12 feet wide at the base and 44 feet wide at the top would be excavated to grade in the old oxbow. The reconnected channel would replace approximately 3,000 feet of the current channel with approximately 8,200 feet of channel in the historic oxbow. The oxbow channel and floodplain would contain floods while allowing the river the opportunity to rework the morphology of the oxbow and still interact with the floodplain at more typical flows. The anticipated amount of reconnected floodplain is expected to total 179 acres (see Figure 2-3 Phase I Channel Cut Plan View). The new channel will total approximately 1,018 acres.



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Source: USGS Bitter Lake Quadrangle, 1999

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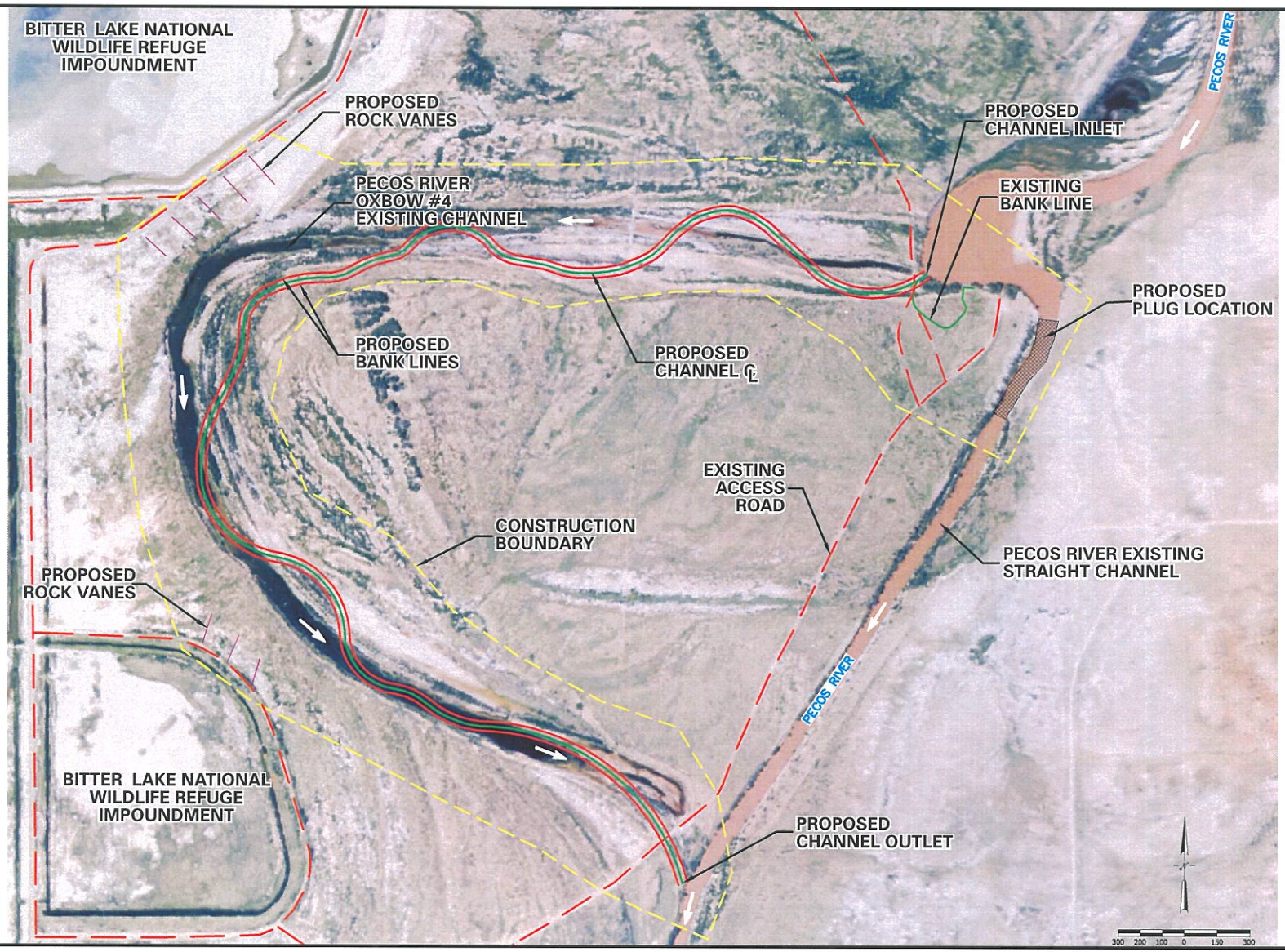
Phase I Project Area - Bitter Lake National Wildlife Refuge

Chaves County, New Mexico

Tetra Tech, Inc

Figure 2-2



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Phase I Channel Cut Plan View

Chaves County, New Mexico

Tetra Tech, Inc.

Figure 2-3

Portions along the western extent of the historic oxbow channel would be armored with rock vane revetments to decrease the risk to the refuge ponds and Pecos Sunflower habitat. Before construction, the lower plug of the oxbow lake would be removed. Spring flows that had been contained within the oxbow lake would flow into the river. By blocking the current channel downstream from the oxbow entrance and only plugging the north end of the channel, new backwater habitat connected to the river would also be formed.

The thick growths of saltcedar along the banks, in the historic channel bed, and in the outlets from the oxbows would be removed. The banks would be lowered to further facilitate river interaction with the floodplain.

The extent of revegetation would be based on available funding and site requirements. A revegetation strategy would be developed by the Service based on site and soil conditions and adapted from lessons learned during on-site tests, the effectiveness of establishment methods, and survival of plant species. The refuge would monitor and control undesired species after restoration is complete. All disturbed areas would be reseeded.

There would be no diversion into Oxbow 5 proposed at this time due to concerns about the possible effects on private property and the channel at the Highway 380 Bridge. The results of the diversion into Oxbow 4 would be monitored for several years before a decision would be made pertaining to Oxbow 5. The perpendicular flow of the river as it exits Oxbow 4 into the current excavated channel may increase the sinuosity of the channel and provide some passive restoration benefits where it bypasses Oxbow 5.

Construction

Phase I restoration work is proposed to begin in early 2009 and to be completed by the end of 2009. Other elements of the project such as revegetation and burning of woody debris would be conducted when conditions for planting or fire are met and when funding permits.

The anticipated construction disturbance footprint and staging areas would total approximately 270 acres and are defined in Figures 2-2 and 2-3. Construction would be timed and conducted to avoid environmental impacts and to protect habitat and species, consistent with best management practices (BMPs) and other environmental commitments outlined in Chapter 5. Primary site access would be through refuge roads, although there would be some off-road travel within the construction footprint. Most of the earthmoving is anticipated to be completed within four to twelve weeks and would involve a maximum of ten workers. An amphibious excavator would be used to excavate the channel and mechanically remove the saltcedar from the lower portions of the oxbow. The excavator may need to be disassembled and reassembled on-site in order to be transported from Socorro. At least one gate on the refuge would need to be removed temporarily to provide equipment access. Conventional excavating equipment would be used where soils are stable. All excavated materials would be used for berms and plugs or would be redistributed on-site. Additional rock from off-site commercial sources would

be required to construct the rock vanes. Service fire crews would stack and burn woody debris, and water for dust abatement would be obtained from the refuge artesian well.

The anticipated construction sequence is as follows:

- Remove the lower plug of the oxbow lake and create channels to drain and remove excess moisture from the channel;
- Begin monitoring the spring flows entering the river from the oxbow lake;
- Remove decaying organic matter from the channel to other parts of the site, if necessary;
- Excavate and reshape the sinuous channel starting at the southern end of the historic oxbow;
- Remove and stack saltcedar and other woody debris;
- Install reinforcing rock vanes along the eastern edge of the oxbow to protect the pond and Pecos Sunflower habitat;
- Remove material at the oxbow entrance;
- Remove and relocate Pecos bluntnose shiners from the area between the oxbow entrance and the sediment plug;
- Plug the current river channel with material excavated on-site and allow the river to enter the oxbow;
- Reseed disturbed areas;
- Plant new vegetation; and
- Monitor the effects of the restoration during and immediately after the restoration and take corrective action, if necessary.

Flooding of the oxbow would be timed with a higher flow or block release to ensure that the river remains continuous at all times. The river naturally carries a heavy sediment load and there would be additional sediment mobilized, especially during the initial block release. A discussion of the additional sediment load is found in Section 4.3.2. Care would be taken to minimize any detrimental effects of sediments and debris, as outlined in Chapter 5, Environmental Commitments. The lead agencies would ensure the implementation of the USACE's Section 404 Nationwide Permit 27 and the NMED's SWQB Section 401 water quality certification regarding soil, sediments, and debris. The oxbow and plug would be monitored during and after storms and block releases. Reclamation and the Service would also monitor the success and effects of the restoration and would address any problems that develop in the short or long term.

Viewing Platform

As a future action, the Service is proposing to develop an auto loop pullout, viewing platform, and interpretive site. The viewing platform and interpretive signage would afford the public the opportunity to observe the Pecos River in the restored oxbow and to learn about the river restoration. This would be the only site on the auto loop where the

Pecos River is visible. The proposed location and maximum disturbance footprint is shown on Figure 2-2. It is anticipated that parking would be provided for up to ten vehicles, and the design would be similar to existing facilities elsewhere on Bitter Lake NWR. No final design, timetable for construction, or funding is in place for this project.

2.3.2 Phase II Restoration

Phase II of the restoration seeks to repair floodplain connectivity in Reaches 2 and 3. The Service in its role of refuge manager is leading a collaborative partnership with the WWF and the NMISC to conduct this work. The Service also has substantial technical expertise on the Pecos River's biology, geomorphology, and hydrology. The NMISC would collaborate with the Service on monitoring and measuring the effects of restoration on the Pecos River water supply. The WWF would collaborate with the Service on outreach and communications to build knowledge and awareness about how river ecosystem restoration benefits both people and nature. Funding is through the River Ecosystem Restoration Initiative (RERI) of the Surface Water Quality Bureau of the New Mexico Environment Department. The role of the respective partners and a detailed description of Phase II actions is included in the *Proposal for New Mexico's 2007 River Ecosystem Restoration Program, Pecos River Restoration, Phase II: Repairing Floodplain Connectivity* (US Fish and Wildlife Service 2007*)*. Reclamation funded the original restoration planning and is assisting the Service by preparing the NEPA analysis and documentation for this phase as a connected action with Phase I restoration.

Restoration Techniques

Restoration actions proposed for Phase II include removing nonnative vegetation from bank levees and bars, lowering the bank, reconnecting a small oxbow lake, and revegetating. The restoration is planned to be conducted during the winters of 2009 and 2010, when the river is less prone to flood events. The amount of physical restoration proposed under Phase II is less than what was recommended for these reaches in the FLO Engineering (1999) Report, reflecting current costs and available funding. Additional restoration phases described in Section 2.3.3 may include actions in Reaches 2 and 3, as funding becomes available.

Saltcedar growth and the development of a natural levee have limited the ability of Reach 2 to develop an active floodplain. Hydraulic analysis of this reach shows that flows below 3,700 cfs are confined within the channel. Saltcedar growth has also hindered bar development in this reach since it has locked the banks in place and discouraged active exchange of sediment between the channel and floodplain. Reach 3 is still dynamic and continues to erode banks and shift course. However, the heavy growth of saltcedar on the floodplain has contributed to the development of natural levees and hindered floodplain connectivity at flows greater than 1,200 cfs. Saltcedar growth on point bars has further hindered floodplain connectivity and threatens to encourage the future development of additional natural levees (FLO Engineering 1999).

As a first priority, saltcedar thickets would be removed from banks and active bars to deter the development of future natural levees. These activities would be accomplished in

tandem to maximize efficiency. Following this removal, additional restoration actions would be undertaken, as needed.

Bank levees would be removed and banks would be lowered within Reaches 2 and 3. The combined width of the channel and floodplain could be restored up to 350 feet, providing room for the existing 150-foot-wide channel and adequate floodplain. Within Reach 2, the natural levees would be removed and, where necessary, the floodplain would be excavated to be connected at flows greater than 1,200 cfs. Lowering the bank elevation and removing saltcedar would improve the ability of the river to shift course across the floodplain and to create more floodplain by eroding into the terrace. In areas where the banks need to be lowered by more than two feet, vegetation removal would be inherent since the saltcedar root crowns would be removed.

By lowering bank levees and saltcedar thickets in Reaches 2 and 3, as well as removing saltcedar thickets on point bars, it is hypothesized that bar mobility and construction would be enhanced within the two reaches (FLO Engineering 1999). By reconnecting the floodplain at higher flows, sediment storage and exchange, bank erosion, and bar accretion processes would be enhanced. These processes would create improved fish habitat at flow levels between 300 cfs and 1,200 cfs, in addition to the increased floodplain habitat at flows greater than 1,200 cfs (US Fish and Wildlife Service 2007).

In addition to natural levee lowering and saltcedar removal, a small oxbow lake would be reconnected with the northern part of Reach 2 as backwater habitat at flows greater than 100 cfs. This reconnection would be accomplished by cutting a high-flow pilot channel through the sediment plug that has formed at the northern entrance to the oxbow and at the outflow. Prior to cutting the pilot channel, saltcedar would be removed in the oxbow to reduce the formation of future natural levees. It is estimated that this action would create an additional six acres of low-velocity flooded habitat during discharges between 300 cfs and 1,200 cfs.

The FLO Engineering Report (1999) estimates that in Reach 2 levees need to be lowered and saltcedar removed within 160 acres, and in Reach 3 levees need to be lowered and saltcedar removed within 260 acres. Funding is not in place for that level of restoration at this time. The Service will determine priorities for staging the restoration within the Phase II project area based on refuge needs, resource protection, and efficient use of available funds, staffing, and equipment. Tentative actions planned for winter 2009 include the oxbow reconnection and testing combinations and variations of these restoration techniques along with revegetation, instream debris piles, and patchwork removal of saltcedar for transitional bird habitat. These restoration strategies would be monitored as to their effectiveness, impact on fish and bird communities, and impact on the water budget (see Appendix C). Restoration during the winter of 2010 would use these data and observations to effectively accomplish as much channel-floodplain habitat improvement as feasible. It is anticipated that a minimum of 100 acres of active restoration would occur on the floodplain, and 75 acres would occur on point bars. These activities would encourage passive restoration improvements within the entire 5.7 river miles of Reaches 2 and 3.

It is anticipated that habitat would be improved on 420 acres with approximately 150 acres enhanced for the rare flood above 3,700 cfs, 100 acres enhanced for annually recurring floods between 1,200 and 3,700 cfs, and 170 acres for flows between 300 and 1,200 cfs. The net area of the flooded habitat for the lower flows (300 to 1,200 cfs) would not increase from the present condition, but the point bar habitat would be improved by the removal of vegetation and the re-activation of sediment transport processes (US Fish and Wildlife Service 2007).

It is assumed that follow-up maintenance would be needed to address saltcedar re-colonization and associated natural levee reestablishment. The extent of these activities would depend greatly on the flood hydrology in the years immediately following restoration. The Service would pursue funding for such activities once their extent and nature is understood following Phase II assessment. The refuge currently uses the Carlsbad Irrigation District for the maintenance of saltcedar re-sprouting within non-riverine areas of the refuge. A site-specific revegetation strategy would be developed based on site and soil conditions and adapted from lessons learned during on-site tests of the effectiveness of establishment methods and survival of plant species.

Construction

Phase II restoration work is proposed to begin in 2008 and to be completed by 2010. The anticipated construction disturbance footprint and staging areas are defined in Figure 2-1, Project Area.

Construction would be timed and conducted to avoid environmental impacts and to protect habitat and species, consistent with BMPs and other environmental commitments outlined in Chapter 5. Primary site access would be through refuge roads, although there would be some off-road travel within the construction footprint. Water for dust abatement would be obtained from the refuge artesian well. Most of the earthmoving is anticipated to be completed within three to six weeks in winter of 2009 and again in winter of 2010. A maximum of ten workers would be needed. Other elements of the project such as revegetation and burning of woody debris would be conducted when conditions for planting or fire are met and when funding permits. Care would be taken to minimize any detrimental effects of sediments and debris, as outlined in Chapter 5, Environmental Commitments. The lead agencies would ensure the implementation of the USACE's Section 404 Nationwide Permit 27 and the NMED's SWQB Section 401 water quality certification regarding soil, sediments, and debris.

The construction in winter of 2009 would focus primarily on saltcedar removal. A mechanical excavator with a special bucket may be used to extract the plants from the soil with as much root mass intact as possible and with little soil attached to the root system. Other planned activities may include the experimental work with combinations of restoration techniques on 50 acres within Reaches 2 and 3. Bank levees and associated saltcedar would be removed and saltcedar thickets on active bars would be removed to deter the development of future natural levees. The Reach 3 oxbow would be reconnected by cutting a high-flow pilot channel through the sediment plug that has formed at the

northern entrance to the oxbow and at the outflow. Techniques used in winter of 2010 would be based on the experimental work. It is anticipated that a minimum of 100 acres of active restoration will occur on the floodplain and 75 acres will occur on point bars, encouraging passive restoration improvements within Reaches 2 and 3.

The restoration would be monitored during and after storms and block releases. Reclamation and the Service would also monitor the success and effects of the restoration and would address any problems that develop in the short term or long term.

2.3.3 Additional Restoration

Over the next ten years the Service would continue to pursue partnerships and funding to conduct additional restoration projects on the Pecos River within Bitter Lake NWR. Based on the conceptual restoration plan, the actions described below would be considered for future implementation (FLO Engineering 1999). The proposed combination of restoration activities is tailored to the specific characteristics of each reach, would be complementary to Phases I and II, and would be similar in scope. Some or all of these actions may eventually be implemented. These actions would be enhanced using lessons learned from Phase I and II. As these projects are further defined, additional planning documents, permits, approvals, and funding may be needed for full implementation.

Reach 1. Reach 1 has several oxbows where the river is already reworking the floodplain. Removing vegetation and lowering the banks would greatly increase their instability and the interaction between the river and the floodplain. In parts of this reach, bank lowering would consist of removing the natural levees that have formed due to the thick saltcedar growth. The banks would not be lowered where the river is eroding the terrace. Bank lowering would mean removing the vegetation not just on the levees, but on some of the floodplains behind the levees. Additional vegetation would need to be removed after lowering the banks. The reach would then be monitored for several years to determine if the actions have produced the desired results. At that point the reach would be reevaluated to determine if the additional cost for reworking the morphology would be necessary. Revegetation with native plants would be considered, where appropriate.

Reach 2. Two small oxbows would be reopened, including one at the north end of the reach and one at the south end of the reach. These oxbows were shaped by the post dam hydrology, so they should continue to erode into the terrace once flow is restored. The small oxbow at the south end of the reach was cut off by the river in 1999. The sediment plug at the north end of this oxbow would be excavated to connect to the river at flows greater than 300 cfs. Remaining saltcedar would be removed from the channel banks and floodplains downstream of the excavated channel. The banks would be lowered and the vegetation would be removed on the remainder of the reach not included in the Phase II work. There are no current plans to rework Oxbow 1 and open it to flow in order to avoid the risks to the levee ponds and oxbow lakes. The reach would be monitored for several

years to determine if the morphology needs to be reworked. Revegetation with native plants would be considered, where appropriate.

Reach 3. The Service may seek to expand the work proposed and funded in Phase II in this reach by removing vegetation, destabilizing banks and point bars, and reworking the channel. Revegetation with native plants would be considered, where appropriate.

Reach 4. The Service would monitor the Phase I restoration and apply corrections and habitat enhancements, if needed. Revegetation with native plants would be considered, where appropriate. No diversion of the river into Oxbow 5 is proposed at this time. The reach would be monitored for several years to determine if the morphology needs to be reworked.

Reach 5. Due to concerns about the channel stability at the Highway 380 Bridge, no restoration is planned for this reach. This reach would be monitored for effects from upstream restoration actions (FLO Engineering 1999).

2.4 Alternatives Considered but Eliminated from Detailed Analysis

To be considered for evaluation, an alternative had to meet the purpose and need of the EA described in Sections 1.3 and 1.4. The Proposed Action includes the two defined restoration phases and a suite of available restoration techniques that have been screened as appropriate for a particular river reach (FLO Engineering 1999). Within the Proposed Action, all or some of the restoration actions may be implemented as resources become available.

The Service did not consider alternative locations for restoring habitat because the lands considered in this EA are already part of the Bitter Lake NWR, which is managed by the Service. This area has been set aside for enhancing habitat conditions to benefit fish, wildlife, and plant species that rely on the Pecos River corridor for their existence. The Service has jurisdiction over these lands and their water rights.

Reclamation is actively considering other locations along the Pecos River to meet its habitat restoration obligations under the Biological Opinion. Reclamation has chosen this location (Oxbow 4) as its first project because of the existing restoration planning that it has funded, the ideal location on federal refuge land, the time to implement, and the opportunity to work cooperatively with the Service and use their expertise.

In the course of developing the Proposed Action, Reclamation considered constructing a new, shorter oxbow channel instead of restoring the whole historic oxbow. This was dismissed due to elevations that would have required moving a large amount of material to cut a channel. Reclamation also considered a proposal to cut a pilot channel in the oxbow, plug the current channel river and allow river to reoccupy the oxbow. This was rejected due to increased uncertainty and risks of environmental and infrastructure

impacts and concerns expressed by agency partners and stakeholders. Also, the Service has decided not to consider any active restoration projects south of Oxbow 4 due to downstream stakeholder concerns.

The Proposed Action restores habitat in reaches where the benefits of restoration can be realized, combined with other efforts funded by other entities and demonstrated to the public. No other alternatives were identified that met the purpose and need and could be implemented closer to the timeframe required by the Biological Opinion.

3. Affected Environment

This section is a description of the environment in which the Proposed Action would take place. Each aspect of the environment that would be affected by the Proposed Action is discussed to the level of detail commensurate with the potential for environmental impact. Additional data specific to the phases of development are included when relevant and available. Those aspects of the environment that would not be affected by the Proposed Action are discussed briefly. The information in this EA is tiered to and derived primarily from the information in the *Bitter Lake NWR Comprehensive Conservation Plan* (Research Management Consultants 1998). Unless referenced to a different source, all data and information pertaining to the affected environment were obtained from the *Bitter Lake NWR Comprehensive Conservation Plan*.

3.1 Regional Setting

The Pecos River is the largest tributary of the Rio Grande. The Pecos River represents a hybrid of Rocky Mountain and Plains stream which originates in the Sangre de Cristo Mountains of north-central New Mexico. The Pecos River is confluent with the Rio Grande at what is now Amistad Reservoir near Laredo, systems, containing equally important snow melt and summer rain components of the annual hydrograph. At its origin the river drains crystalline rocks of the southern Rocky Mountains with high water quality. Below Fort Sumner, New Mexico, the river enters a naturally saline basin composed primarily of evaporitic sedimentary rocks, resulting in higher salinity loads.

The Bitter Lake NWR was established on October 8, 1937, by Executive Order 7724 “as a refuge and breeding ground for migratory birds and other wildlife.” Additional laws direct refuge activities. These include the Migratory Bird Conservation Act (16 USC 715d), which identifies the refuge “for use as an inviolate sanctuary, or for any other management purpose for migratory birds.” The Refuge Recreation Act (16 USC 460-1) identifies the refuge as being suitable “for incidental fish and wildlife-oriented development, the protection of natural resources, and the conservation of endangered or threatened species.” The Wilderness Act of 1964 (PL 88-577) directs the Service to “maintain wilderness as a naturally functioning ecosystem” on portions of the refuge.

The refuge supports plant and animal communities adapted to the diverse and unique habitat within the region. The isolated springs, seeps, and associated wetlands protected by the refuge have been recognized as providing the last known habitats in the world for several unique species. Management emphasis on the refuge is placed on protecting and enhancing habitat for endangered species and federal candidate species, maintaining and improving wintering crane and waterfowl habitat, and monitoring and maintaining natural ecosystem values.

Human activities have reduced the range and in some cases have extirpated native plants and animals. Saltcedar introduced for bank stabilization in the 1940s has significantly altered both the stream channel habitats and the native riparian plant communities. Channelization, groundwater withdrawals, and the construction and operation of dams for consumptive uses has further altered habitats and affected native aquatic communities. The environmental baseline for the refuge and the Pecos River is the current altered environment, not the environment that existed before.

3.2 Land Use

The Bitter Lake NWR is bordered by private land, Bureau of Land Management- (BLM-) administered land, and state trust lands. Surrounding land uses include residential, farming and ranching, recreational, mining, and oil and gas development. The refuge is within Chaves County, which covers 6,026 square miles and has a population of approximately 61,000. Roswell is the largest city in Chaves County, with a population of 45,293. Roswell is approximately nine miles west of the Bitter Lake NWR.

The Bitter Lake NWR encompasses 24,536 acres in three tracts. The North Tract is the Salt Creek Wilderness. The Middle Tract includes most of the developed infrastructure, including the refuge headquarters, visitor center, roads, maintenance facilities, and water impoundments. The South Tract is not open to the public and includes refuge croplands, which support and attract flocks of wintering birds. The Service does not control subsurface mineral rights on the refuge. The proposed restoration would be conducted entirely within the Middle Tract.

Most of the major natural features of the refuge have been designated by the Secretary of the Interior as the Bitter Lake Group National Natural Landmark. The National Natural Landmarks Program was established under the authority of the Historic Sites Act of 1935 (16 USC 461 et seq.) to identify and encourage the preservation of the full range of geological and ecological features that are determined to represent nationally significant examples of the nation's natural heritage. Federal agencies are required to consider the unique properties of these nationally significant areas under the National Environmental Policy Act (NEPA), and the Secretary of the Interior is required to provide an annual report to the Congress on damaged or threatened National Natural Landmarks. Special management areas on the Bitter Lake NWR include those detailed below.

Salt Creek Wilderness. The 9,621-acre Salt Creek Wilderness was established under PL 91-504 on October 23, 1970. The Wilderness Act defines wilderness as an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions. The wilderness includes a line of red clay-gypsum bluffs, gypsum sinkholes, sand dunes, and native plant communities. The tract is managed as a "naturally functioning ecosystem" for scientific research, vegetation management, wildlife management, and monitoring. The area provides opportunities for primitive

recreation, including hiking, equestrian use, hunting, and sightseeing. Within the Salt Creek Wilderness there is an underground natural gas pipeline, installed along a right-of-way in the early 1950s, which crosses the tract diagonally from northeast to southwest. Also, there is a distribution power line along much of the south Wilderness boundary and an active natural gas well lease in the southwest corner of the area.

Bitter Lake Research Natural Area. Research Natural Areas (RNAs) are lands permanently reserved for research and education. Natural processes are supposed to dominate in these tracts, which preserve some natural feature or features. Principal goals in protecting these lands are 1) to preserve a representative array of all significant natural ecosystems as sources of baseline data, against which the effects of human activities in similar environments can be measured; 2) to provide sites for studies of natural processes in undisturbed ecosystems; and 3) to provide gene pool preserves for plant and animal species, especially rare ones. The guiding management principle is to prevent unnatural encroachments. All kinds of human manipulation are discouraged, and public uses that might impair natural values are generally discouraged. Scientists who wish to use a Research Natural Area on refuge land must obtain a special use permit.

The 300-acre Bitter Lake RNA, a mile north-northwest of refuge headquarters, is dominated by the Bitter Lake playa. In winter, large numbers of waterfowl, sandhill cranes, and migratory shorebirds inhabit the lake, and species such as the snowy plover nest here. The depth of Bitter Lake ranges from 0 to four feet and receives water from Bitter Creek, Lost River, Dragonfly Spring, and Sago Spring on its west side. These aquatic systems, along with several associated sinkholes, provide unique habitat for uncommon native fish species.

Lake St. Francis Research Natural Area. The 700-acre Lake St. Francis RNA, two miles north-northwest of refuge headquarters, encompasses about 30 small, round, steep-sided sinkholes. These sinks formed by overlying strata collapsing into hollows formed by dissolution of pockets of gypsum. All sinks at one time held water, and several still do. The largest sinkhole is Lake St. Francis, which is 200 feet across and 60 feet deep. The RNA also includes Bitter Creek, a small intermittent stream, which flows southward through the west side of the RNA into Bitter Lake. Streamflow into Bitter Creek is augmented by Dragonfly Spring, Lost River, and Sago Spring. Water levels in the sinkholes declined from the mid-1940s through the 1970s, but the levels have been slowly rising in recent decades. These sinkholes support unique algae, native fish, and invertebrate communities.

Inkpot Research Natural Area. The two-acre Inkpot RNA is within the Salt Creek Wilderness on the North Tract of the refuge. The chief feature is the “Inkpot,” a vertical-walled sinkhole, 150 feet in diameter and 90 feet deep. The Inkpot is at the edge of the scenic Red Bluffs, a 50-foot Permian escarpment that runs across the north end of the refuge. The Inkpot contains the marine algae *Bataphora oerstedii* and supports a variety of native fish, including a population of endangered Pecos gambusia.

3.3 Geology and Soils

The Bitter Lake NWR is in the Lower Pecos Valley Subsection of the Great Plains Physiographic Province of southeastern New Mexico. Much of the Pecos Valley Section is underlain by Permian bedrock units composed of gypsiferous and saline evaporites, limestone and dolomite, mudstone, shales, and sandstone. Dissolution of evaporite and carbonate units is an active geomorphic process affecting landscape evolution in much of the region, and various sizes of solution-subsidence depressions are common landforms. From the headwaters of the Pecos River, the sedimentary rocks of limestones, shales, and sandstones dip off the mountains in an easterly direction to form a large continuous regional aquifer system. The permeability of the aquifers varies considerably depending on the degree of dissolution or fracturing that has taken place. These processes have been most active in the southern part of the area and have resulted in the Roswell Artesian Basin. The limestone aquifer south of Roswell is the ancient Capitan Reef, in which the Carlsbad Caverns were formed by percolating groundwater.

Soils in the area are dominated by aridisols, which are not well suited for dryland agriculture because they lack the necessary moisture to support any long-term growth, except arid-adapted vegetation. The soil horizon is low in organic matter and is light in color. Aridisols also exhibit special fertility problems due to unavailable micronutrients resulting from a high pH. Floodplain soils in the project area are Vinton-Glendale Association and Glendale loam (USDA NRCS 2005). There are no prime or unique farmlands in the proposed project area.

3.4 Climate/Air Quality

Annual rainfall in the Roswell/Bitter Lake area averages 12.25 inches, and annual snowfall averages 7.4 inches. Annual temperatures typically range from near 0°F in winter to 110°F in summer, with average lows of 41.2°F in January and average highs of 83.7°F in July. The wet season usually runs from mid-June to late August, and the average relative humidity is 48 percent. Prevailing winds are southwesterly. Late winter and spring are the seasons most closely associated with moderate to strong winds, which can bring blowing dust.

Mean annual temperatures have risen across New Mexico and the southwestern US since the early 20th century, and warming trends in the southwestern US have exceeded the global averages by nearly 50 percent since the 1970s. Long-term tree-ring records show severe droughts and mega-droughts to be part of the natural climate variability of the southwestern US. However, increased carbon dioxide and other greenhouse gas emissions in the earth's atmosphere are generally believed to be linked with worldwide climate trends, including the rapid melt of polar ice sheets, sea level rise, and the warming temperatures of the past century. Temperature and precipitation strongly influence the abundance and distribution of plant and animal life. Drought and climate change are likely to exacerbate the effects of natural and human disturbances, including

wildfire, insect outbreaks, flooding, and erosion. The Bitter Lake area has experienced smaller increases in temperature and smaller decreases in precipitation than other parts of the state. However, warmer, drier climate trends in the headwaters of the Pecos River may affect the timing and availability of flows through the project area in the future (Enquist and Gori 2008).

The Bitter Lake NWR is in the Pecos-Permian Basin Intrastate Air Quality Control Region. Air quality can be affected by both near and distant sources of air pollution, including mobile sources (e.g., cars, trucks, off-road vehicles), stationary sources (e.g., power plants and industry), and area sources (e.g., oil and gas development, agriculture, fires, and road dust). Some of the most common and abundant pollutant emissions include nitrogen oxides, ammonia, and sulfur dioxide. These air pollutants can affect air quality and natural resources, including vegetation, wildlife, soils, water quality, and visibility. High levels of ozone, for example, may affect vegetation, as well as the health of refuge visitors and staff. Nitrogen compounds from the atmosphere can affect water quality and biota, soil nutrient cycling, and plant species composition (Fenn et al. 2003). Pollutant particles in the air reduce visibility in the region and affect how far and how well we can see. Atmospheric deposition of toxic organic compounds and metals, including mercury, may have a wide range of effects on fish and wildlife (US EPA 1997).

Under the Clean Air Act (42 USC 7401-7671q, as amended in 1990), the Service has a responsibility to protect air quality and related values from the adverse effects of air pollution and to comply with federal, state, and local air pollution control laws and regulations. The Salt Creek Wilderness is designated as a Class I area. In such areas limits are placed on the maximum allowable increases of sulfur dioxide, particulate matter, and nitrogen oxides above established baseline concentrations. Visibility impairment at the Salt Creek Wilderness is monitored by the Service as part of the Interagency Monitoring of Protected Visual Environments (IMPROVE) Program. The rest of the Bitter Lake NWR, including the proposed project area, is considered a Class II air quality area. Class II areas are protected under the Clean Air Act but are identified for somewhat less stringent protection from air pollution damage than Class I.

Air quality at the Bitter Lake NWR is good. Chaves County is in attainment status for state and federal ambient air quality standards for criteria pollutants (particulate matter less than 10 microns, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, and lead). The most immediate air pollution problem is blowing dust. The New Mexico Environment Department records concentrations of particulate matter at a monitoring station at the city offices in Roswell. In 2003, a violation of the federal standard for particulate matter occurred due to a dust storm, requiring the creation of the Chaves County Natural Events Action Plan to avoid nonattainment for this pollutant. The action plan is a series of measures to reduce particulate matter in the county from construction sites, cleared lands, and other potential sources of human-caused windblown dust. It does not require control of naturally occurring windblown dust (NMED 2004, 2008).

3.5 Water Resources

The Bitter Lake NWR is at the juncture of the Roswell Artesian Basin of southeastern New Mexico and the Pecos River. The Roswell Artesian Basin is a natural hydrologic basin extending six to eighteen miles west of the Pecos River and twenty miles north of Roswell, in Chaves County, to twenty miles south of Artesia, in Eddy County, a distance of approximately eighty miles. The Pecos River runs through the eastern side of the basin from north to south through the refuge. Several large tributaries drain from the west to the east. These two systems and their interactions account for the diversity of water resources within the refuge, including sinkholes, springs, wetlands, oxbow lakes, and riverine habitat. An expanded discussion of water resources is provided as Appendix D.

3.5.1 Surface Water Hydrology

The refuge has about 1,200 surface acres of water in the form of natural lakes, impoundments, sinkholes, and streams. The portion of the Pecos River being considered for the proposed river restoration is entirely within the boundaries of the refuge. For much of its length through the refuge, the river is bordered by impounded wetlands on the west side and a 300-foot-high bluff running along the east side of the river valley.

The hydrology of the Pecos River through the Bitter Lake NWR is controlled by reservoir releases from Sumner Reservoir, inflows from tributaries, and agricultural return flows south of Sumner Reservoir and north of Roswell. Before Sumner Dam was built in 1938, floods were much more intense, and base flows were higher than under post-dam conditions. Since 1937 the quantity of water released from Sumner Reservoir has been determined by the irrigation needs of the Carlsbad Irrigation District (CID) and state line water delivery requirements. Brantley Reservoir is the delivery point for Carlsbad Project water. Water is transported most efficiently to Brantley Reservoir using larger block releases. The maximum release through the gates at the reservoir at typical reservoir levels is 1,400 cubic feet per second (cfs), which typically results in a flow of approximately 1,200 cfs at the Acme Gage. The frequency of these block releases depends on downstream irrigation needs, water availability, and river conditions. Releases usually begin in March, and there can be several each year, lasting up to two weeks. Storms events can also cause peak flows above 1,200 cfs at the Acme Gage and through the refuge (FLO Engineering 1999).

As a result of a jeopardy determination in 1992 for the shiner on water operations on the Pecos River, Reclamation is working to maintain a minimum discharge to support fish populations in the river and to avoid block releases at periods in the shiner's life cycle where the release could be harmful. Current Pecos River operations are governed by the 2006 – 2016 Biological Opinion which sets a year-round target flow of 35 cfs, as measured at the Taiban Gage (Pecos River Below Taiban Creek Ft. Sumner, NM, USGS gage number 08385522) and to keep the river continuous.

Actual flows through the Bitter Lake NWR are variable. A base flow of 35 cfs at Acme Gage has been used for planning restoration actions, although this flow is not expected to

be met consistently during the irrigation season (US Fish and Wildlife Service 2003). The portion of the Pecos River being considered for the proposed river restoration is a gaining reach due to groundwater inflows and is not subject to the same concerns about intermittency as the reach above the Acme Gage.

The construction of Sumner Dam and the excavation of the channels in the Bitter Lake NWR in the 1940s also altered the channel morphology of the Pecos River. The original meanders had greater sinuosity or curving and meander length, meander amplitude, and mean radius of curvature. Current Reaches 2 and 4 are now straight excavated channels, so their morphology cannot be compared to the original meanders. Reaches 1, 3, and 5 have developed a new morphology, which is characterized by lower sinuosity, as a result of the present hydrology.

Each reach of the river has adapted to the lower flows associated with post-dam hydrology and to the straightening of the meanders. The river is a dynamic system and continues to reoccupy and cut off older oxbows. The section of the Pecos River in Reach 3 has a meandering pattern that can be used as a template for the restored areas. This section has been developing within the context of the post-dam hydrology since the southern channel was dug in the 1940s. The river also continues to carry a significant amount of sediment. The Pecos River at the Acme gage has an average sediment transport rate of approximately 640,000 tons per year (Tetra Tech, Inc. 2003).

Other Surface Water Features. The Bitter Lake NWR includes a large variety of surface water types, including arroyos, spring-fed streams, isolated oxbow lakes, large and small playa lakes, developed impoundments, artesian springs, and approximately sixty sinkholes throughout the refuge. These surface water features depend highly on local groundwater flows, which in turn depend on precipitation and water use to the north and west.

3.5.2 Groundwater Hydrology

The Bitter Lake NWR is in the discharge zone for the Roswell Groundwater Basin. The basin encompasses 10,779 square miles and includes most of Chaves County and portions of Torrance, Guadalupe, and Roosevelt Counties. Groundwater supplies are derived from several geological formations, including the Yeso and San Andres Formations, the Artesia Group, the Glorieta Sandstone, and alluvium and terrace deposits. The two major aquifers that provide the largest supplies of water are the Permian artesian aquifer and the shallow-water aquifer, located in the alluvium deposits and terraces. These two aquifers provide water for the cities of Roswell, Artesia, Dexter, Lake Arthur, and Hagerman. Irrigation wells have been developed throughout the basin, with the largest concentration located in the Pecos River Valley between Roswell and Seven Rivers.

Groundwater from the artesian zone flows from west to east into the sinkholes, springs, and seeps of the refuge and maintains the wetlands and surface water impoundments. Groundwater also preserves perennial flows in the Pecos River through the proposed

project area. Artesian flows historically maintained groundwater levels that were 80 feet above the mean topographic surface (mts, 3,500 feet) of the refuge. This level dropped to 20 feet above mts in the 1970s and since then has been on the rise toward the current level of 40 feet above mts. Trends suggest that spring flows will continue to increase, and sinkhole levels will continue to rise. The refuge uses groundwater wells to support various facilities.

3.5.3 Water Rights

The Bitter Lake NWR holds a variety of water rights. For example, there is a water right associated with the North Tract for 440 acres, with a priority date of 1916. As part of the adjudication of its federally reserved water rights by the State of New Mexico, the Service agreed not to use this water right because it wished to enhance natural hydrologic conditions within this wilderness unit. The stipulation states that the refuge shall not use this water right unless the State Engineer would allow for the change in purpose of use from agriculture to instream flow.

The refuge has received recognition from the State of New Mexico for their federally reserved water right. This right allows for the refuge to manage wetlands on the Middle Tract of the refuge and protects spring resources from impairment. Since the mid-1990s the Service has changed how the impounded wetlands of the Middle Tract are managed. Formerly, water levels in these wetlands were kept high year-round. Now lake levels are left low during the summer when evaporation is highest and are allowed to rise during the colder months. While the primary reason for this change was to mimic natural conditions and improve wetland habitat, this change may also have reduced losses due to evaporation.

The refuge also has groundwater rights associated with its Middle Tract and on its Farm Unit south of the 380 bridge. In June 1995 the United States and State of New Mexico stipulated to a consumptive right of 339.1 acre-feet of water per year from an artesian well within the Middle Unit. In December 1996, the United States and State of New Mexico stipulated to a consumptive right of 1368.9 acre-feet per year from both artesian and shallow sources within the Farm Unit.

The refuge has been very active in conserving water. The refuge has cleared saltcedar trees on the Middle Unit within the spring system and partially along the Pecos River. This project plans to clear saltcedar along the Pecos River of the Middle Unit and to manage these lands to maintain native species, including coyote willow, sacaton grass, and seep willow. The Service believes that the projected changes in plant density and use of managed native plants may consume less water than unmanaged saltcedar (US Fish and Wildlife Service 2008c), although the New Mexico Interstate Stream Commission (NMISC) is reluctant to acknowledge a net benefit to the hydrologic system from phreatophyte control.

NMISC and the Service have agreed to monitor changes in the water budget resulting from the project and to determine if there is a net depletion. The preliminary estimate of a

depletion from Phase I and Phase II, discounting any benefits from phreatophyte control, is 9.5 acre-feet a year. The Service is committed to ensuring that any net depletions to the water budget from the project will be compensated for and that there will be no adverse impact on downstream water rights or on interstate compact deliveries (Tashjian 2008).

3.5.4 Water Quality

Potential contaminant sources in the area include natural salinity, irrigated agriculture, grazing, feedlots, oil and gas production wells and pipelines, septic tanks, and historic municipal wastewater discharges to Hunter Marsh.

Upstream of the refuge, the Pecos River enters a basin dominated by evaporitic sedimentary rock. Natural salinity in the Pecos River and refuge water bodies greatly increases below this point due to geologic-based salt-loading and high evaporation rates. Water quality in the river is also affected by return flows from upstream agricultural diversion. Return flows are usually more saline than native river waters because salts are concentrated when water is removed through transpiration. The river also carries runoff from fertilizer application and other upstream contaminants. For many years during the last century, salts, selenium, and other contaminants were further concentrated in the water of refuge sinkholes due to dramatic declines in water levels. Reduced groundwater withdrawal in recent years has led to higher water levels in the sinkholes and probable decreases in salt concentrations. Change in the management of the impounded lakes may have reduced the salinity of these waters, and the removal of saltcedar may have helped remove surface salt and mineral encrustations.

There are three active oil wells and three active natural gas wells on the refuge that were included in lands acquired from the BLM in the late 1960s. The BLM continues to permit extensive natural gas development in the Pecos River floodplain just north of the boundary of the refuge Middle Tract, and leasing activity has accelerated throughout the region, including on the mesa immediately east of the refuge. The refuge does not control subsurface mineral rights, and additional development could occur. Oil spills have occurred in the past within the holding berm of the oil tanks, and there is an area that has crusted oil in spots and is void of vegetation. In 1997, a gathering system was installed to transport produced water and oil from leases on the refuge onto private property to the south. Fluids are now pumped to a central battery located off-refuge, which greatly reduces the chance of any future spills and associated habitat damage. An old abandoned delivery line and three produced water storage tanks were also removed.

The BLM now administers a habitat protection zone (HPZ) within the 500-year source water capture zone for the refuge. All oil and gas activities within the primary area of the HPZ must incorporate groundwater protection features, including steel tanks instead of earthen pits and a stringent casing protocol (US BLM 2002).

Sediment and water samples were collected from Oxbow 4 in March of 2008. The samples were analyzed for PCBs, pesticides, and metals in order to assess any potential water quality impact of the reconnection of Oxbow 4 to the Pecos River main stem

channel. All samples were clear of PCBs and pesticides. The water sample had trace amounts of arsenic (0.090 micrograms per liter of water [μg/l]) and barium (0.021 μg/L). The sediment samples had concentrations of arsenic (~10mg/kg), barium (~100 mg/kg), and chromium (~9 mg/kg). These concentrations are at or below average New Mexico background concentrations for these elements (AALI 2008, Tashjian 2008).

3.6 Biological Resources

3.6.1 Vegetation

Vegetation on the refuge consists primarily of mixed Chihuahuan shrub/grassland with areas of riparian vegetation. The South Tract is a working farm and as a result is dominated by cultivated plants. The shrub vegetation is dominated by four wing saltbush (*Atriplex canescens*) and is associated with a scattering of mesquite (*Prosopis* spp.), creosote (*Larrea tridentata*), iodine bush (*Allenrolfea occidentalis*), and Russian thistle (*Salsosa* spp.). The grassy understory is dominated by alkali sacaton (*Sporobolus airoides*), salt grass (*Distichlis spicata*), and gyp grama (*Bouteloua breviseta*). Areas adjacent to the water courses contain riparian vegetation composed primarily of coyote willow (*Salix exigua*), seepwillow (*Baccharis salicifolia*), common reed (*Phragmites australis*), and exotic saltcedar (*Tamarix ramossisima*). Cottonwoods (*Populus* spp.) occur only in scattered patches influenced by freshwater springs (Research Management Consultants 1998). Vegetation in and along the narrow riparian zone provides cover and nutrient input for fish and wildlife and is a barrier to prevent sediments, debris, and pollution from entering the river.

Common reed, Russian thistle, kochia (*Bassia scoparia*), and saltcedar are the major invasive plant species on the refuge. Saltcedar poses particular problems because of its high water use, deep root system, increased soil salinity, reduced biodiversity in riparian zones, impacts on special species habitat, increased fire risk, and effects on channel morphology, sedimentation, erosion, and flooding (USDA 2005). The refuge does not have a formal plan for invasive species control but treats invasive species as needed using available resources. As part of the refuge's Annual Performance Planning data provided to the Service, the refuge staff documents acres treated and sets annual treatment goals. Invasive species control efforts will continue throughout the refuge as funding and personnel becomes available. The refuge prepared a draft environmental assessment in 2007 for the use of saltcedar leaf beetles (*Diorhabda elongata*) on selected areas of the refuge as a biological control for saltcedar, but there has been no further action or decision to date (Sanchez 2008).

3.6.2 Wetland Habitats

Refuge wetlands support a variety of plant and animal species and are vital to migratory birds. The isolated gypsum springs, seeps, and associated wetlands protected by the refuge have been recognized as providing the last known habitats in the world for several

unique species. Wetlands range from relatively freshwater flowing streams and oxbow lakes to brackish impoundments and natural sinkholes to hypersaline playa lakes. Each of these wetland types has an intricate community of aquatic invertebrates, associated vegetation, and native fish.

As described previously, impounded wetlands are now managed to mimic natural conditions and thus improve wetland habitat. Water manipulation is crucial to managing optimum diversity and abundance of fish and wildlife on the refuge. Previously the Service attempted to maintain all pond and lake levels at their maximum capacity, which resulted in highly saline waters. Salt water holds significantly less dissolved oxygen, which is crucial to the survival of many fish and aquatic insects. Since 1994, water levels have been manipulated to flush out accumulated salts. Typically, impoundments are filled to capacity during the fall and winter to provide roosting and feeding areas for migratory waterfowl. Wetlands are slowly flooded to continually inundate vegetation grown during the summer, which makes a steady supply of food available for migratory birds as they arrive. These same wetlands are slowly lowered during the spring, summer, and early fall, exposing mud flats that provide feeding areas for migratory shorebirds and other waterbirds that require these shallow areas to forage in. The salt flats exposed during spring and summer also provide an important nesting area for snowy plovers, avocets, and least terns that otherwise would concentrate their nests along lake edges where they are much more susceptible to predators. Some lakes are kept low during winter to provide shallow roosting areas for sandhill cranes and snow geese.

The isolated limestone and gypsum springs, seeps, and wetlands of the refuge create unique habitat for diverse assemblages of endemic fish, plants, mollusks, and crustaceans. Some of the sinkholes contain the only known inland populations of marine green algae (*Bataphora oerstedii*). The sinkholes also support Pecos gambusia and protected aquatic invertebrates. There is potential for discovery of new endemic species in these special environments, and the role of these features in the ecosystem protected by the refuge requires further study.

3.6.3 Wildlife

To date, more than 360 bird species have been documented on the refuge, including 44 nesting species. Twenty thousand snow geese, Ross's geese, and Canada geese and more than 18,000 lesser sandhill cranes typically overwinter in the refuge. Marsh bird, waterbird, and shorebird populations reach over 3,000 individuals each spring and fall. In addition, 59 mammal species, 40 reptile species, 12 amphibian species, and 24 fish species have been identified on the refuge and surrounding area. The refuge also supports one of the most diverse populations of dragonflies and damselflies (Odonates) in North America. Over 90 Odonate species occur here, including the continent's largest and smallest dragonfly species. Species lists are provided in the *Bitter Lake NWR Comprehensive Conservation Plan* (Research Management Consultants 1998).

3.6.4 Special Status Species

Special status species are those listed as threatened or endangered under provisions of the Federal Endangered Species Act of 1973, as amended (ESA), those proposed or considered as candidates for such listing, and those considered rare or species of concern by federal or state agencies. Special status species also include those animals listed as state threatened or endangered under provisions of New Mexico Statutes, Chapter 17, Article 2: 17-2-37 through 17-2-46 and plants listed as state endangered under provisions of New Mexico Statutes, Chapter 75, Article 6: 17-6-1. Chaves County includes over 75 special status species, including New Mexico species of concern, many of which are found on the refuge (NHNM 2007, NMDGF 2008).

The Bitter Lake NWR provides a critical role in maintaining a sanctuary for at least 27 state or federal threatened, endangered, or candidate species (See Table 3-1). There are two special status plant species: the Pecos sunflower and the Wright's marsh thistle. The Pecos sunflower is a wetland plant that grows on wet alkaline soils at spring seeps, wet meadows, and pond margins. One of the largest Pecos sunflower wetlands occurs on the refuge, which has been identified in the *Final Pecos Sunflower Recovery Plan* as an important core conservation area for the species. The Service is developing a refuge management plan to address water and wetlands management for Pecos sunflower, while meeting the other refuge requirements for waterfowl and aquatic wildlife habitats. The schedule of filling and draining the water impoundments can greatly influence the population of the Pecos sunflower (US Fish and Wildlife Service 2005a). Critical habitat has been established for this plant on 672 acres within the refuge (US Fish and Wildlife Service 2008a, 2008b).

Table 3-1
State or Federal Threatened, Endangered, or Candidate Species of the Bitter Lake NWR

Species Type	Common Name	Scientific Name	Occurrence	Federal Status	New Mexico Status
Plants					
	Pecos sunflower	*Helianthus paradoxus*	Resident	T	E
	Wright's Marsh Thistle	*Cirsium wrightii*	Resident	SoC	SoC
Aquatic Invertebrates					
	Pecos assiminea snail	*Assiminea pecos*	Resident	E	E
	Noel's amphipod	*Gammarus desperatus*	Resident	E	E
	Say's pond snail (wrinkled marsh snail)	*Stagnicola caperatus*	Resident	--	E
	Roswell pyrg (springsnail)	*Pyrgulopsis roswellensis*	Resident	E	E
	Koster's springsnail	*Juturnia kosteri*	Resident	E	E

Table 3-1
State or Federal Threatened, Endangered, or Candidate Species of the Bitter Lake NWR *(continued)*

Species Type	Common Name	Scientific Name	Occurrence	Service Status	New Mexico Status
Reptiles					
	Western river cooter	*Pseudemys gorzugi*	Possible Resident	--	T
	Western (arid land) ribbon snake	*Thamnophis proximus*	Resident	--	T
Mammals	Swift fox	*Vulpes velox velox*	Hypothetical	C	--
	Least shrew	*Cryptotis parva*	Resident	--	T
	Black-footed ferret	*Mustela nigripes*	Hypothetical (may be extirpated)	E	--
	Pecos River muskrat	*Ondatra zabethicus ripensis*	Resident	SoC	S
Birds					
	Bald eagle	*Haliaeetus leucocephalus*	Migrant	-	T
	Interior least tern	*Sterna antillarum athalassos*	Breeding	E	E
	American peregrine falcon	*Falco peregrinus anatum*	Migrant	R	T
	Baird's sparrow	*Ammodramus bairdi*	Migrant	--	T
	Mountain plover	*Charadrius montanus*	Migrant	C	--
	Southwestern willow flycatcher	*Empidonax traillii extimus*	Migrant	E	E
	Lesser prairie chicken	*Tympanuchus pallidicinctus*	Resident	C	--
	Bells vireo	*Vireo belli*	Migrant	--	T
	Brown pelican	*Pelicanus occidentalis*	Migrant	E	E
	Neotropical cormorant	*Phalacrocorax olivaceus*	Migrant	--	T
Fish					
	Pecos bluntnose shiner	*Notropis simus pecosensis*	Resident	T	T
	Arkansas River shiner	*Notropis girardi*	Resident	E	E
	Pecos gambusia	*Gambusia nobilis*	Resident	E	E
	Pecos pupfish	*Cyprinodon pecosensis*	Resident	--	T
	Mexican tetra	*Astyanax mexicanus*	Resident	--	T
	Bigscale Logperch	*Percina macrolepia*	Resident	--	T
	Greenthroat darter	*Etheostoma lepidum*	Resident	--	T

C=Candidate; E=Endangered; R=Recovered; S=Sensitive (informal state designation); SoC=Species of Concern; T=Threatened

Sources: NHNM 2007; NMDG&F 2008; Research Management Consultants 1998; Service 2001

The Wright's marsh thistle is a federal and state species of concern. The thistle lives near desert springs and marshes. Its habitat is rare and threatened by aquifer depletion and infestation of nonnative plants. Outside of the refuge there are no known remaining populations in Chaves County. The plant also still grows in the lower elevations of the Sacramento Mountains, southwestern Socorro County, and isolated locations in Arizona and West Texas.

The Service has designated as endangered species the Roswell springsnail, Koster's springsnail, Pecos assiminea, all aquatic snails, and Noel's amphipod, a freshwater shrimp. These invertebrates are found exclusively in the springs, seeps, and sinkholes of the Pecos River basin in New Mexico and Texas. These animals depend on the health, quality, and quantity of groundwater in their environment, and their main threats are the introduction of nonnative species, surface and groundwater contamination, oil and gas extraction, local and regional groundwater depletion, severe drought, and habitat loss. No critical habitat was designated within the refuge because these lands are already managed for the conservation of wildlife, and special management considerations or protections are not required (US Fish and Wildlife Service 2005b). As part of a recent legal settlement with environmental groups, the Service is considering critical habitat designations within the refuge (Bryan 2009).

Special status reptiles include the western river cooter (a turtle) and the western ribbon snake. The turtle has been documented mostly in the south of Brantley Dam, but there is one record of it at the Bitter Lake NWR. It is primarily a stream species, preferring waters with slow to moderate current, firm bottoms, and abundant aquatic vegetation. Most records are from streams with relatively clear water and rocky or sandy bottoms. The Western or arid land ribbon snake is found in open sandy areas along the margins of water bodies.

Special status mammals include the swift fox, least shrew, black-footed ferret and the Pecos River muskrat. Swift foxes have been found to inhabit grasslands habitat in New Mexico and have been recorded historically at the Bitter Lake NWR. There are also historical accounts of the presence of black-footed ferret, also a grassland species, in Chaves County, but it is now believed to have been extirpated from New Mexico. The least shrew is a small burrowing species favoring herbaceous vegetation on moist soils, especially inland salt grass, and is known to be present at the Bitter Lake NWR. The Pecos River muskrat is a resident species that inhabits dome-shaped lodges constructed of vegetation near shallow, fresh-water sources with clumps of marshy vegetation.

As described previously, migratory and nesting birds were the primary reason that the refuge was chartered. A small population of interior least terns has nested at the Bitter Lake NWR consistently for over 50 years. Terns typically nest in colonies on broad unvegetated sandbars and flats and feed exclusively on small fish. Until 2004, the refuge was the only location in New Mexico where least terns have nested in recent history. In May of 2006, 20 adults were observed, with an estimated six nesting pairs on the shore of Brantley Lake, 60 miles south of the Bitter Lake NWR (Bureau of Reclamation 2006b). Terns have returned in subsequent years, and nesting and brood-rearing habitat is now

maintained by the CID off the western shore of Brantley Lake (Bureau of Reclamation 2006b). The refuge appears to be the only other regular nesting location on the southwestern periphery of the interior least tern's historic range. Special status migrant or wintering bird species that have been recorded but not actively managed include the bald eagle, American peregrine falcon, Baird's sparrow, mountain plover, southwestern willow flycatcher, Bell's vireo, brown pelican, and the neotropical cormorant.

Fish species include the Arkansas River shiner, Pecos gambusia, Pecos pupfish, Mexican tetra, greenthroat darter, and the Pecos bluntnose shiner. The Arkansas River shiner is an introduced species to the Pecos River and feeds on invertebrates and detritus and spawns in summer. The Pecos gambusia is not known in the mainstem of the Pecos River in New Mexico but inhabits the backwaters, pools in small tributaries, and springs of off-channel sites. The Pecos pupfish inhabits shallow groundwater springs associated with sinks and marsh habitat. The Mexican tetra is found in the river and is associated with pool and backwater habitats in clear-flowing water over gravel bottoms. The Bigscale Logperch occurs in gravel and sand runs and pools of the Pecos river and also in impoundments. The greenthroat darter inhabits swift-flowing streams and springs, especially vegetated riffle areas with gravel and rubble substrates.

Of the above fish species, the Pecos bluntnose shiner requires a more detailed description and analysis to determine possible effects resulting from proposed restoration at the Bitter Lake NWR. Since its listing as threatened in 1987, the Pecos bluntnose shiner has been the subject of conservation efforts within its current range by several agencies. Information on this species is primarily taken from the *Biological Opinion for the Bureau of Reclamation's Proposed Carlsbad Project Water Operations and Water Supply Conservation EIS, 2006-2016* (US Fish and Wildlife Service 2006) and, which should be consulted for a more detailed description of the species and its requirements.

Pecos Bluntnose Shiner. Historically, bluntnose shiner, *Notropis simus,* were found in main channel habitats of the Rio Grande, Rio Chama, and Pecos River, New Mexico, and Texas. The Rio Grande subspecies (*Notropis simus simus*) was last collected in 1964 and was determined to be extinct during the 1970s. In 1976, the State of New Mexico gave formal protection to the Pecos River subspecies (*Notropis simus pecosensis*). In 1987, the Service listed the shiner as threatened and defined critical habitat. At the time of listing, intermittent water flow in the river was identified as the greatest threat to the shiner and its habitat. Water diversions, groundwater and river water pumping, and water storage have reduced the amount of water in the channel and altered the hydrograph with which the shiner evolved (US Fish and Wildlife Service 2006). The current range of Pecos bluntnose shiner is believed to be limited to the mainstem Pecos River between Sumner Dam and Brantley Reservoir, but it may now be extirpated from the 14-mile section between Sumner Dam and the FSID Diversion Dam (Platania and Altenbach 1998). A preliminary study indicates that the shiner population is not genetically divergent between spatially distinct sampling localities throughout its current range (Osborne and Turner 2006) .

The Pecos bluntnose shiner is a relatively small, moderately deep-bodied minnow, rarely exceeding 3.1 inches total length. The shiner primarily feeds on plant matter, filamentous algae, aquatic invertebrates, and terrestrial invertebrates, such as ants, wasps, flies, and midges. The shiner's average life span is two to three years. The shiner is found in wide river channels with a shifting sandbed and erosive banks. Sandbeds are maintained by a combination of sediment and floodwater inflows. Erosive bed and banks allow channel configurations to change in response to flows. Flood inflows from many uncontrolled tributaries on the Pecos River contribute to favorable river channel conditions but occur too infrequently to maintain a wide channel in many places. Throughout much of the shiner's range, impoundments that control floods and block sediment transport have eliminated many of these features (US Fish and Wildlife Service 2006).

Female shiners spawn in response to rapid increases in river flow caused by summer rainstorms and reservoir releases (Dudley and Platania 2000, 2007). Platania (1993) found that females released an average of 370 eggs with each spawning and spawn multiple times during the spawning season. Spawning occurs from late April to September, usually peaking during July and August. Females release nonadhesive semibuoyant eggs into the water column where they are immediately fertilized by the males. Eggs remain suspended in the current for 24 to 48 hours until they hatch (Platania and Altenbach 1998). Within two to three days after hatching, blood begins to circulate, the yolk sac is absorbed, and the swim bladder, mouth, and fins develop. If not retained in back water or low velocity areas, larvae continue to drift downstream until they are sufficiently strong to seek suitable habitats (Dudley and Platania 2000, 2007). It is believed that the changes from a natural hydrograph have increased the downstream transport of eggs and larvae to Brantley Reservoir, where they do not survive. Small juveniles are also susceptible to downstream displacement but are better able to seek low-velocity habitats. Channel conditions that reduce downstream displacement and provide low-velocity habitats are favorable for successful shiner survival and recruitment (US Fish and Wildlife Service 2006). Successful shiner reproduction is also unlikely when fish are confined to isolated pools due to flow intermittence. Loss of reproductive cues, isolation from reproductive individuals, predation, and extremes in water chemistry reduce or eliminate reproduction (Davenport 2008).

There have been ongoing studies to determine the life requisites of the shiner for each of its stages, its depth and velocity preferences, and habitat availability in the Pecos River (for example, see Brooks et al. 1991, 1994, 1995; Hatch 1982; Hatch et al. 1985; Hoagstrom 1997, 1999, 2000, 2002, 2003; Hoagstrom et al. 2008a, 2008b; Kehmeier et al. 2004a; Platania and Altenbach 1998; Roberts et al. 2004). Recent studies have clarified the habitat and flow requirements of the shiner through its life stages. The subsegments of the Pecos River, which are occupied by the core population of the shiner, are buffered from the direct effects of dams and irrigation releases, high subsegment length, substantial sediment inputs from uncontrolled tributaries, substantial base flow, high channel width in relation to discharge, and lower salinity (Hoagstrom et al. 2008a, 2008b). Long-term monitoring has indicated that significant decreases in shiner abundance and density followed surface flow intermittence and extreme low flow.

Surface flow intermittence should be recognized as the primary threat to the remaining population of shiners (Davenport 2008).

The maintenance of a dynamic sand bed channel with low-velocity areas is also an important component of good supporting habitat. The ongoing drought, combined with the continued demands on the river for irrigation and compact deliveries to Texas, may be putting additional strain the remaining population and thus the long-term survival of the shiner.

The shiner has been found in every major habitat type within its range except for stagnant pools. Hatch et al. (1985) found the shiner most often in water 6.7 to 16 inches deep, with smooth nonturbulent flow and sandy substrate. In a series of studies conducted from 1992 to 1999, Hoagstrom found that larger fish are present in higher-velocity flows. Adults most frequently use velocities between 0.33 and 1.4 feet/second (ft/s), typically found in open-water runs, riffles, and shallow pools. Juveniles most frequently use velocities between 0.03 and 0.91 ft/s, which are most commonly associated with shoreline areas. A variety of depths are used by different fish size classes. Adult shiners most frequently use depths between 5.1 and 13 inches. Juvenile shiners use a variety of depths from 2 to 17 inches (Hoagstrom 2002, 2003). Use of a variety of depths may be caused by the need to avoid high-velocity areas, regardless of depth. The shiner showed a preference for depths greater than 20 inches and velocities ranging from 0 to 28 inches per second (Hoagstrom 2003). Larvae presumably use backwater habitats with negligible velocity, relatively high water temperature, and high water clarity (Platania and Altenbach 1998).

Kehmeier et al. (2004a) reported that water depths and velocities overlapped considerably for habitats used by small-bodied minnows in the Pecos River, including the shiner. In this study the shiner were observed to select or avoid certain mesohabitat types that provided particular combinations of features, such as depth, velocity, substrate, turbulence, cover, and food. The shiner and other small-bodied minnows strongly selected perpendicular and parallel plunge habitats, with average depths of 9 inches and average velocities of 7 inches per second. These habitats were characterized by sudden increases in depth and reduced velocity, often with vertical recirculation or an eddy effect that have the potential to provide areas for resting, food entrainment, and adjacent cover for escape from predators. More than 60 percent of shiners were collected in these plunge habitats, which made up a very small percentage of all available habitats at all flows. These habitats were found to be available in similar quantities at the low- and high-flow river conditions.

Designated critical habitat for the shiner is divided into two reaches. The upper critical habitat extends from the confluence of Taiban Creek downstream to the Crockett Draw. The lower critical habitat reach is from Hagerman to Artesia. The upper critical habitat has a wide sandy river channel with only moderately incised banks and provides habitat suitable for all age classes. The lower critical habitat is deeply incised, has a narrow channel, and has a compacted bed. Although the lower critical habitat has permanent flow, the habitat is less suitable for shiners and only smaller size classes are common in this reach. Lack of growth, reduced survival, and reduced recruitment in this reach is

attributed to poor habitat conditions and the periodic downstream displacement of eggs, larvae, and small juveniles (US Fish and Wildlife Service 2006). Although it is not part of the designated critical habitat, the area with the highest densities of shiner is below the upper critical habitat, between river miles 605 and 588, just above the Acme gage (Davenport 2008). This reach was not designated as critical habitat because portions have been subject to intermittency in the past under drought conditions.

The Bitter Lake NWR is between the two critical habitat reaches. The Middle Tract of the Bitter Lake NWR is just south of the Acme gage and is also the boundary between the Rangelands and the Farmlands reaches of the Pecos River. These designations have been used for fish surveys and habitat descriptions for many years (US Fish and Wildlife Service 2006). Downstream of the Acme gage in the Middle Tract and the Farmlands reach, the river gains water from artesian aquifer inflows and irrigation returns and is not subject to drying (FLO Engineering 1999; US Fish and Wildlife Service 2006).

The Rangelands reach is considered a stronghold for the shiner because of good habitat availability and suitability and the presence of relatively stable populations of shiner of all size classes (Hoagstrom 2003). Generally the current channel morphology is maintained in this reach through block releases, but the peak flows are much less than those that occurred before the upstream dams were built. This altered hydrograph encourages the proliferation of nonnative vegetation, such as saltcedar, which armors the banks and causes channel narrowing. Channel narrowing increases water velocity, reduces backwater areas, and leads to the removal of fine sandy sediments. Consequently, the habitat becomes much less suitable for the shiner.

From 1992 to 1999, shiner density within the Rangelands reach showed a gradual increase. During these years there was a normal snow pack and spring runoff, frequent local summer precipitation, and experimental Sumner Dam operations, all of which contributed to sustaining perennial flows from Sumner Dam to Brantley Reservoir (Hoagstrom 1999, 2000; US Fish and Wildlife Service 2006). In 1999, New Mexico entered a period of sustained drought, which worsened over the next five years. Surface flow intermittence occurred in the Rangeland section, where most adult Pecos bluntnose shiner population occurs during the reproductive period. The Farmland section was maintained by spring flow, but significant decreases in population still occurred, due in part to impacts on the breeding population upstream (Davenport 2008; US Fish and Wildlife Service 2006).

From the long-term population surveys, it appears that the prolonged and extensive intermittency that occurred from 2002 to 2004 in the Rangelands, in combination with limited spawning opportunities, had a negative impact on the shiner population. Abundance declined to 1992 levels. No other physical or biological factors have been identified that would lead to such a pronounced decline in population density. Both the relative abundance and shiner density dropped precipitously in the Rangelands reach, where the habitat is the best and where the population would be the most resilient (Davenport 2008; US Fish and Wildlife Service 2006). Reclamation and other agencies have multiple efforts in progress to conserve the shiner and irrigation water supplies by

maintaining target flows, expanding a fish conservation pool at Sumner Lake, acquiring water, and restoring habitat (US Bureau of Reclamation. 2006a; US Fish and Wildlife Service 2006).

3.7 Cultural Resources

Cultural resources are locations of human activity, occupation, or use. The term includes archaeological sites, buildings, structures, and places associated with the traditional cultural practices or beliefs of a living community.

NEPA requires consideration of "important historic, cultural, and natural aspects of our natural heritage." Consideration of cultural resources under NEPA includes the necessity to independently comply with the applicable procedures and requirements of other federal and state laws, regulations, and executive orders. The principal federal law addressing cultural resources is the National Historic Preservation Act (NHPA) of 1966, as amended (16 USC Section 470), and its implementing regulations (36 CFR 800). The regulations commonly referred to as the Section 106 process describe the procedures for identifying and evaluating historic properties, for assessing the effects of federal actions on historic properties, and for project proponents consulting with appropriate agencies to avoid, reduce, or minimize adverse effects. Historic properties are cultural resources that meet specific criteria for listing on the National Register of Historic Places (NRHP). The Proposed Action is a federal undertaking, as defined by 36 CFR 800.3, and is subject to the Section 106 process and consideration under other federal and state requirements. The Section 106 process requires consultation with the State Historic Preservation Office (SHPO) and other parties.

Archaeological investigations in the Pecos River Basin indicate human use for perhaps 11,000 years. Broad shifts in the archaeological evidence of native adaptations are observed from the Paleo-Indian through the Archaic and Ceramic to the Protohistoric Periods. Spanish contact and settlement came later to this region than to other parts of New Mexico along the Rio Grande. Attempts at Spanish and American settlement of this frontier were hindered by the lack of security from Apache and Comanche raiding that continued through much of the 19th century. When native populations were subdued, agriculture and ranching provided the economic basis for the region.

Site and survey records were researched to determine the presence and potential for cultural resources to be present within the Area of Potential Effects (APE) for the Proposed Action. Research was conducted through the Archaeological Records Management System of the New Mexico Historic Preservation Division in Santa Fe. Cultural resource locations are generally confidential, except in the case of historic structures, and are not published in order to prevent disturbance and unauthorized collecting.

No surveys have been conducted in the immediate vicinity of the Proposed Action, and no sites have been recorded within the APE. There are two old records (LA 8834, LA 8835) with poor locational information of lithic and lithic/ceramic scatters approximately 1400 and 1900 meters to the west of the APE. Lithics and ceramics have also been recorded as close as two miles away on top of a large upland mesa above the floodplain. This mesa has been extensively surveyed for cultural resources as a result of oil exploration and development, and several prehistoric archaeological sites have been recorded. Federally recognized tribes and pueblos with potential ties to the project area were notified via letter of the proposed project. The only responses received requested notification should archaeological resources or human remains be found during restoration. No concerns or traditional cultural properties were identified by the parties consulted.

With the exception of the staging and river access locations, work would be conducted in active or recently active floodplains, channels, or oxbows. Access to these areas would be through refuge roads. The APE has experienced episodic flooding, refuge maintenance actions, channel diversion and shaping, and parking and associated earthmoving activities over the years, resulting in a highly disturbed setting. Portions of the APE are inaccessible due to dense vegetation and/or perennial water. No structures are present. Surveys have not been conducted, but the possibility of finding intact cultural resource sites retaining integrity is low. Although unlikely, consideration must also be given to the possibility of buried or undiscovered cultural resources that could be found during restoration.

3.8 Recreation/Visitor Facilities

The Bitter Lake NWR attracts approximately 35,000 to 40,000 visitors annually. Principal recreational activities include wildlife observation, hiking, photography, environmental education, and limited hunting and camping.

A 6,000-square-foot visitor center was recently constructed that includes a gift shop, interpretive displays, and a small theatre/meeting room. Films and exhibits highlight the unique qualities of the refuge's water resources and wildlife. A main feature is a large deck and rear panel of windows set directly above a bluff that overlooks refuge wetlands.

An 8.5-mile auto tour route circles most refuge wetlands and provides visitors with an opportunity to view a variety of habitats and diverse wildlife from several stops and overlooks. There are four short and two longer hiking trails adjacent to the wildlife drive or refuge headquarters. The Bitter Lake NWR is identified as a Watchable Wildlife Site in New Mexico and the most popular public use activity on the refuge is wildlife observation. Traditionally, late fall and early winter are the most popular times for visitors who come to witness the large concentrations of ducks, geese, and sandhill cranes. Some observation areas are wheelchair accessible and include interpretive panels. The refuge also has an observation area for the South Tract along Highway 380.

Endangered species tours are scheduled from October through May to take visitors into areas normally closed to the public, allowing them to see some of the unique sinkholes and springs protected by the refuge. In late summer there is a dragonfly festival conducted with the assistance of the Friends of Bitter Lake NWR, which works with the refuge to increase public awareness and appreciation of the refuge and to support school outreach and special projects.

A variety of other wildlife-oriented activities attract visitors to the refuge. Photography is popular with both amateurs and professionals, and typically about twenty percent of visitors comment that they were taking photographs during their visit. Bicycling has become more popular and is permitted on the auto tour loop or the refuge's paved four-mile (round trip) bike trail. The entire North Tract is open to hiking and horseback riding, the latter being the most popular activity in the Salt Creek Wilderness. Camping is allowed in the Salt Creek Wilderness by special use permit only, but few visitors make use of this area for backpacking or camping due to the lack of drinking water in the area. The refuge also provides a small camping area about one mile east of headquarters for organized scout and youth groups. The area is available to groups by special use permit. Waterfowl, sandhill crane, quail, dove, pheasant, and deer hunting are available at the refuge seasonally. Fishing is prohibited at the Bitter Lake NWR to protect native fish species (Research Management Consultants 1998).

3.9 Visual Resources

Visual resources refer to both the natural and artificial landscape features that contribute to perceived visual images and the aesthetic value of a view. This value is determined by contrasts, forms, and textures exhibited by geology, hydrology, vegetation, wildlife, and human-made features. Individuals respond differently to changes in the physical environment, depending on prior experiences and expectations and proximity and duration of views. Therefore, visual effects analyses tend to be highly subjective. Because of the land use as a wildlife refuge and primary visitor use as a location for wildlife observation, the refuge is more visually sensitive than an area used for industrial, commercial, or residential purposes.

The visual resources of the Bitter Lake NWR have not been formally assessed. The proposed project area is east of the auto tour loop in the Middle Tract of the Bitter Lake NWR. Typical views from the west side of the auto tour loop and the visitor center site include a broad valley that ends abruptly on the east side with a mesa. Playa lakes and human-made impoundments dominate the valley floor. The river corridor is just below the mesa, and the oxbows extend to the west. The river itself is not visible, but its location is outlined by native and nonnative riparian vegetation. Riparian and wetland vegetation are also associated with the impoundments, playa lakes, and ditches. Other vegetation is sparse and includes typical Chihuahuan shrub/grassland species with some weedy areas. There are some areas that have been cleared. The east side of the auto tour

loop is in the valley and is east of most of the impoundments. Views to the project area do not include the visual quality available from the west side.

3.10 Noise

Noise is generally defined as unwanted or harmful sound. Noise may be intermittent or continuous, steady or impulsive. Vibration is an element of impulsive noise that can cause annoyance and structural damage. Human response to noise is extremely diverse and varies according to the type of noise source, the sensitivity and expectations of the receptor, the time of day, and the distance between the source and the receptor. Noise also can adversely affect and disturb wildlife. Noise analyses focus on the effects on sensitive receptors.

There are no noise studies at the Bitter Lake NWR, but noise levels are very low and typical of remote areas. Visitor and refuge vehicles, maintenance activities and equipment, and aircraft are the primary sources of occasional and intermittent noise. As a wildlife refuge and a location for wildlife observation, there is a higher degree of sensitivity to increases in noise levels.

3.11 Socioeconomic Resources

The Bitter Lake NWR is in Chaves County. The population, demographic, and economic characteristics of Chaves County are detailed in Table 3-2, along with comparable data from the state of New Mexico and the US. The estimated population of the county in 2006 was 62,474, an increase of 1.8 percent from 2000 (61,382). During the same period, New Mexico's population increased by 7.5 percent (from 1,819,046 to 1,954,599), and the US population increased by 6.4 percent (from 281,421,906 to 299,393,484). Roswell is the largest city in Chaves County, with a population of 45,582 in 2006. Major employers include government, health care and social assistance, accommodations and food service, manufacturing, agriculture, construction, transportation, and warehousing. Total non-farm employment in the county increased by 4.2 percent from 2000 to 2005, compared with an 8.4 percent increase in New Mexico and an 2.0 percent increase in the US. Per capita personal income increased in the area by 11.9 percent from 1993 to 2003. This compares with a 15.5 percent increase in New Mexico and a 15.6 percent increase in the US (Fedstats 2008; US Census 2006; NMDWS 2008a, 2008b; USDA ERS 2008a, 2008b, 2008c; and Service 2005c).

Table 3-2
Population, Demographics, Economic Characteristics, and Poverty Status

	Chaves County	New Mexico	United States
Total Population (2006 Estimate)	62,474	1,954,599	299,398,484
Percent White (2006)	94.1	84.6	80.1
Percent Black (2006)	2.3	2.5	12.8
Percent American Indian, Eskimo, or Aleut (2006)	1.4	9.8	1.0
Percent Asian (2006)	0.9	1.3	4.4
Percent Native Hawaiian or Other Pacific Islander (2006)	..01	0.1	.2
Percent reporting two or more races (2006)	1.2	1.6	1.6
Percent reporting Hispanic/Latino Origin (2006; may be of any race)	47.4	44.0	14.8
Percent unemployment rate (2007)	3.6	3.5	4.6
Personal income per capita (2003)	$22,300	$25,670	$31,472
Median household income (2005)	$32,124	$37,603	$46,242
Percent Below Poverty (2005)	22.5	18.4	13.3

Original data were gathered from a variety of sources and may have been derived using different methods.
Race and ethnic categories are based on self-reporting during the decennial census.
Sources: Fedstats 2008, US Census 2006, NMDWS 2008a, 2008b; USDA ERS 2008a, 2008b, 2008c; and Service 2005c

The Roswell Chamber of Commerce lists the refuge as one of the area's main attractions. Visitor recreation expenditures for the refuge totaled $666,400 in 2004, with nonresidents accounting for $457,300 (69 percent of total expenditures). Refuge visitor spending in 2004 totaled $908,000. In turn, this generated 11 jobs (both full-time and part-time), with total job income of $227,000. Total county, state, and federal tax revenue generated by the refuge amounted to $179,000 (US Fish and Wildlife Service 2005c).

3.12 Environmental Justice

On February 11, 1994, President Clinton issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. This Executive Order requires federal agencies to identify and address disproportionately high or adverse human health and environmental effects of federal programs, policies, and activities on minority and low-income populations. Consideration of environmental justice concerns includes race and ethnicity data and the poverty status of populations, as shown in Table 3-2. The 2005 estimated median household income in Chaves County was $32,124, and 22.5 percent of the residents were classified as living in poverty, a higher percentage than in New Mexico or in the US. Minority populations, as defined by the US Census Bureau, are present in the county (NMDWS 2008a, 2005b; USDA ERS 2005a, 2005b, 2005c).

3.13 Indian Trust Assets

Indian Trust Assets (ITAs) are legal interests in assets held in trust by the United States through the Department of the Interior, Bureau of Indian Affairs, for Indian tribes or individual Indians. This trust responsibility requires that all federal agencies, including Reclamation, ensure their actions protect Indian Trust Assets.

"Assets" are anything owned that has monetary value. The asset need not be owned outright but could be some other type of property interest, such as a lease or a right of way. They can be real property, physical assets, or intangible property rights. Common examples of trust assets may include lands, minerals, hunting and fishing rights, water rights, other natural resources, and money. "Legal interest" means there is a primary interest for which a legal remedy, such as compensation or injunction, may be obtained if there is improper interference. Trust assets do not include things in which a tribe or individual have no legal interest, such as off-reservation sacred lands in which a tribe has no legal property interest. It should be noted that other federal laws pertaining to religious or cultural laws should be addressed if impacts on such lands were to occur from Reclamation actions.

No issues involving Indian Trust or specific ITAs were identified in the Pecos River Basin during the preparation of the Carlsbad EIS (Reclamation 2006a). Letters regarding the proposed restoration at Bitter Lake NWR were sent to representatives of 12 tribes and Native American pueblos on June 20, 2007 (See Chapter 6). No ITA issues have been identified to date.

4. Environmental Consequences

4.1 Introduction

This section is an evaluation of the potential environmental effects of the Proposed Action and the No Action Alternative. The Proposed Action is inclusive of the Phase I and Phase II work as described in Chapter 2, as well as additional restoration actions that may be conducted at Reaches 1 through 4 as funding becomes available. Additional effects specific to the phases of development are included when relevant and foreseeable. This analysis includes likely beneficial and adverse effects on the human environment, including those that are short term or long term, direct or indirect, and cumulative. The analysis of effects on resources focuses on environmental issues in proportion to their potential effects. Detailed consideration is given to those resources that have a potential for environmental effects. Interpretation of effects in terms of their duration, intensity, and scale are provided, where possible.

The restoration techniques outlined in the Proposed Action are designed to improve riparian and in-channel habitat, extending the reach of connected good-quality habitat for the benefit of native aquatic and riparian plant and animal communities. Some or all of these actions may eventually be implemented, and the individual actions may be implemented at different times. However, impacts are assessed on the basis that the actions would be implemented together so that the total impact on the environment can be evaluated. Implementation of all actions may require additional permits, approvals, and funding. Environmental commitments and mitigation measures are recommended, where appropriate.

4.1.1 Terminology

Terms referring to intensity, context, and duration are used in the effects analysis. Unless otherwise stated, the standard definitions for these terms are as follows:

- *Negligible:* The effect is at the lower level of detection, and there would be no measurable change.
- *Minor:* The effect is slight but detectable, and there would be a small change.
- *Moderate:* The effect is readily apparent, and there would be a measurable change that could result in a small but permanent change.
- *Major:* The effect is severe, and there would be a highly noticeable, permanent, measurable change.
- *Localized Impact:* The effect occurs in a specific site or area. When comparing changes to existing conditions, the effects are detectable only in the localized area.

- *Short-Term Effect:* The effect occurs only during or immediately after implementation.
- *Long-Term Effect:* The effect could occur for an extended period after implementation. The effect could last several years or more and could be beneficial or adverse.

4.1.2 Thresholds of Significance

Significance thresholds are listed in Table 4-1 to help the reader and decision makers understand the magnitude and intensity of effects. Some thresholds are determined using quantitative data, while others rely on qualitative data.

Table 4-1
Thresholds of Significance

Resource	Thresholds of Significance
Land use	Significance threshold would be reached if there were conflicts with established land uses or land use plans in the area, disruption or division of established land use configurations, or a substantial change in existing land uses.
Geology and soils	Significance threshold would be reached if an alternative were to result in a change in or loss of a unique geologic resource; if an alternative were to result in a substantial soil loss because of increased erosion or if there were a substantial risk of damage due to erosion; if an alternative were to convert federal prime farmland soils to incompatible uses; if an alternative were to contaminate the soil; or if an alternative resulted in a measurable decrease in water infiltration into soils.
Climate/air quality	Significance threshold would be reached if an alternative were to lead to an exceedance of the National Ambient Air Quality Standards or would result in substantial contribution to global climate change.
Water resources	Significance threshold would be reached if an action were to cause substantial flooding or erosion; if it were to substantially impair any significant water body, the health of any watershed, or the functionality of major rivers, wetlands, or floodplains; or if it were to decrease surface or groundwater quality or quantity. Significance threshold would be reached if an action were to cause substantial increases in flooding on adjacent properties or violate the limits of existing water rights or compact agreements.

Table 4-1
Thresholds of Significance *(continued)*

Resource	Thresholds of Significance
Biological resources	Significance threshold would be reached if there were any of the following: • An action that introduced or substantially encouraged the spread of invasive species; • A substantial loss or impairment of riparian or wetland habitats; • Harm or destruction of plant species, natural community, or habitat that is biologically significant; • An alteration or destruction of habitat that would prevent the reestablishment of native biological communities that inhabited the area prior to the disturbance; • A loss of a number of individuals of any native animal species sufficient to affect the viability of the local population of that species; • A substantial interference with movement of any resident or migratory fish or wildlife species sufficient to adversely affect the viability of the local population of the species; • Harm, harassment, or destruction of a species, natural community, or habitat that is recognized for scientific, recreational, ecological, or commercial importance; or • Harm, harassment, or destruction of any federally listed endangered, threatened, or candidate plant or animal species, its habitat, or its breeding areas.
Cultural resources	Significance threshold would be reached if an alternative were to directly or indirectly alter the integrity and characteristics of a resource that would qualify it for inclusion in the National Register of Historic Places (36 CFR 800.5a). Significance threshold would be reached if it were determined that, in consultation with federally recognized tribes or other tradition-based communities, an alternative were to inhibit access to or use of culturally important locations or would interfere with cultural or religious practices.
Recreation and visitor facilities	Significance threshold would be reached if there was a substantial decline in the quality or quantity of recreational facilities. Effects on recreational activities would be considered significant if they were to result in a substantial decline in the quality or quantity of opportunities to participate in these recreational activities.
Visual resources	Significance threshold would be reached if an alternative were to noticeably increase visual contrast and reduce the scenic quality, if it were to block or disrupt existing views, or if it were to substantially reduce public opportunities to view scenic resources.

Table 4-1
Thresholds of Significance *(continued)*

Resource	Thresholds of Significance
Noise	There are no universally applicable regulatory thresholds for assessing significance of noise effects, but environmental noise regulations and guidelines are defined by various federal and state agencies that provide a general context for assessing noise issues. In a refuge, there is a higher degree of sensitivity to noise levels than in many other environments. Significance threshold would be reached if an alternative were to violate any applicable noise standards at the boundaries of the project area over an extended period or were to disturb or harass protected animal species.
Socioeconomics	Significance threshold would be reached if an alternative were to create a substantial increase or decrease in population growth, demand for services, economic activity, or local employment.
Environmental justice	Significance threshold would be reached if a project alternative were to disproportionately negatively affect low-income and minority populations.
Indian Trust Assets	Significance threshold would be reached if the value, use, or enjoyment of Indian real property, physical assets, or intangible property rights would be substantially impaired by the action.

4.2 Land Use

4.2.1 No Action Alternative

Direct and Indirect Effects

Implementing the No Action Alternative would not have any effect on existing land use in the project area or surrounding lands. The lands in the project area would continue to be managed for wildlife conservation but would not benefit from the proposed restoration. Ongoing smaller-scale actions to remove nonnative species and improve habitat at the refuge would continue.

4.2.2 Proposed Action

Direct and Indirect Effects

The Proposed Action would occur entirely within the Bitter Lake NWR, which is managed for wildlife conservation, wildlife-dependent recreation, and environmental education and interpretation. Efforts to improve riparian and in-channel habitat in the long term is consistent with the established land use at the refuge. There would be no change or effects on surrounding land uses, no anticipated effects on refuge facilities and infrastructure, and no effects on the refuge research natural areas or the Salt Creek Wilderness.

4.3 Geology and Soils

4.3.1 No Action Alternative

Direct and Indirect Effects

Implementing the No Action Alternative would have no impacts on geology and soils. The existing conditions would continue.

4.3.2 Proposed Action

Direct and Indirect Effects

The proposed restoration techniques for Phases I and II would disturb soil along the banks, floodplain, and terraces in the project area, access routes, refuge roads, on-site disposal areas, and staging areas. Abatement measures would be used to reduce dust, though most of the disturbed soils are likely to be unstructured sand. Mechanical clearing methods would be used to remove soil and vegetative cover, leaving soils temporarily exposed and subject to wind and water erosion and the potential for spread of invasive species. There would be short-term increases in sedimentation in the river associated with soil disturbance, erosion, and dust. Sediments would generally be redistributed within the river channel in the refuge.

Soils would be subject to minor short-term compaction from heavy equipment use. There would be minor improvement in soil quality, primarily through removal of salt deposition caused by saltcedar. No loss of prime and unique farmlands or mineral resources is expected.

The Pecos River is a dynamic system and naturally moves a great deal of sediment. The river at the Acme gage has an average sediment transport rate of approximately 640,000 tons per year (Tetra Tech, Inc. 2003). Within the Phase I project area, sediment is estimated to have a density of 116 pounds per cubic foot (lb/ft^3), assuming soil composition of “sand, dense and mixed” (Lindeburg 2003). Total excavation for the restoration is estimated to be 56,000 cubic yards, which has a corresponding weight of 87,696 tons. Thus, the total amount of sediment excavated for the Phase I project is about 14 percent of what the river transports in an average year (Reclamation 2008).

The sediment volume excavated for the project is not necessarily equivalent to the amount of sediment that would be mobilized into the river as a result of the project. Much of the excavated sediment would be used to plug and fill the existing channel; it is very unlikely that the river would transport this sediment. Conversely, some additional sediment would be eroded from the banks of the newly constructed channel as it widens during high flows, such as during block releases and summer storms. Consequently, it is difficult to predict the exact amount of sediment that would be mobilized for transport as a result of the project. However, comparison of the excavated sediment volume probably results in a conservative estimate (i.e., higher than would likely occur) of the increase in sediment transported by the river (Reclamation 2008). Sediment would be transported,

but much would be redistributed by the river on-site, facilitating a natural process that has been inhibited by the channelization.

Lowering banks, reworking channel morphology, and diverting the river into historic oxbows would alter the long-term topography and geomorphology of the project site. There would be some minor increased risk to property and refuge facilities, such as impoundments, levees, and roads from erosion during subsequent storms. These risks were considered in defining the proposed restoration techniques for each reach. Soils should stabilize after vegetation regenerates in the disturbed areas, and water infiltration rates and moisture-holding ability should improve. Levels of sedimentation consistent with a dynamic sand bed river should develop and be passively maintained by block releases and storms. The wider river bed should decrease flow velocity and erosion hazard in time through the affected reach and downstream. The Service would monitor the effects of the restoration during and immediately after construction. If it determines that there would be a risk to infrastructure and property, the Service or Reclamation would take corrective actions, if necessary.

4.4 Climate/Air Quality

4.4.1 No Action

Direct and Indirect Effects

Implementing the No Action Alternative would have no impacts on air quality. The existing conditions would continue.

4.4.2 Proposed Action

Direct and Indirect Effects

Implementing the Proposed Action would result in short-term increases in fine particulate matter (PM_{10}) and other pollutants due to truck traffic and construction-related fugitive dust, diesel exhaust emissions and burning of woody debris. Visibility impacts due to dust would be reduced as soils stabilize. Smoke from the burning of woody debris would be temporarily visible on-site but would dissipate before reaching any population centers. The Proposed Action is in a Class II air quality area, which allows for moderate amounts of air quality degradation. The Salt Creek Wilderness is a Class I airshed but would not likely be impacted due to distance and the southwesterly prevailing winds.

Because of a violation in Chaves County of the federal standard for PM_{10}, measures to reduce particulate matter from human-caused sources would be incorporated into the project plans (NMED 2004, 2008). With these measures the potential for impacts would be minor. The project would not violate any other air quality standard or contribute substantially to air quality degradation.

The Proposed Action would contribute negligible amounts of greenhouse gases to the atmosphere from the use of construction equipment and worker vehicles during the restoration and from debris burning. Nonnative vegetation would be gradually replaced by other desirable species, and beneficial effects of plants on local cooling and the removal of carbon dioxide and production of oxygen would continue. Because climate change is global in scope, the mechanisms and interactions that may result in climate change are complex and speculative. However, because the project would be associated with negligible and short-term emissions, no effects are anticipated.

Effects on the Proposed Action from drought and climate change could include earlier snowmelt, reduced summer base flows, and warming and could potentially affect sediment movement, creation of backwater habitats, Pecos bluntnose shiner survival, and success of passive restoration measures. Effects are anticipated to be negligible.

4.5 Water Resources

4.5.1 No Action Alternative

Direct and Indirect Effects

Implementing the No Action Alternative would result in the continuation of current conditions. Reclamation and the Service would not improve the channel and riparian habitat, as proposed, but ongoing smaller-scale actions to remove nonnative species and improve habitat at the refuge would continue. Saltcedar would continue stabilizing the banks, decreasing the erosion at the bends and locking the straight sections in place. The straight sections would become increasingly entrenched, reducing interaction with the floodplain and further reducing the dynamic nature of this reach and the quality of instream and riverine habitat. There would be no actions that would affect the oxbow lakes or impoundments. Benefits to river flows, groundwater levels, and water quality would not be realized.

4.5.2 Proposed Action

Direct and Indirect Effects

The potential impacts of the Proposed Action on water resources are discussed for surface water hydrology, groundwater hydrology, water rights, and water quality.

Surface Water Hydrology. The Proposed Action is designed to have a major long-term positive effect on channel morphology and river function within the physical context of current conditions and river operations. Effects on other surface water features should be negligible or minor and positive.

Vegetation removal and bank lowering would decrease the stability of the banks and would enhance the river’s interaction with the floodplain. The thick growth of vegetation

along the river banks induces sediment deposition and the buildup of natural levees, which reduce the frequency of beneficial overbank flows. The width of vegetation removal and current flows would be sufficient to allow the river to develop lateral movement and eventually create meanders with an average amplitude of 1,850 feet (FLO Engineering 1999). Where the channel morphology is reworked, the pattern of meanders would be created immediately. Returning the river to the historic oxbow under Phase I and developing meanders would increase the length of this section of the Pecos River, thereby decreasing the slope and increasing the sinuosity.

Bank lowering and grading of vertical cut banks, along with the changes in channel morphology, would reduce the current bank cutting and improve sediment transport. The river naturally carries a significant amount of sediment. There would be short-term increases in sedimentation in the river from construction, soil disturbance, erosion, and dust. Sediments dispersed within the river channel are expected to return to normal shortly after the restoration excavation work is completed. Sediments would generally be redistributed within the river channel in the refuge and would be unlikely to have any discernable downstream negative effects on infrastructure or property. Sediment loads would be redistributed, and there would be a more natural balance between sediment supply and flow, leading to improved instream bed form features and a dynamic floodplain. A variety of depths, velocities, substrates, and bed form features would be beneficial to instream habitat and river function.

The effects of the Proposed Action on flood control would be moderate and beneficial. The current channel allows the water to pass quickly, resulting in bank cutting and a rapid increase in peak flow downstream. Reconnecting the channel with the floodplain and returning sinuosity to its length would improve flood peak attenuation and flood flow storage. At locations where the channel is restored and slopes are reduced, water velocity would decrease and water would be stored in the floodplain, reducing damaging flood potential. As the water level recedes, the stored water in the floodplain would slowly reenter the stream. The potential for serious overbank flooding has been diminished due to the construction of Sumner Dam. While the river has adapted to less extreme floods, the channel would still remain capable of transmitting flood flows safely.

Any overbank flooding is not anticipated to damage property on or off the refuge. A channel would be excavated through Oxbow 4 and debris would be removed from the channel area, reducing the likelihood of any downstream damage due to debris flow. Rock vanes are included in the proposed action to ensure that infrastructure in the immediate vicinity of Oxbow 4 is protected. All actions are at least 1.9 miles above any downstream infrastructure.

The Proposed Action is designed to minimize risks of damage or loss of other surface water features. The rock vane revetments would decrease the risk to the refuge ponds and levees from diverting the river. There would be loss of oxbow lake habitat, but these features are not unique on the refuge. Surface water features that are connected to the shallow aquifer may benefit from higher water tables resulting from vegetation removal

in the short term. The higher water table should not impair the operation of refuge impoundments.

The Service would monitor the effects of the restoration during and immediately after the construction. If determines that there would be a risk to infrastructure and property, the Service or Reclamation would take corrective actions, if necessary. The Service would establish a long-term monitoring program to determine the river's response to restoration activities (Appendix B). Cross sections have been surveyed and set to datum points throughout the river reaches and oxbows. The monitoring plan includes annual assessments of surface flows, groundwater levels, and channel morphology, including sediment and bed forms.

Groundwater Hydrology. Although debated, removal of nonnative vegetation could raise the water table in the shallow aquifer adjacent to the Pecos River. Because of the head pressure of the artesian aquifer, the accrual location of any savings is expected to be in the shallow aquifer and the river rather than in the artesian aquifer. There would be no expected effect on the natural lakes and sinkholes of the refuge. The impact of the use of well water on aquifers for construction and dust abatement would be minor, and this use would be negligible, relative to the groundwater rights held by the refuge.

Water Rights. The Proposed Action would not exceed water rights held by the Bitter Lake NWR or affect the water rights of other parties. As described in detail in Section 3.5.3, the Bitter Lake NWR has surface and groundwater rights associated with the North Tract, Middle Unit, and the Farm Unit, which the State of New Mexico has recognized and allows the Service to manage its constructed wetlands and protect springs (Tashjian 2008). In recent years the Service has been implementing water conservation measures as part of its management of impounded wetlands and programs to remove saltcedar. The section of the Pecos River considered for restoration is a gaining reach and is not subject to the intermittency that has been experienced upstream in the past. In the Phase I project area, base flows may also be enhanced by reconnecting the oxbow to the river. The oxbow is spring-fed and has perennial water.

While the Proposed Action would increase areas subject to evaporation loss, the Service expects full implementation of Phase I and Phase II to increase the flow in the Pecos River channel due to greater connectivity with the local aquifer. Removing nonnative phreatophytes from the channel banks may also initially increase water to the system; however, a long-term increase to the system thus far has not been scientifically demonstrated.

The NMISC manages the state's limited water supply through a system of permits and licenses. In the Pecos River Basin, the NMISC is responsible for compliance with the Pecos River Compact (between New Mexico and Texas) and the Carlsbad Project Settlement Agreement. This requires that the water budget be quantified and water resources carefully managed using the best available science. Depletion estimates for both phases of the restoration prepared by the NMISC are found in Appendix C, Water Budget. These estimates do not include assumptions by the Service that removing

nonnative vegetation would result in contributions of water into the river system (US Fish and Wildlife Service 2008c). The Service and NMISC estimates are part of the hypothesis, which will be tested through monitoring, that there will be small changes to the water budget from this project.

Based on conservative estimates of water usage—that is, higher than would likely occur—the NMISC anticipates that Phase I restoration may consume 1.9 ac ft/yr, and Phase II may consume 7.6 ac ft/yr, for a total of 9.5 ac ft/yr . While the Service expects that less water would be used and benefits would be gained due to reduced evapotranspiration, depletions, if any, are expected to be minor. The Service will work with the NMISC to quantify and offset any changes to the water budget due to this project. The Service is committed to ensuring that any net depletions to the water budget resulting from the project will be compensated for and that there will be no adverse impact on downstream water rights nor interstate compact deliveries (Tashjian 2008).

Water Quality. The Proposed Action would cause short-term increases in sedimentation in the river associated with ground disturbance, exposed soils, and erosion (Reclamation 2008). There would also be a minor risk of inadvertent discharge of pollutants into surface waters from construction equipment and vehicles that would be used in the restoration and from burning of woody debris. No herbicide use is proposed. Water from the oxbow lake would be added to the main stem of the river, temporarily increasing organic matter immediately after reconnecting the oxbow. Sediment and water samples from Oxbow 4 were tested and were clear of PCBs and pesticides and had concentrations at or below average New Mexican background concentrations for arsenic, barium, and chromium (AALI 2008, Tashjian 2008). Negligible and short-term effects on water quality are anticipated during restoration work.

These impacts and risks would be minimized by implementing measures to control sediments, remove decayed vegetation from the oxbow, and burn debris and to prevent spills during restoration actions. Additional sediment would be mobilized by these actions, but it would be a small contribution relative to the load the river already carries. Dispersal of sediments within the river channel are expected to return to normal shortly after the restoration excavation work is completed. As beneficial vegetative cover returns, water quality in this section would improve in the long term to a better balance between flows and sediment loads, thereby restoring the sand beds and floodplain and reducing salt deposited by saltcedar. Better river function can also improve the ability of the river to contend with pollutants from other sources.

The Service applied for a Section 404 permit on May 22, 2008, with the US Army Corps of Engineers (USACE), Albuquerque District in compliance with Section 301 of the Clean Water Act, which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE. The USACE Albuquerque District Regulatory Branch determined on June 17, 2008 that the proposed work would not result in more than minimal individual or cumulative adverse effects and that the public interest would best be served by allowing the work to proceed under Nationwide Permit 27: Aquatic Habitat Restoration, Establishment and Enhancement Activities (Appendix E).

The NMED SWQB has reviewed the application and issued a Section 401 water quality certification on November 10, 2008 (Appendix E).

The Service would meet the requirements of USACE Section 404 Permit and the NMED Section 401 water quality certification. If needed, the Service would obtain an NPDES permit for discharges into the waters of the United States and would prepare a Stormwater Pollution Prevention Plan (SWPPP), which would detail specific sediment and erosion control measures for the project site during restoration. Actions in the floodplain would be timed to reduce the risk of floods and adverse downstream effects. Woody debris would be removed from the channel and burned, in compliance with site-specific burn plans (US Fish and Wildlife Service 2004) to avoid affecting water quality.

4.6 Biological Resources

4.6.1 No Action Alternative

Direct and Indirect Effects

Implementing the No Action Alternative would result in the continuation of current conditions. The Service would not improve the channel and riparian habitat as proposed, but ongoing smaller scale actions to remove nonnative species and improve habitat at the refuge would continue. Treatment of land for invasive species would continue under existing programs and annual goals, using other funding sources and the limited resources available to the refuge. Some natural channel corrections may occur, but the trend of reduced interaction with the floodplain and negative impacts on functioning channel habitat would continue. Nonnative vegetation is expected to continue to crowd out native riparian species and to spread to other parts of the refuge. Anticipated benefits to fish and wildlife habitat, vegetation, and wetlands would not be realized.

4.6.2 Proposed Action

Direct and Indirect Effects

The potential impacts of the Proposed Action on biological resources are discussed for vegetation, wetlands, wildlife, and special status species, with emphasis on the shiner.

Vegetation. The Proposed Action is designed to have a major long-term positive effect on riparian vegetation. Nonnative invasive saltcedar has crowded out most of the other types of vegetation and understory. Removing the saltcedar would allow the development and expansion of more diverse riparian vegetation and habitat capable of supporting a greater variety of wildlife. Removing the saltcedar would also decrease the risk of wildfire. While saltcedar would be targeted, other species, such as willows, cottonwoods, grasses, and cattails on the banks, may be affected by mechanical removal. There would be a short-term loss of natural cover provided by vegetation. While a complete revegetation effort is not anticipated, the Service would selectively plant native perennial

species after saltcedar removal to improve the success and speed of restoring riparian species and habitat, to reduce erosion, and to help keep the area free of weedy species. On the sections of the Bitter Lake NWR where saltcedar has been removed in the past, native grasses have reestablished in the original habitat within a few years, and the return to native habitat seems to be permanent. Areas where strips of saltcedar were removed in the early 1960s still retain the distinctive stripped pattern today, with no encroachment into the restored areas to date. The restored areas would be closely monitored to prevent the reestablishment of saltcedar and other nonnative species.

Wetland Habitats. Similar long-term positive effects for wetland vegetation and function are anticipated by removing saltcedar, reconnecting the river and the floodplain, and creating the new meanders. These actions are anticipated to result in a higher water table, more diverse plant communities, and more areas where self-sustaining wetlands would develop. Benefits of the improved wetlands include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining surface water flow during dry periods. No adverse effects are anticipated on refuge impounded wetlands or other wetlands outside of the immediate vicinity of the Pecos River.

Wildlife. Long-term positive effects are anticipated for wildlife species. Restored channels, floodplains, wetlands, and riparian vegetation are expected to increase the abundance of birds, mammals, reptiles, amphibians, and fish relative to expanded habitat availability and quality. Some species may have declined in the past due to loss of natural riparian, wetland, and instream habitats; the restoration and expansion of these habitats should benefit these species in the long term. Effects on wildlife would not be immediate but would come with improved river function and the establishment of diverse native vegetation. Investigations of the native fishery within the Pecos River have revealed a preference of the native fishes for a wide, sand substrate and active channel bed. An active channel allows for the formation of backwaters, pools, and a variety of features that would provide additional habitat favorable to native species. During restoration some wildlife species may be killed and their dens or nests destroyed by heavy equipment. Heavy equipment in the channel, potential drying of pools, and changes in sediments could kill fish. Noise associated with restoration could also affect nesting or reproductive behavior of some species. However, work would be conducted to avoid nesting seasons and locations, and expected wildlife loss would be very limited. Removing vertical structure of vegetation would likely affect birds seeking cover or perches. These minor short-term adverse impacts in areas of poor habitat would be outweighed by the overall benefits to wildlife and habitat that would result from the Proposed Action during the life span of the project.

Special Status Species. In order to completely assess the impacts on special status species, the Service conducted an Intra-Service Section 7 consultation with the Ecological Services Field Office in Albuquerque. The Endangered Species Act requires this process for actions that may affect listed and proposed species. Although including candidate species is not required by law, it is Service policy to consider candidate species when relevant in making natural resource decisions. Through the Intra-Service Section 7

consultation, the Service has determined that the Pecos River Restoration at Bitter Lake National Wildlife Refuge, Chaves County, New Mexico, may affect, but is not likely to adversely affect, the Pecos bluntnose shiner. The restoration is expected to improve habitat for other riverine fishes. The Pecos gambusia is not found in the Pecos River but lives in spring heads and sinkholes at off-channel sites and would not be negatively affected by the restoration (Appendix E). Consultation has resulted in measures to minimize impacts from restoration and to avoid jeopardy; these measures are discussed in Chapter 5.

The Intra-Service Section 7 consultation included consideration of the species discussed below, which could be affected by the proposed restoration project. Effects on other special status species that were not subject to the Intra-Service Section 7 consultation would be expected to be similar to those described in general for vegetation, wetland habitats and wildlife.

Pecos sunflower. The only state or federal threatened, endangered, or candidate plant species included in Intra-Service Section 7 consultation is the Pecos sunflower. Favorable habitats have been reduced by lower water tables and encroachment by alien plants (US Fish and Wildlife Service 2005a). Because the Bitter Lake NWR has been identified as important core conservation and recovery area for the Pecos sunflower, restoration actions should be coordinated with the current review of water and wetlands management at the refuge. The goal of this review is to maximize the sunflower population, while meeting the other Refuge requirements for waterfowl and aquatic wildlife habitats.

The Pecos sunflower should benefit from this action. Saltcedar competes with the sunflower for space, light, moisture, and nutrients. Sunflowers often establish themselves beneath the former canopy of saltcedar once it has been top-killed by fire or otherwise removed. Gradually reduced soil salinities, as a result of saltcedar removal, should also promote the germination and growth of sunflowers.

Currently there is one population of Pecos sunflowers in the critical habitat that could be negatively affected if protective measures are not taken during Phase I. This population is adjacent to Oxbow 4 and could be impacted if not avoided during restoration construction or if the restored river eroded into the location of the population. In order to avoid negative impacts on these Pecos sunflowers, rock vane revetment structures would be set in place in order to block and reroute the river away from this sunflower stand.

Aquatic invertebrates. Protected aquatic invertebrates include the Roswell springsnail, Koster's springsnail, Noel's amphipod, and Pecos assiminea. These species inhabit springs, seeps, sinkholes, and outflows in the vicinity of Bitter Creek, the Sago Springs, Hunter's Marsh, and portions of some impoundments. Restoration is not expected to negatively impact their habitats, which are located far from the Proposed Action and the river, although negligible or minor beneficial effects could occur if a higher water table improves spring flows or supports suitable habitat. The removal of saltcedar along the river should increase water quantity and quality in the springs and ditches in surrounding areas, upon which all four species depend. Increasing spring flows to more historic levels

may allow populations to expand into presently unoccupied habitat. The Service is considering designating critical habitat for these species that may require additional consultation for implementing future restoration phases (Bryan 2009).

Migratory birds. Generally, special status bird species are not expected to nest or to be resident in the proposed restoration project area. Depending on the season, the Proposed Action may have minor short-term negative effects on some special status migratory birds due to noise and removal of vegetation used for cover, perches, or possibly nesting.

Southwestern willow flycatcher. Southwestern willow flycatchers are not known to nest along the Pecos River drainage in New Mexico, though they have been observed migrating through the Bitter Lake NWR. Restoration may benefit this species during migration, thus providing an increased diversity of prey after saltcedar has been removed and native vegetation persists and recovers. The effort should benefit this species due to increased available acreages of native riparian habitat that should harbor flycatcher prey items. There are no nesting pairs within 150 miles of any Proposed Action; therefore, only positive effects are expected from this action.

Interior least tern. The interior least tern nests on salt flats at the Bitter Lake NWR. The restoration is not expected to create any additional nesting areas along the river but may provide additional feeding and loafing areas among backwaters and small sandbars. Removal of dense saltcedar stands and dead saltcedar would remove habitat used by striped skunks or raccoons, which are potential predators of nesting terns. The action should also enhance tern prey (fish and invertebrate) abundance and/or accessibility. Saltcedar removal and increased floodplain habitat should ultimately increase native fish populations by improving the quantity and quality of refuge waters. There are no nesting tern colonies within 330 yards of any Proposed Action; therefore, no negative effects are expected from this action.

Lesser prairie chicken. Lesser prairie chickens occur rarely at the Bitter Lake NWR because refuge habitat does not generally correlate to desirable prairie chicken habitat. Prairie chickens are not associated with riparian habitats within the refuge and are not expected to be affected by these actions.

Pecos gambusia. The Pecos gambusia is not known to inhabit the Pecos River in the refuge. It is found in spring heads and sinkholes at off-channel sites. Pecos gambusia may benefit from this action. Further removal of saltcedar from the Pecos River drainage may increase spring flow and quantity and quality of fish habitat within surrounding systems. Since Pecos gambusia requires unique, clear spring-head and/or sinkhole habitats and there is no such suitable habitat within the action area, the Proposed Action should not negatively affect this species.

Pecos Bluntnose Shiner. Impacts on the shiner are discussed in more detail since this threatened species is the focus of multiple conservation efforts on the Pecos River, including this proposed restoration. The restoration project is a reasonable and prudent measure (RPM) of the Biological Opinion on the selected alternative from the Carlsbad

Water Operations EIS and implements goals of the refuge comprehensive conservation plan for this species (Research Management Consultants 1998, Reclamation 2006a, US Fish and Wildlife Service 2006).

The proposed restoration is expected to have long-term minor to moderate beneficial effects on shiner reproduction, recruitment rates, and survival at all of its life stages. The shiner spawns on flow events, such as spring runoff, summer storms, and irrigation releases. Females lay semibuoyant eggs that drift downstream. In order to develop into adulthood, drifting eggs and larvae must be retained in quality habitat. Degraded channelized conditions are associated with relatively high egg and larval transport rates to Brantley Reservoir. Where the energy of a flow event is dissipated by low velocity floodplain habitats, such as flooded bottomlands, oxbow lakes, and secondary channels, there is better retention of drifting eggs and larvae (Kehmeier et al. 2004b). Restoring this section of the Pecos River, where habitat transitions from quality to poor, would improve the reproduction efforts of the species by extending the quality reach and creating a critical downstream egg and larvae refugia.

Recent studies have clarified the habitat and flow requirements of the shiner through its life stages. The subsegments of the Pecos River, which are occupied by the core population of the shiner, have the combination of being buffered from the direct effects of dams and irrigation releases, high subsegment length, substantial sediment inputs from uncontrolled tributaries, substantial base flow, and high channel width in relation to discharge and lower salinity (Hoagstrom et al. 2008a, 2008b). It is clear that channels with uniformly high velocities and high depth do not provide for the needs of the shiner. Naturally functioning sand bed river channels are geomorphically complex and provide the shiner with a variety of depths, velocity, substrates, turbulence, cover, and food. The availability of lower-velocity areas, whether in plunge habitats or shoreline areas, appears to be important for shiner survival. As the juvenile shiners mature, they are less susceptible to downstream displacement but still need off-channel habitats for resting, food, and cover (Hoagstrom 2003; Kehmeier et al. 2004a). Backwaters and off-channel habitats are highly productive environments for maximizing the growth of larval and juvenile fish. Based on studies of other species, it is possible that juvenile and adult fish use these habitats for different segments of their life history, variously moving between main channel and off-channel habitats as flood pulses move through the system (Kehmeier et al. 2004b). The Proposed Action would correct degraded channel morphology in this reach and would allow the development and maintenance of habitat features that would support the shiner through its life stages.

The Phase I restoration actions would create additional shiner habitat (approximately 7,000 feet) that is far more favorable for shiner use than that of the current incised channel. After reconnection of Oxbow 4, the incised channel would likely be used as a nursery/breeding backwater for the shiner during high flows. Phase II and subsequent alterations of the channel would also influence the river to create plunge-pools, backwater, and open water areas, providing improved shiner habitat.

This species is adapted to high sediment loads, which naturally occur in the Pecos River with increased discharge. Temporary increased sediment loads and turbidity due to disturbances created by these actions would not negatively affect shiners currently residing downstream. Sediments and water samples from Oxbow 4 have been tested and would not likely pose a risk to aquatic life, nor to any endangered species should they be disturbed during proposed restoration efforts in Oxbow 4 (AALI 2008; Tashjian 2008).

The Proposed Action would result in negative effects on the shiner during restoration from the use of construction equipment in the channel and disturbance of sediments. Impacts would be short term but could result in take of a small number of the species in the immediate vicinity of actions. Through the Intra-Service Section 7 consultation, the Service has determined that the proposed restoration may affect the shiner. The shiner is not likely to be adversely affected if the specified measures, including seining and removal, are met to minimize impacts due to habitat restoration. This short-term negative effect to these individuals is not major compared to the benefits this project would provide for the species as a whole (Appendix E).

4.7 Cultural Resources

4.7.1 No Action

Direct and Indirect Effects

The No Action Alternative would result in no change in existing conditions and would have no effect on cultural resources.

4.7.2 Proposed Action

Direct and Indirect Effects

The Proposed Action is not expected to have any effects on cultural resources. No cultural resources have been recorded or are expected to be present in the proposed restoration project area. Federally recognized tribes and pueblos with potential ties to the project area were notified via letter of the proposed project. The only responses received requested notification should archaeological resources or human remains be found during restoration. No concerns or traditional cultural properties were identified by the parties consulted.

With the exception of the staging and river access locations, work would be conducted in active or recently active floodplains, channels, or oxbows. Access to these areas would be through refuge roads. Rock for the rock vanes would be obtained from commercial sources and would not require expansion of quarry facilities. The APE has experienced episodic flooding, refuge maintenance actions, channel diversion and shaping, parking, and associated earthmoving activities over the years, resulting in a highly disturbed setting. Portions of the APE are inaccessible due to dense vegetation and/or perennial

water. The APE for restoration staging and river access locations is enlarged so that sensitive plant resources and wet locations can be avoided, if necessary. Surveys have not been conducted, but the possibility of finding intact cultural resource sites that retain integrity is low. Although unlikely, consideration must also be given to the possibility of buried or undiscovered cultural resources that could be found during restoration.

Reclamation and the Service have consulted with the New Mexico State Historic Preservation Office (SHPO) on the Phase I and Phase II portions of the restoration project. Reclamation and the Service have completed the Section 106 process for identifying and evaluating historic properties, for assessing the effects of federal actions on historic properties, and for consulting with appropriate agencies to avoid, reduce, or minimize adverse effects. The SHPO has concurred with the finding that no historic properties would be affected. Future phases of restoration in Reaches 1 through 4 are not fully developed as undertakings, and additional SHPO consultation would be needed for implementation.

4.8 Recreation/Visitor Facilities

4.8.1 No Action

Direct and Indirect Effects

Implementing the No Action Alternative would have no effects on recreation and visitor facilities.

4.8.2 Proposed Action

Direct and Indirect Effects

Implementing the Proposed Action would result in minor short-term negative effects on wildlife-based recreation and visitor facilities in the refuge. During restoration there would be heavy equipment use, land disturbance, vegetation removal, and noise, which could interfere with recreational activities such as wildlife viewing, hunting and photography. Hunter access would be accommodated. Refuge roads would be more heavily used to move workers, supplies, and equipment, creating dust in visitor areas and possibly requiring additional maintenance. However, restoration would be conducted in phases, and with the exception of the Phase I activities, most actions would be half a mile or more from the auto loop and other popular visitor facilities. After restoration these impacts would cease. Abatement measures would be used to reduce dust. The proposed auto loop pullout, viewing platform, and interpretive signage at the Phase I restoration site would afford the public the opportunity to observe the Pecos River in the restored oxbow and to learn about the river restoration. This would be the only site on the auto loop where the Pecos River would be visible to the public. In the long term, visitors may experience an increase in the abundance and variety of wildlife and more recreational and interpretive opportunities in the restored areas near the Pecos River.

4.9 Visual Resources

4.9.1 No Action

Direct and Indirect Effects
The No Action Alternative would have no effect on visual resources.

4.9.2 Proposed Action

Direct and Indirect Effects
Implementing the Proposed Action would have a short-term minor negative effect on visual resources in the refuge. Minor visual effects could occur from construction vehicles and equipment, dust, and the loss of vegetative cover. Some of the restoration actions may be visible in the distance from the west side of the auto tour loop and the visitor center site. Occasional truck traffic and dust would also be visible on the auto tour route. Abatement measures would be used to reduce dust. Views from the east side of the auto tour loop would be closer to the restoration actions and at a similar elevation. The staging area for Phase I as well as the construction site for the viewing platform would be adjacent to a portion of the auto tour loop road. After the Phase I restoration is complete, there may be a time lag before the viewing platform is constructed. After restoration these impacts would cease. In the long term, visitors may experience improved visual quality of the site and its surroundings consistent with natural riparian function and vegetation. The viewing platform at the Phase I restoration site would create a new viewpoint and afford the public a new opportunity to observe the Pecos River in the restored oxbow. The river is currently not visible along the auto tour loop.

4.10 Noise

4.10.1 No Action Alternative

Direct and Indirect Effects
Implementing the No Action Alternative would retain current ambient noise levels.

4.10.2 Proposed Action

Direct and Indirect Effects
Implementing the Proposed Action would result in noise and ground-borne vibrations from construction vehicles and equipment. These impacts would be short term, variable, and minor but may exceed 80 dBA in the immediate vicinity of the activity. With the exception of the Phase I construction, most actions would be half a mile or more from the auto loop and other popular visitor facilities. Although there would be some noise from

trucks on the auto tour road, there may be potential for effects on particular wildlife species or their nesting behavior. After restoration, these noise impacts would cease.

4.11 Socioeconomics

4.11.1 No Action

Direct and Indirect Effects

Implementing the No Action Alternative would not result in any impacts. The local economy would not benefit from construction expenditures or the indirect effects of the restoration.

4.11.2 Proposed Action

Direct and Indirect Effects

Implementing the Proposed Action would result in minor temporary increases in federal spending in Chaves County for construction support materials, fuels, and labor. In the long term, there would be indirect positive impacts on local and regional economies that may result from the restoration. New recreational opportunities in the restored areas may lead to increased refuge visitation and visitor spending in the local economy.

4.12 Environmental Justice

4.12.1 No Action

Direct and Indirect Effects

Implementing the No Action Alternative would not result in any environmental justice impacts.

4.12.2 Proposed Action

Direct and Indirect Effects

Implementing the Proposed Action would not result in any disproportionate impacts on minority or low-income communities, so there would be no environmental justice impacts.

4.13 Indian Trust Assets

4.13.1 No Action

Direct and Indirect Effects

Implementing the No Action Alternative would not result in any impacts on Indian Trust Assets.

4.13.2 Proposed Action

Direct and Indirect Effects

Implementing the Proposed Action would not result in any impacts on Indian Trust Assets. No Indian Trust Assets have been identified in the Pecos River Basin. There are no reservations or ceded lands present. Because resources are not believed to be present, no impacts are anticipated to result.

4.14 Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that this use could have on future generations. Irreversible effects primarily result from the use or destruction of specific resources that cannot be replaced within a reasonable time frame, such as energy and minerals. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action, such as extinction of a threatened or endangered species or the disturbance of a cultural resource. Neither the Proposed Action nor the No Action Alternative would result in a large commitment of nonrenewable resources.

Project construction would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, and lubricants used by construction equipment and vehicles. The Proposed Action would result in unavoidable harm or harassment of some wildlife, including special status species. The Service would implement measures to minimize impacts as defined in the Intra-Service Section 7 consultation. Anticipated levels of take would not jeopardize the continued existence of any species.

4.15 Cumulative Impacts

4.15.1 Introduction

Cumulative effects are the direct and indirect effects of a proposed project alternative's incremental effects when they are added to other past, present, and reasonably foreseeable actions, regardless of who carries out the action (40 CFR, Part 1508.7). Guidance for implementing NEPA recommends that federal agencies identify the temporal and geographic boundaries of the potential cumulative effects of a Proposed Action (CEQ 1997). For the purposes of this EA, the temporal boundary of analysis is from approximately 2008 to 2012. This boundary encompasses a range within which data are reasonably available and forecasts can be reasonably made.

The geographic boundaries of analysis vary depending on the resource and potential effects. For most resources, the Bitter Lake NWR or Chaves County represent the analysis area. Impacts on resources with farther-reaching effects, such as those to surface water, are analyzed with a more regional perspective. The analysis area is described under each resource. Other projects, plans, agreements, and agency actions that may be relevant to the cumulative effects analysis are identified in Section 1.7. Some resources would be affected by several of the described activities, while others could be affected very little or not at all.

4.15.2 Land Use

The cumulative effects analysis area for land use is Chaves County. Implementing either of the alternatives would have no impact on land use in Chaves County and would not contribute to any cumulative impacts.

4.15.3 Geology and Soils

The cumulative effects analysis area for geology and soils includes the refuge and downstream environments that may be affected by sediments and erosion resulting from this project and other restoration or saltcedar removal projects. The increases in sediments resulting from the restoration project would be minor and beneficial when combined with those resulting from other similar actions. Minor beneficial downstream effects on erosion hazards would be expected from the dissipation of energy in a wider channel.

4.15.4 Air Quality/Climate

The cumulative effects analysis area for air quality is the area covered by the Chaves County Natural Events Action Plan (NEAP). With the incorporation of dust suppression measures, the project would not result in a cumulative net increase in PM_{10}. The project would result in negligible and short-term contributions of emissions from vehicles, equipment, and woody debris burning and would not contribute to cumulative air quality or climate change impacts.

4.15.5 Water Resources

The cumulative impacts analysis area for water resources is defined as the Pecos River, the surface water features at the Bitter Lake NWR, and the shallow aquifer. The Proposed Action is anticipated to contribute minor beneficial effects when combined with past, present, and reasonably foreseeable future actions on the Pecos River. There are concurrent actions to restore river segments or remove saltcedar for the benefit of the river channel morphology, flows, flood control, water quality, and riparian habitat. Reclamation has committed to restore an additional 1.5 miles of quality habitat by 2014. Actions to control saltcedar, primarily through aerial herbicide application without mechanical removal, are complementary to the Proposed Action but are less effective than restoration in producing positive water resource effects. Depletions, if any, are expected to be minor. The water budget will be monitored and the Service will work with the State of New Mexico to quantify and offset any changes to the water budget due to this project. The Service is committed to ensuring that any net depletions will be compensated for and that there will be no adverse impact on water rights nor interstate compact deliveries (Tashjian 2008). No effects are anticipated on downstream users, property, and state line water deliveries. Monitoring described in Appendix B would be conducted to determine actual effects.

4.15.6 Biological Resources

The cumulative impacts analysis area for biological resources is defined as the Pecos River and the Bitter Lake NWR. Effects of the Proposed Action are anticipated to contribute positively to cumulative effects in the area. Improved riparian and instream habitat that may aid in the recovery of the shiner would be extended. When combined with future river restoration projects, there would be further restoration of good habitat. Other actions to control saltcedar are complementary to the Proposed Action in creating more diverse vegetation that supports wildlife and in restoring wetlands.

4.15.7 Cultural Resources

The cumulative effects analysis area for cultural resources minimally includes the refuge and lands within five miles on each side of the river corridor. No direct or indirect effects on cultural resources are anticipated if the Proposed Action were implemented, so no cumulative effects are expected.

4.15.8 Recreation and Visitor Facilities

The cumulative effects analysis area for recreation and visitor facilities is the Bitter Lake NWR. Other maintenance and construction on the refuge could add to the minor short-term impacts on recreation and visitor facilities under the Proposed Action, but no cumulative effects are expected.

4.15.9 Visual Resources

The cumulative effects analysis area for visual resources is the Bitter Lake NWR. Other maintenance and construction on the refuge could add to the minor short-term impacts on visual resources under the Proposed Action, but no cumulative effects are anticipated.

4.15.10 Noise

The cumulative effects analysis area for noise is the Bitter Lake NWR. Other maintenance and construction on the refuge could add to the minor short-term noise impacts under the Proposed Action, but the project would not have a cumulative net increase in local noise levels.

4.15.11 Socioeconomic Resources

The cumulative effects analysis area includes Chaves County. The project would result in negligible positive cumulative socioeconomic effects through expenditures. To the extent that the restoration is able to improve habitat for the shiner, while not depleting water, the risk of other actions that would take money out of the local economy, such as forbearance or a priority call, would be precluded.

4.15.12 Environmental Justice

The cumulative effects analysis area is Chaves County. The project would not result in any environmental justice impacts and would not contribute to any cumulative impacts.

4.15.13 Indian Trust Assets

The cumulative effects analysis area is the Pecos River Basin. No Indian Trust Assets are present, and there would be no cumulative impacts.

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5. Environmental Commitments

5.1 Introduction

This chapter outlines the environmental commitments that Reclamation or the Service, or both, would implement as part of the Proposed Action. Specific lead responsibilities are addressed in agreement documents provided in Appendix A. These measures are designed to be applied on a site-specific basis to reduce, prevent, or avoid adverse environmental or social impacts.

5.2 Land Use

The Proposed Action would not affect land use, so no further measures to reduce impacts or environmental commitments are required.

5.3 Geology and Soils

In the Phase I project area, portions of the western extent of the historic oxbow channel would be armored with rock vane revetments to decrease the risk to the refuge ponds and other facilities and to Pecos Sunflower habitat.

The lead agencies would ensure the implementation of the USACE's Section 404 Nationwide Permit 27 and the NMED's SWQB Section 401 water quality certification regarding soil, sediments, and debris (see Appendix E).

In summary, appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance..

All actions in the floodplain would be timed to reduce the risk of floods that could wash soil downstream. Depending on the project phase, Reclamation and/or the Service would be responsible for implementing the sediment and erosion control plan for the project site during restoration. Erosion control measures would be implemented for all portions of the project area that drain toward surface water. Excavated trenches must be backfilled and compacted to match the density and elevation of adjacent undisturbed soil. Construction

areas outside the channel that are not otherwise physically protected from erosion would be reseeded or replanted to help stabilize soils (Appendix E). Dust suppression measures would be taken to minimize airborne soil transport. Erosion would be assessed and corrected, if necessary, through the monitoring program outlined in Appendix C.

5.4 Climate/Air Quality

Measures to reduce PM_{10} from construction-related fugitive dust, in accordance with the Chaves County Natural Events Action Plan (NEAP), would be incorporated into the project plans to avoid nonattainment for this pollutant (NMED 2004, 2008). Burning of woody debris would be conducted under procedures outlined in site-specific Burn Plans based on the Service's New Mexico Programmatic Piles, Ditches, and Debris Prescribed Fire Burn Plan (US Fish and Wildlife Service 2004).

5.5 Water Resources

In summary, the Section 404 Nationwide Permit 27 permit from the USACE requires that:

- "To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities);
- For fills within 100-Year Floodplains, the activity must comply with applicable FEMA-approved state or local floodplain management requirements;
- No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts; and
- If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water and/or restricting its flow must be minimized to the maximum extent practicable".

The New Mexico Environment Department Section 401 water quality certification (see Appendix E) requires that:

- Erosion control measures for all portions of the project area that drain toward surface water must be properly selected, installed, inspected, repaired, and

maintained. Erosion and sediment control structures (e.g., silt fences and sediment basins) must be inspected after significant storms and repaired as necessary. Sediment must be removed from erosion control structures when the sediment reaches half the height of the structure or when wet storage volume is reduced by half.

- Fuel, oil, hydraulic fluid, lubricants, and other petrochemicals must not be stored within the 100-year floodplain and must have a secondary containment system to prevent spills. Appropriate spill cleanup materials, such as booms and absorbent pads, must be available on-site at all times during construction.
- All heavy equipment used in the project area must be pressure washed or steam cleaned, or both, before the start of the project and must be inspected daily for leaks. A written log of inspections and maintenance must be completed. Leaking equipment must not be used in or near surface water. Equipment must be refueled at least 100 feet from surface water.
- Working within the channel during spring runoff season or summer thunderstorm flows should be avoided. Local weather forecasts must be monitored to avoid working in high water. Releases from dams must be incorporated into the work schedule to avoid working in high water. Work in the stream channel should be limited to periods of no flow when practicable, and must be limited to periods of low flow.
- Temporary protective mats are required for heavy equipment working in wetlands to minimize impacts on soil and vegetation and are to be removed when no longer necessary. Wetland crossings must be restricted to a single location and constructed perpendicular to and at a narrow point of the wetland. Flows to wetlands must not be permanently disrupted. Permeable fills should be designed and installed, when practicable. Fill materials must be clean and consist of coarse material with minimal fines. Ditches or culverts in wetlands must have properly designed, installed and maintained siltation or sedimentation structures at the outfall.
- Excavated trenches must be backfilled and compacted to match the bulk density and elevation of the adjacent undisturbed soil.
- All areas adjacent to the watercourse that are disturbed because of the project, including temporary access roads, stockpiles and staging areas, must be restored to pre-project conditions. Disturbed areas outside the channel that are not otherwise physically protected from erosion must be reseeded or planted with native vegetation.
- A copy of the Section 401 Water Quality Certification must be kept at the project site during all phases of construction. All contractors involved in the project must be provided a copy of this certification and made aware of the conditions prior to starting construction.
- The SWQB must be notified at least five days before starting construction, to allow time to schedule monitoring or inspections."

If required, the Service would obtain a National Pollution Discharge Elimination System (NPDES) permit for discharges into the waters of the United States and would prepare a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP would detail specific sediment and erosion control measures for the project site during restoration. Actions in the floodplain would be timed to reduce the risk of floods. Burning of woody debris would be conducted in compliance with site-specific Burn Plans (US Fish and Wildlife Service 2004) to avoid affecting water quality. If required, the Service will obtain a permit from the Office of the State Engineer for use of water in construction.

The Service would establish a monitoring program to determine the river's response to restoration activities (Appendix B). Cross sections have been surveyed and set to datum points throughout the river reaches and oxbows. The monitoring plan includes annual assessments of surface flows, groundwater levels, and channel morphology, including sediment and bed forms. While Reclamation, the Service, and the New Mexico Interstate Stream Commission anticipate only minor depletions, the water budget will be monitored and the lead agencies will work with the State to quantify and offset any changes to the water budget due to this project. The Service is committed to ensure that any net depletions to the water budget resulting from the project will be compensated for and that there will be no adverse impact on downstream water rights nor interstate compact deliveries (Tashjian 2008).

5.6 Biological Resources

Before implementing the Proposed Action, the Service would define all of the project disturbance areas, including staging zones, access routes, and disposal locations, and would determine the need and protocols for preconstruction surveys for native plants, wetlands, and wildlife. Intra-Service Section 7 Consultation has been completed with the Ecological Services Field Office in Albuquerque on the potential effects of the proposed restoration on special status species (See Appendix E). The Service and the refuge staff would implement the actions described in the consultation and would develop site-specific protocols to avoid affecting native plants, wetlands, and wildlife. These could include conducting the work during certain seasons, procedures to clear areas for nests or to tag avoidance areas, stopping work if a species is present, and controlling sediment..

Anticipated actions to avoid impacts include:

- Three rock vanes will be constructed to protect the sunflower habitat near Oxbow 4. If additional protection is needed to buffer potential erosion of the unit 17 Pecos sunflower critical habitat from the effects of Phase I (Oxbow 4) restoration project, individual sunflower plants will be flagged and avoided during construction.
- The burning of saltcedar brush piles/standing dead trees would be conducted during the winter (November– February), prior to germination of Pecos puzzle sunflowers and after plants have dried and dropped seeds.

- No human activity (including this action) will take place near least tern nesting colonies or populations of Koster's springsnails, Noel's amphipods, Roswell springsnails, and/or Pecos assimineas.
- Personnel will enclose the area of Pecos River that will be filled with sediment, in order to remove Pecos bluntnose shiners from harm by relocating them upstream, outside of the action area. Personnel will search out and seine Pecos bluntnose shiners from river pockets that become isolated due to the Oxbow 4 diversion plug and relocate seined fish upstream of the sediment plug.

Actions taken during construction as conditions of the Section 404 and Section 401 permits are also designed to protect vegetation, wildlife and aquatic species. Equipment washing prior to construction would reduce the potential for introducing additional invasive species to the refuge.

The Service would implement a monitoring program, as described in Appendix B, to determine stream channel, vegetative, and fish community response to restoration activities. The restored areas would be monitored to prevent the reestablishment of saltcedar and other nonnative species.

As the project is implemented, the Service will determine protocols for preconstruction surveys and guidelines for avoiding impacts on birds that may be using the proposed restoration project area. In the long-term, the restored habitats would provide more habitat diversity, which would be beneficial to bird species.

5.7 Cultural Resources

Reclamation and the Service have consulted with the SHPO on the Phase I and Phase II portions of the restoration project. The SHPO has concurred with the finding that no historic properties would be affected (See Appendix E). Future phases of restoration in Reaches 1 through 4 are not fully developed as undertakings, and additional SHPO consultation would be needed for implementation. If additional areas would need to be disturbed additional SHPO consultation would be required. The agencies would also continue contacts with relevant Native American groups on a government-to-government basis to identify any concerns about the potential effects of this action on cultural resources and TCPs.

Prior to construction, workers would be briefed on the importance of immediately reporting findings of any archaeological materials to a designated individual with the authority to suspend construction. Should unforeseen cultural resources be discovered during the course of restoration, provisions for halting work in the vicinity of any unanticipated discoveries have been incorporated into the proposed project. Maps of the restoration footprint and the following stipulations would be included in materials provided to restoration personnel:

- Archaeological Discoveries. Should evidence of possible scientific, prehistoric, historic, or archeological data be discovered during the course of this action, work shall cease at that location and the Refuge Manager and Service archaeologist shall be notified by phone immediately, with the location and nature of the findings. Care shall be exercised so as not to disturb or damage artifacts or fossils uncovered during operations, and the proponents shall provide such cooperation and assistance as may be necessary to protect the location and to preserve the findings for removal or other disposition by the Government.
- Discovery of Human Remains. Any person who knows or has reason to know that he or she has inadvertently discovered human remains on Federal lands must provide immediate telephone notification of the inadvertent discovery, with written confirmation, to the Refuge Manager and Service archaeologist who will report to the responsible agency official. The requirement is prescribed under the Native American Graves Protection and Repatriation Act (PL 101 601; 104 Stat. 3042) of November 1990 and National Historic Preservation Act, Section 110(a)(2)(E)(iii) (PL 102 575, 106 Stat. 4753) of October 1992. Should evidence of suspected human remains be discovered during the course of this action, work shall cease in the vicinity and the location protected until a decision is made regarding removal or other disposition by the Government.

5.8 Recreation/Visitor Facilities

Dust and noise suppression measures would be taken to minimize disturbance of recreational activities. Access to recreational areas and refuge facilities would continue to be accommodated.

5.9 Visual Resources

Dust suppression measures would be taken to minimize airborne transport and avoid visible impairment due to dust, in accordance with the Chaves County Natural Events Action Plan (NEAP). As funding and staffing permit, the Service would revegetate selected areas with desirable species to help stabilize soils.

5.10 Noise

Noise suppression measures would be taken to minimize disturbance and protect workers. The potential for effects from noise and vibration on particular wildlife species or their nesting behavior would need to be reviewed with refuge staff as the project is implemented. Possible measures to reduce impacts may include avoiding certain areas during nesting periods if special status species are present.

5.11 Socioeconomic Resources

The Proposed Action would not affect socioeconomics, so no environmental commitments are needed.

5.12 Environmental Justice

The Proposed Action would not affect environmental justice, so no measures to reduce impacts or environmental commitments are needed.

5.13 Indian Trust Assets

The Proposed Action would not affect Indian Trust Assets, so no measures to reduce impacts or environmental commitments are needed.

5.14 Summary Comparison of the Environmental Consequences of the Alternatives

The environmental effects of the Proposed Action with environmental commitments and the No Action Alternative are presented in Table 5-1. The Proposed Action would have long-term beneficial effects on geology and soils, water resources, and biological resources. During restoration, there would be short-term adverse effects on geology and soils, air quality, water resources, biological resources, recreation, visual resources, and noise. No effects are expected on land use, cultural resources, socioeconomics, environmental justice, or Indian Trust Assets. No adverse effects are expected under the No Action Alternative, other than continued long-term negative trends in channel morphology, river function, invasive species expansion, and habitat loss.

Table 5-1
Summary of Environmental Effects

Resource	Proposed Action	No Action Alternative
Land use	The Proposed Action is consistent with refuge and surrounding land uses.	No effect.
Geology and soils	Short-term disturbance and erosion of soil and banks; long-term beneficial effects on channel geomorphology.	Continuation of adverse geomorphic trends.

Table 5-1
Summary of Environmental Effects *(continued)*

Resource	Proposed Action	No Action Alternative
Climate/air quality	A short-term increase in dust levels during restoration until vegetative cover is restored. Short-term negligible contributions of greenhouse gases during construction.	No effect.
Water resources	Long-term positive effects on channel morphology, river function, and flood control. Negligible effects on other surface waters. Positive effects on groundwater levels, increased inflows to the Pecos River, and improved water quality. Negligible depletions or no depletions are anticipated. No impairments to water rights are expected. Short-term increase in sedimentation affecting water quality.	Continuation of current adverse trends.
Biological resources	Long-term positive effects on vegetation, wetland habitats, wildlife, and special status species. Extension of instream habitat that would be beneficial to the Pecos bluntnose shiner. Short-term impact during restoration from loss of vegetative cover and harassment and loss of wildlife. Impacts would not be significant with implementation of measures to reduce impacts.	Continued expansion of nonnative riparian species and loss of instream habitat.
Cultural resources	Cultural resources are not anticipated; no impacts are expected.	No effect.
Recreation and visitor facilities	Minor short-term negative effect on wildlife-based recreation during construction.	No effect.
Visual resources	Minor short-term negative effect on visual resources due to dust, equipment use, and land clearing during construction.	No effect.
Noise	Minor short-term increase in noise during construction.	No effect.
Socioeconomics	No adverse effect. Some negligible increase in spending in local communities related to restoration activities.	No effect.
Environmental justice	No effect.	No effect.
Indian Trust Assets	No effect.	No effect.

5.15 Conclusions

Measures to minimize adverse effects have been incorporated into the Proposed Action, and a monitoring program would be conducted to ensure that the restoration is successful. Based on the analysis in this EA, implementing the entire Proposed Action or staging restoration actions would have no potentially significant direct, indirect, or cumulative effects on the quality of the natural or human environment. The project does not require an environmental impact statement, and a finding of no significant impact will be published. The Reclamation and the Service plan to implement the Proposed Action when other necessary approvals, permits, and funding are obtained.

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6. Consultation and Coordination

The following lists the organizations that were consulted in preparing this environmental assessment and in developing the proposed action.

Agencies and Local Governments	Pueblo and Tribal Governments
US Bureau of Reclamation	Pueblo of Jemez
US Army Corps of Engineers	Kiowa Tribe of Oklahoma
US Fish and Wildlife Service, Bitter Lake National Wildlife Refuge	Fort Sill Apache Tribe of Oklahoma
US Fish and Wildlife Service, New Mexico Ecological Services	Apache Tribe of Oklahoma
US Fish and Wildlife Service, New Mexico Fishery Resources	Hopi Tribe
New Mexico Department of Game and Fish	Navajo Nation
New Mexico Environment Department, Surface Water Quality Bureau	Jicarilla Apache Nation
New Mexico Historic Preservation Division	Comanche Indian Tribe
New Mexico Interstate Stream Commission	Pueblo of Ysleta del Sur
Carlsbad Irrigation District	Pueblo of Isleta
Chaves County	Mescalero Apache Tribe
Chaves County Flood Control District	
DeBaca County	
Eddy County	
Guadalupe County	
Pecos Valley Artesian Conservancy District	

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7. List of Preparers

NAME	EDUCATION / EXPERIENCE	RESPONSIBILITIES
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US Fish and Wildlife Service		
Jeff Howland	MS, Zoology BS, Biology 18 years	Refuge Manager, Site access
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Kevin Doyle	BA, Sociology 23 Years	Project Management; Principal Author; Chapters 1 and 2; Multiple Resources
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APPENDIX A
MEMORANDA OF AGREEMENT

May 9, 2008

Memorandum of Agreement between US Bureau of Reclamation and US Fish and Wildlife Service Bitter Lake National Wildlife Refuge for the Pecos River Channel Restoration at Bitter Lake National Wildlife Refuge

I. Introduction

The Bureau of Reclamation (Reclamation) and the U.S. Fish and Wildlife Service's Bitter Lake National Wildlife Refuge (Refuge) have formed a partnership to implement habitat restoration on Refuge property. The habitat restoration project (project) will be designed to improve riparian and in-channel habitat at specific locations along approximately 12 miles of the Pecos River. Reclamation's work will be concentrated on Oxbow #4 while the Refuge has broader and more encompassing plans for restoration within a 12-mile reach. In July 2007, Reclamation and the Refuge entered into a Memorandum of Agreement that describes environmental compliance responsibilities of each agency. Since that time, the agencies have further defined project implementation details which are identified in this present Memorandum of Agreement (MOA).

II. Purpose

The purpose of this MOA is to further define Reclamation's and the Refuge's responsibilities before, during, and after construction of the project.

The purpose of the project is to improve riparian and in-channel habitat, extending the reach of connected good quality habitat for the benefit of native aquatic and riparian plant and animal communities. The project is a combination of restoration techniques which include removing vegetation, lowering banks, changing the channel morphology, restoring flow into historic oxbows and revegetation. The project is needed to correct or improve degraded ecological conditions within the Refuge section of the Pecos River caused by excavating straight channels, encroaching nonnative vegetation, and parts of the river to more natural flow conditions within the context of the modern hydrological regime, including reconnecting the river to the floodplain. The project would support the need of the US Fish and Wildlife Service to implement Bitter Lake National Wildlife Refuge comprehensive conservation plan goals and objectives and would support broad Service mandates to restore, preserve, and enhance riparian habitat and the overall mission of the national wildlife refuge system. In addition, restoration work in Oxbow #4 would partially fulfill a requirement of the May 18, 2006 Biological Opinion for the Bureau of Reclamation's Proposed Carlsbad Project Water Operations and Water Supply Conservation, 2006-2016. Reasonable and Prudent Measure #1 involves two habitat restoration projects and the proposed project would serve as one of those required projects.

III. Responsibilities

Reclamation will:

a) Continue to carry out responsibilities (a) thru (i) specified in the July 2007 MOA
b) Conduct hydraulic analysis
c) Design and construct project
d) Establish staging area for equipment used in bank stabilization
e) Mobilize equipment
f) Remove lower plug of Oxbow #4 lake
g) Excavate sinuous channel in the existing oxbow to grade
h) Place excavated material for the plug or otherwise distribute onsite

i) Remove saltcedar and non-native vegetation at lower elevations and stack
j) Install rock vanes to protect banks serving to protect adjacent wetlands and Pecos sunflower
k) Remove fine grained anoxic sediment and associated detritus if necessary
l) Plug existing channel
m) Excavate opening at entrance to oxbow
n) Reseed road/staging areas/old channel/rock vanes
o) Contribute funding for FWS to conduct biological monitoring
p) Develop and implement an Adaptive Management Plan
q) Fund Oxbow #4 construction and restoration with the exception of services and rock to be provided by the Refuge

The Refuge will:

a) Continue to carry out responsibilities (a) thru (h) specified in the July 2007 MOA
b) Issue special use permit that would allow Reclamation to perform construction on Refuge property
c) Determine soil composition
d) Obtain the Corp of Engineers 404/401 permits
e) Obtain ESA compliance via Intra-Service consultation
f) Monitoring geomorphology/groundwater
g) Monitor fish habitat and use by the fish community including Pecos bluntnose shiner
h) Contribute existing stock of 8-12" rock for the rock vanes to be installed and assist with installation as needed using available resources
i) Remove saltcedar and non-native vegetation at higher elevations and stack
j) Burn all removed and stacked vegetation
k) Coordinate the water quality and sedimentation study
l) Coordinate with the New Mexico Environment Department
m) Acquire color infrared imagery
n) Allow Reclamation to use fuel storage tanks for Reclamation-purchased fuel
o) Conduct revegetation as appropriate

IV. Agency Designee
Reclamation and the Refuge will designate points of contact and may change these designations at any time by informing the other agency.

V. Resolution of Disputes
The signatories agree to use all reasonable efforts to resolve any disputes arising among them and to do so at the level at which the dispute arose and in a collaborative and timely manner. Disputes that cannot be resolved at the lower level will be elevated within the agencies for resolution. Disputes that remain unresolved will be mediated or facilitated. The signatory agencies will document in the administrative record the nature of any dispute and the resolution process used.

VI. Implementation, Amendment, and Termination
This agreement will become effective on the date of the last signature, and may be subsequently amended through written agreement of all signatories. Either signatory agency may terminate this agreement by providing written notice of termination to the other party. If not terminated sooner, this agreement will end when the current biological opinion expires, in 2016.

VII. Authority

The authority of the US Fish and Wildlife Service to participate in this agreement is provided by the Migratory Bird Conservation Act of 1929, Fish and Wildlife Act of 1956, and Endangered Species Act of 1973, as amended. Reclamation participates as part of its responsibilities under the Endangered Species Act of 1973 in combination with authority provided by Carlsbad Project authorizations and the Fish and Wildlife Coordination Act.

VIII. Signatures

The parties hereto have executed this memorandum of agreement as of the dates shown below:

Bureau of Reclamation

John R. Poland — 5/12/08

Area Manager, Albuquerque Area Office — Date

United States Fish and Wildlife Service, Bitter Lake NWR

Thomas E. Harvey — 5-20-08

Supervisor — Date

Memorandum of Agreement between US Bureau of Reclamation and US Fish and Wildlife Service (FWS) for the Pecos River Channel Restoration at Bitter Lakes National Wildlife Refuge Environmental Assessment

I. Introduction

The Bureau of Reclamation (Reclamation) is preparing an Environmental Assessment (EA) to analyze the effects of restoration techniques designed to improve riparian and in-channel habitat at specific locations along approximately 12 miles of the Pecos River. These efforts are referred to as the Project. Reclamation as lead agency, must assure the EA complies with the National Environmental Policy Act (NEPA) and other applicable statutes, regulations, and Executive Orders. Reclamation is the lead agency and FWS has agreed to serve as a joint lead agency under NEPA for full participation in the planning process for the Project.

II. Purpose

This environmental assessment addresses the effects of the proposed restoration of portions of the Pecos River channel at Bitter Lake National Wildlife Refuge in Chaves County, New Mexico. It analyzes the potential environmental and human effects of the Proposed Action and a No Action Alternative. The Proposed Action encompasses a variety of restoration techniques designed to improve riparian and in-channel habitat at specific locations along approximately 12 miles if the Pecos River. Some or all of these actions may be implemented, or work may be conducted in phases.

The purpose of the proposed action is to improve riparian and in-channel habitat, extending the reach of connected good quality habitat for the benefit of native aquatic and riparian plant and animal communities. This action meets a Biological Opinion requirement to do this restoration and fulfill RPM #1 of the 2006-2016 BiOp. This is needed to correct or improve degraded ecological conditions within the Bitter Lake National Wildlife Refuge (NWR) section of the Pecos River caused by excavating straight channels, encroaching nonnative vegetation, and parts of the river to more natural flow conditions within the context of the modern hydrological regime, including reconnecting the river to the floodplain. The proposed action would support the need of the US Fish and Wildlife Service (Service) to implement Bitter Lake NWR comprehensive conservation plan goals and objectives and would support broad Service mandates to restore, preserve, and enhance riparian habitat and the overall mission of the NWR system.

III. Federal Actions

a. Reclamation's action requiring NEPA compliance:

- Provide funding for oxbow 4 project
- Establish staging area for equipment used in bank stabilization
- Remove banks and reestablish oxbow in different location
- Removal of saltcedar and non-native vegetation
- Revegetation of cleared areas

b. Fish and Wildlife Service action requiring NEPA compliance:

- Construct a viewing platform

- Removal of saltcedar and non-native vegetation
- Revegetation of cleared areas
- Removal of bank levees
- Lower banks by removing material
- Re-connect small oxbows

IV. Agency Designee
Reclamation and FWS will designate a representative and a backup to act as the point of contact for the EA. An entity may change its point of contact at any time by providing written notice to Reclamation.

V. Authority
The authority of the lead agency (Reclamation) to participate in this agreement is provided by the National Environmental Policy Act, 42 USC 4321 *et seq.*

VI. Lead Agency Responsibilities
As lead agency, Reclamation will:

a) Be responsible for the preparation of, quality of scope and content of the EA.
b) Identify FWS in the EA as a joint lead agency and summarize its roles and responsibilities as a joint lead agency.
c) Be available to discuss with FWS any questions or issues related to EA documents.
d) Incorporate, as it deems useful and appropriate, the information provided by FWS into the appropriate EA documents.
e) Provide FWS with copies of the various EA public reports as part of the public review process. These are expected to include a scoping report, newsletters, and a draft and final EA.
f) Assure compliance with Federal environmental and other statutes including, but not limited to, NEPA, and the National Historic Preservation Act.
g) Be responsible for identifying 1) the purpose and need for the proposal, 2) which alternatives are selected for evaluation, 3) scope of analysis, and 4) decisions to be made.
h) Make the final decision on the content of all EA documents
i) Make a final decision to be documented in a Reclamation decision document.

VII. Joint Lead Agency Responsibilities
As a joint lead agency, FWS will:

a) Participate in the NEPA process at the earliest possible time.
b) Participate in the scoping process.
c) Assume responsibility for preparing the internal Section 7 documentation and the Section 401/404 permit application to the Corp of Engineers in a timely manner for completion with the environmental assessment timeframes (ESA and CWA compliance).
d) Provide guidance and recommendations to the EA Team in those areas where FWS as special expertise.
e) Facilitate access to the refuge for data collection, field work and possibly construction (if approved).

f) Be available to discuss with the EA team and stakeholders any documents or analyses provided by FWS.

g) Fund its own participation as a joint lead agency in the EA process and additional hydrological monitoring as required.

h) Prepare and sign a Fish and Wildlife Service decision document if needed.

VIII. Organizational Structure

Reclamation's EA Project Manager leads the EA Team, is responsible for day-to-day project management and is supervised by the Manager of the Environment Division. The EA Project Manager is supported in the areas of stakeholder and public participation by a NEPA specialist from Tetra Tech contractor.

IX. Resolution of Disputes

The joint lead agencies agree to use all reasonable efforts to resolve any disputes arising among them and to do so at the level at which the dispute arose and in a collaborative and timely manner. Disputes that cannot be resolved will be mediated or facilitated. The joint lead agencies will document in the administrative record the nature of any dispute and the resolution process used.

X. Implementation, Amendment, and Termination

This agreement will become effective on the date of the last signature, and may be subsequently amended through written agreement of all signatories. Either joint lead agency may terminate this agreement by providing written notice of termination to the other party. If not terminated sooner, this agreement will end when the decision documents are signed.

XI. Signatures

The parties hereto have executed this memorandum of agreement as of the dates shown below:

Bureau of Reclamation

Connie L. Rupp
Area Manager, Albuquerque Area Office

July 9, 2007
Date

United States Fish and Wildlife Service

Chris S
Supervisor Regional Refuge Chief

7-31-07
Date

APPENDIX B
MONITORING PLAN

B. Monitoring Plan

B.1 Monitoring Purpose

The Pecos River (Pecos) at Bitter Lake National Wildlife Refuge (Refuge) is an ideal location for riverine habitat restoration. The Pecos is home to a diverse fish fauna assemblage, including the federally threatened bluntnose shiner. Investigations of the native fishery within the Middle Pecos River (Hatch 1982; Hoagstrom 1999) have revealed a preference of the native fishes for a wide, sand substrate and active channel bed. Such habitats are common north of the Refuge and become rare as one goes south from the Refuge towards Brantley Reservoir. The Refuge sits at a juncture between good quality fish and riparian habitat towards the north and poor quality habitat towards the south. The Refuge spans roughly 25 river miles of the Middle Pecos from the northern boundary of the Salt Creek Wilderness Unit to the confluence of the Hondo River within the southern Farm Unit. The good-quality habitat of the Middle Pecos in New Mexico contains some of the most diverse native fish communities within the Southwestern United States, and investigations strongly suggest that a restoration of quality habitats from poor ones is critical to the long-term survivability of these fishes (Hoagstrom 1999; Hoagstrom et al. 2008).

Planning for the restoration of the Pecos at the Refuge to date includes investigations of the hydrology and geomorphology of the Pecos at the Refuge, a preliminary restoration plan (FLO Engineering. 1999; US Bureau of Reclamation 1999), several interagency meetings for the project, and the completion of an environmental assessment for the project.

In order to establish meaningful baseline data prior to restoration, the following monitoring protocol has been developed.

B.2 Reach Delineations and Site Locations

The section of the Pecos that is being restored starts at the northern boundary of the Middle Unit of the Refuge. It continues downstream to the southern boundary of the Middle Tract, approximately 1 mile north of the Highway 380 bridge. This river section is approximately eight miles long, with a 300-foot bluff running along the east side of the river valley. For much of the length, the river is bordered by Refuge impounded wetlands on the west side. In order to plan the restoration, the river has been divided into five reaches (Figure 1; Bureau of Reclamation 1999a). Each reach has specific restoration options, which are tailored to the characteristics of that reach. The reaches are defined as follows:

1. Upstream refuge boundary to cross section BL-10 (BL = Bitter Lake), river mile 15.9 to 10.7.2.

2. Oxbow bend 1, from cross section BL-10 to BL-14, river mile 10.7 to 7.8.

3. Active channel reach, oxbow bends 2 and 3, from cross section BL-14 to BL-24, river mile 7.8 to 5.0.

4. Oxbow bends 4 and 5, from cross section BL-24 to BL-27, river mile 5.0 to 3.3.

5. Downstream reach, from cross section BL-27 to BL-32 downstream of Highway 380, river mile 3.3 to river mile 0 (confluence with Rio Hondo).

The Proposed Action calls for channel restoration within Reaches 2, 3, and 4 in the near term. In Reaches 2 and 3, restoration will include saltcedar removal, bank lowering, and native revegetation. In Reach 4, restoration will include returning the Pecos to Oxbow 4. In order to monitor these activities, four monitoring sites have been selected:

1. Scout Camp: This site will start at Scout Camp (river mile 7.8) and extend northward 1,600 feet;

2. Pecos River at Oxbow 3: Start at bottom end of Oxbow 3 (river mile 5.0) and extend northward 1,600 feet;

3. Oxbow 4: 1,600 feet within the center of Oxbow 4; and

4. Channelized Pecos Control: Start at confluence of Oxbow 5 and Pecos (river mile 3.3) and extend northward 1,600 feet.

B.3 Monitoring Objectives

Primary Objective: Monitor the effectiveness of river restoration efforts on the Pecos River at Bitter Lake NWR.

B.3.1 Components of Primary Objective

1. Establish baseline conditions for channel morphology, fish community monitoring, habitat availability, fish habitat use, riparian vegetation, and bird use for the different reaches of the Pecos River at Bitter Lake NWR and for an oxbow lake at the Refuge (Oxbow 4).

2. Monitor changes within river reaches at the Refuge that have undergone restoration activities, and compare these to similarly monitored control (non-restored) reaches.

3. Monitor the changes in open water evaporation associated with the reconnection of Oxbow 4 and activities in all reaches of the project area.

B.3.2 Components of Monitoring

The monitoring project is divided into four components:

1. Fish community monitoring, habitat availability, and use;
2. Vegetation and habitat surveys (aerial photography based);
3. Bird use surveys; and
4. Oxbow 4 evaporative area monitoring.

B.3.3 Timing of Data Collection

Data will be collected four times per year in order to bind seasonal conditions. Depending upon the time of year, the following data will be collected:

A. Winter—January/ February

Transects characterizing in-channel habitat, cross section, discharge measurement, bed forms, shoreline survey, seine hauls, seine haul point measurements, and fish monitoring

B. Late Spring—May/ June

Fish community monitoring

C. Post Summer Rains—August/ September

Transects characterizing in-channel habitat, cross section, discharge measurement, bed forms, shoreline survey, seine hauls, seine haul point measurements, fish community monitoring, and vegetation survey

D. Fall—Late October/ November

Fish community monitoring

1. Fish Habitat Availability and Habitat Use

The following methods will be used to collect data that characterize the macro-habitat and meso-habitat use of each site. It is important to track both the habitat availability and use so that data collected during this investigation can be compared with data collected during the Hoagstrom study of the 1990s.

Macro-habitat (habitat availability):

A. Transects characterizing in channel habitat

B. Cross section

C. Discharge Measurement

E. Bed forms characterization

F. Sediment

G. Shoreline Survey

H. Sediment

Meso-habitat (habitat use):

I. Seine hauls within discrete habitats

J. Seine haul point measurements

K. Fish monitoring

A. Transects: Point Measurements Along Transects and Cross Sections

A point measurement network will be established at each site to characterize macro-habitat. The network consists of 10 transect lines established perpendicular to the bank line/ high-flow thalweg direction at each site, placed 100 feet apart. One of these transect lines will be the cross section for the site.

Point measurement spacing will be 4.0 feet along each transect line. For every point measurement, water column depth (0.01 feet) and mean column velocity (0.01 feet/sec) will be measured. Water column depth will be measured using a top-set wading rod, marked in tenths of feet. Mean column velocity will be measured with a Marsh McBirney Flo Mate 2000 current meter, using the 0.6 depth method for depths < 2.0 feet, and the two-point method will be utilized for depths > 2.0 feet (Rantz et al. 1982). Angle of flow direction to the transect will be measured for each point.

B. Cross Sections

In order to characterize site macro-habitat (channel morphology), 32 cross sections have been established (Bureau of Reclamation 1999a). One cross section will be chosen for monitoring within each of the five sites. Each cross section will be monitored using a Laser Alignment, Inc. LB-10 laser level, stadia rod, and tag line once a year. The endpoints of all cross sections have been surveyed using a survey scale real time kinematic global positioning system, allowing for the monitoring of hydraulic parameters (slope, sinuosity, etc.) within a site and between sites.

C. Discharge Measurement

At each site cross section, a discharge measurement will be conducted. Data will also be commingled with transect line point measurement data (see “Point Measurements Along Transects and Cross Sections”). Mean column velocity and water column depth measurement will be measured at points spaced every 4.0 feet along the cross section. If necessary, cell size will be adjusted to meet the USGS discharge measurement criteria (cell sizes will be adjusted to 1 foot or less).

D. Bed Form Characterization

Within the unvegetated active channel of each cross section, channel bed forms will be characterized. The unvegetated portion of each cross section will be divided into bed form regime segments. Start and stop points of these regimes will be described using the tag line for the cross section survey. Within each regime segment, primary and secondary bed forms will be characterized as to bed form spacing, bed form height, and bed form length. If there is not a distinct break between regimes, the transition zone will be characterized by three sampling points, and the location of each of these points on the tag line will be noted.

E. Sediment Characterization

Sediment samples will be collected within the unvegetated channel every 20 feet along each cross section line using a 2–inch-diameter PVC tube driven 6 inches into the substrate. These samples will be commingled into a single sample representing each site visit. Commingled sediment samples will be analyzed for grain size distribution. Sediment sampling will be done once yearly, during the summer sampling period (see Timing of Data Collection).

F. Shoreline Survey

Shoreline surveys are conducted to assess the shoreline complexity and position at differing flows. A Garmin Global Positioning System Map 76 will be used at the highest track resolution. The survey entails walking the eastern and western shoreline of a site while recording position with the GPS unit in track mode, where feasible. Where shorelines are concealed due to vegetation, the survey will be conducted through point measurements along exposed shorelines.

G. Seine Haul Procedure

Between 15 and 20 seine hauls per site will be done with a 3.0-meter-long by 1.2-meter-deep, 3.2 millimeter seine with double leads. The number of seine hauls per site will be determined by seine crew captain and will continue until all habitats within the site have been sampled. Seining will proceed in direction of flow, and technique will vary with type of habitat sampled. Habitats will be categorized as either: 1) fluvial turbulent (dune crest plunges, lateral plunges, confluence pools, riffles); 2) fluvial non-turbulent (pools, bypass channels, runs, divergence runs); or 3) non-fluvial (lateral embayments, mid-channel embayments, backwaters, forewaters, and isolated pools). Seine hauls will proceed through areas of discrete habitat (areas of similar depth and velocity), and boundaries will be marked with flags. Substrate type (silt, sand, gravel, or cobble) and cohesion (loose or compacted) will be recorded for each haul. Habitat features will be recorded, including type of debry on substrate (woody, non-woody, and detritus), algae, submerged vegetation, and aerial overhang. Fluvial patterns (neutral, diverging, or converging) also will be recorded.

H. Seine Haul Point Measurements

The starting and end points for each seine haul will be marked with flags. Seine haul width and length will be measured, and nine point measurements will be conducted within each seine haul (Hoagstrom 2003). Three transects will be arranged from upstream

to downstream (one transect at top of seine haul, one at mid point, one at bottom of seine haul), with three point measurements on each transect (Hoagstrom 2003). Transects and point measurements will be spaced to fit area seined; point measurements will be more closely spaced in smaller areas seined (Hoagstrom 2003), providing greater resolution for more complex habitats (such as debry on substrate).

Water column depth and water column velocity will be the quantitative measurements used to describe meso-habitat (Aadland 1993). For every point measurement, water column depth and mean column velocity will be determined. Depth will be measured using a top-set rod. Mean column velocity will be determined using a Marsh-McBirney current velocity meter attached to a top-set rod. The sixth-tenths depth method will be utilized for all mean column velocity measurements in depths up to 2.0 feet (Rantz et al. 1982). For depths > 2.0 feet, the two-point (two-tenths and eight-tenths) will be used (Rantz et al. 1982).

Other Data: Standard water quality parameters (dissolved oxygen, pH, salinity, total dissolved solids, and temperature) will be collected three times during the day—when sampling is initiated, at midday, and when sampling is over. Water quality will be collected with a Hydro Lab Surveyor 4A. Collection of water quality will be collected in the main flow and will represent the study area, not individual seine hauls.

2. Vegetation and Habitat Monitoring through Aerial Imagery and Spectral Analysis

Riverine habitat and riparian vegetation will be monitored through aerial imagery. A comprehensive, pre-restoration habitat and vegetation map is to be completed during the summer of 2008. This map will be the baseline for change detection. Upon completion of all restoration activities (summer of 2012), a similar map will be created for change analysis.

3. Bird Use Surveys

The refuge currently runs a MAPS (Monitoring Avian Productivity and Survivorship) banding station, strategically placed along the Pecos River in order to document avian response to these restoration efforts. With the use of mist nets, small-medium sized avian species are captured within this proposed restored area and banded in order to obtain information on avian nesting, fitness, site fidelity, and overall productivity of bird species utilizing the site. This is a long term effort which will be conducted on an annual basis during avian breeding season (see MAPS protocol). All pertinent data is recorded, utilizing Institute for Bird Populations protocols.

When staff becomes available, an off-road point count will be set in place along the Pecos River restoration area. This effort will provide a large scale documentation of bird species utilizing these habitats before and after restoration actions. Refuge personnel and volunteers will conduct a weekly tern survey to document any tern use of the restored river channel during their active breeding season (May to August).

4. Phase I Evaporative Area Monitoring

In order to assess the net effects of reconnecting Oxbow 4 on the net evaporative consumption of water, the following methodology shall be deployed:

1. Monthly monitoring of the stage-area-volume of Oxbow 4 prior to reconnection: On 12/5/06, a staff plate was placed in Oxbow 4 to measure the water level. During the winter of 2007, a survey will be conducted so that this level can be related to stage and volume. Additionally, water levels in the Pecos River shall be monitored.

2. Piezometer transects: A piezometer transect has been installed in association with Oxbow 4 and the Pecos River. Groundwater shall be monitored monthly, and wells are to be outfitted with pressure transducers for high-resolution monitoring.

3. Seepage runs: Seepage runs in the Pecos River in association with Oxbow 4 shall be conducted yearly.

4. Analysis of historic photography: The USFWS has a collection of aerial images of the Refuge from 1996. These images shall be digitized to delineate open water areas in Oxbow 4.

5. Phase II Project Evaporative Area Monitoring

In order to assess the net effects of the Phase II restoration on evaporative consumption of water, the Service will develop monitoring protocols for these reaches, in cooperation with the New Mexico Interstate Stream Commission.

B.4 Additional Monitoring

B.4.1 Fish Community Monitoring on the Middle Pecos River

The following fish community monitoring effort on the Middle Pecos River will provide valuable data on baseline fish community trends.

The purpose of this study is to acquire information on species population status, particularly the Pecos bluntnose shiner, *Notropis simus pecosensis*, and predicting trends in species numbers.

Sites will be selected from the DeBaca-Chaves county line downstream to the upper end of Brantley Reservoir. A total of 12 to 15 sites will be sampled 4 to 6 times per year with a 3.05-meter x 1.5-meter x 3.2-millimeter seine. Eight to fifteen seine hauls will be conducted at each site, depending on the amount of habitat heterogeneity. All habitat types present at the time of sampling will be sampled. Each seine haul will be measured for length and width, and maximum depth will be recorded. Care will be taken to sample only discrete meso-habitat types. Meso-habitat types will be categorized and recorded. Water quality characteristics will be measured at each sample site and will include conductivity ($mS.cm^{-1}$), specific conductance ($mS.cm^{-1}$), dissolved oxygen (mg/l), O_2

percent saturation (%), and salinity (ppt). Additional water quality measurements will be recorded from isolated or nearly isolated habitats.

All fish that can be identified with 100 percent assurance will be measured to the nearest 1.0 millimeter and released. All other fish specimens will be preserved in 10 percent formalin in the field and returned to the laboratory, where they will be rinsed in water, measured and enumerated, and then stored in 70 percent ethanol. Standard length on all preserved fish specimens will be measured with an electronic caliper to the nearest 0.01 millimeter. USFWS-NMFWCO personnel will process, identify, and measure all specimens collected. Once fish have been identified, enumerated, and measured, they will be accessioned into the fish collection at the Museum of Southwest Biology, University of New Mexico for long-term storage.

Sites will be sampled on a seasonal basis: spring, summer, fall, and winter. Sites will be selected to provide broad coverage and on the basis of accessibility. The number of sites and the frequency of sampling will be selected a priori, based on power analysis calculations, which will determine the degree of confidence in predicting trends in species population numbers (i.e., whether species numbers are increasing, decreasing, or not changing appreciably). Global positioning system coordinates will be recorded for each site.

Catch per Unit Effort (CPUE) will be calculated for each species based on fish numbers and total area sampled (square meters). These density estimates will be used to monitor species populations. Relative abundance estimates and species diversity indices will be used to monitor changes in fish community structure.

Mean daily discharge (cfs) will be obtained from the US Geological Survey to assess whether hydrologic patterns influence species numbers, species richness, and species distribution patterns.

Table B-1. List of Sampling Sites for Pecos River Fish Community Monitoring. Site names follow Hoagstrom (2003).

Site	River Mile	County
Willow Creek	623.0	Chaves
Six Mile Draw	615.6	Chaves
Crockett Draw	611.0	Chaves
Cortez Pipeline	606.1	Chaves
Bosque Draw	604.9	Chaves
Gasline Crossing	594.7	Chaves
US Highway 70 Bridge	588.1	Chaves
Scout Camp, BLNWR	575.8	Chaves
US Highway 380 Crossing	570.9	Chaves
Dexter Bridge Crossing	551.9	Chaves
Lake Arthur Falls	522.2	Chaves
US Highway 82 Bridge	503.8	Eddy
Brantley Reservoir Inflow	483.7	Eddy

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APPENDIX C
WATER BUDGET

C. Water Budget

C.1 Overview and Monitoring Commitment

The Draft Environmental Assessment included two partial water budgets constructed by the United States Fish and Wildlife Service (Service) for existing versus anticipated restoration conditions for this project (US Fish and Wildlife Service 2008c). The partial water budgets for Reaches 2, 3, and 4 along eight miles of the Pecos River within the Middle Unit consist of evapotranspiration (ET) estimates for two separate parameters: ET contribution from changes in surface water area and ET contribution from vegetation changes.

Initial ET estimates for changes in surface water area suggest a total depletion of 7.8 acre-feet per year (AFY). Initial ET estimates for changes to vegetation composition suggest a contribution of 867 AFY to the system. This latter estimate remains controversial because presently there is no science to show a sustained decadal increase in surface water flow due to riparian zone vegetation changes.

The hydrologic monitoring associated with the Oxbow 4 reconnection is expected to show additional groundwater contributions to the stream channel via channel incision that will remove additional groundwater from the local aquifer. Current estimates are based on the following:

- Existing and projected future land cover conditions;
- Evaporation data from the Bitter Lake NWR pan evaporation station;
- ET values from studies within the region; and
- Information from groundwater investigations on the Refuge (USFWS 2008c).

Because the “future condition” of the project is unknown and is expected to be variable with time, the Service and the New Mexico Interstate Stream Commission (NMISC) are reviewing necessary monitoring needs to assess true impacts of the project on the water budget.

The NMISC manages the state’s limited water supply through a system of permits and licenses, which allows some portion of water to be permanently removed from the water budget. Some resource management activities may affect the overall water budget of a given basin by changing evapotranspiration patterns. In the Pecos River Basin, the NMISC is responsible for compliance with the Pecos River Compact (between New Mexico and Texas) and the Carlsbad Project Settlement Agreement. This requires that

the water budget be quantified and water resources carefully managed using the best available science. For this reason, depletion estimates for both phases of the restoration prepared by the NMISC are presented here in lieu of the water budget prepared by the Service, which included substantial contributions due to vegetation changes (US Fish and Wildlife Service 2008c). The Service and NMISC estimates are part of the hypothesis, which will be tested through monitoring, that there will be small changes to the water budget from this project.

Based on conservative estimates of water usage—that is, higher than would likely occur—the NMISC anticipates that Phase I restoration may consume 1.9 AFY, and Phase II may consume 7.6 AFY, for a total of 9.5 AFY . While the Service expects that less water would be used and benefits would be gained due to reduced evapotranspiration, the Service and the NMISC will monitor long-term effects and will address any depletions. The Service is committed to ensuring that any net depletions to the water budget resulting from the project will be compensated for and that there will be no adverse impact on downstream water rights or on interstate compact deliveries (Tashjian 2008).

To evaluate potential depletions from Pecos River restoration activities on the Refuge, a monitoring protocol that includes gathering baseline and long-term data will be used to evaluate effects on the local water budget. To quantify changes in the local water budget variables, such as open surface water area, depth of water within the oxbow and the present river channel, channel gradient, depth to groundwater, vegetation changes, and present and future geomorphology will be measured to evaluate a baseline condition and assess the status of the restoration effort and its effects over time. Stream channel measurements both upstream and downstream of the restoration site will be made, along with channel and oxbow cross sections. Using handheld flow meters to measure and record periodic instantaneous velocities and a line of piezometers to measure groundwater levels and flow direction, the responses to the restoration project may be observed. Photo interpretation will be used to evaluate vegetative and geomorphic response. ET will be estimated using the Bitter Lake NWR evaporation pan record.

Memorandum

Date: May 7, 2007

To: Estevan López, ISC Director

Through: Bhasker K. Rao, ISC Pecos Bureau Chief

From: Emile Sawyer, ISC Bitter Lake NWR Project Manager

Copy: Sara Rhoton, NEPA-ESA Project Manager

RE: Evaluation of Additional Net Depletions to Pecos River as a result of the Bitter Lake National Wildlife Refuge River Restoration Project at Oxbow #4

Purpose

This memorandum presents an evaluation of the water budget calculations provided to ISC by Paul Tashjian, Regional Hydrologist with the US Fish and Wildlife Service (**USFWS**) and makes recommendations regarding potential depletions created by the river restoration project at Oxbow #4 on the Bitter Lake National Wildlife Refuge River (**BLNWR)**.

Project

The BLNWR is located approximately seven miles east of Roswell, NM and contains approximately 12 Pecos River miles. Between 1942 – 1953 five meanders were cut off from the flow of the Pecos River by a channelization project.

The May 18, 2006 USFWS Biological Opinion on the preferred alternative of the Carlsbad Project Water Operations and Water Supply Conservation EIS states that, "*Reclamation will partner with Federal, state, and private entities to participate and assist in the completion of ongoing habitat improvement projects on the Pecos River and to restore 1-1.5 miles of quality habitat within the Farmlands reach by 2*009". The USFWS provided the ISC with estimates of depletions to the Pecos River that could occur as a result of this project. ISC has evaluated the USFWS analysis and it is recommended that the State Engineer require offsets for these Additional Net Depletions.

The USFWS analysis multiplies the averaged monthly pan evaporation data (1950 –2002) from BLNWR (E_{mp}) times the monthly surface area of Oxbow #4 (SA_{mo}) plus the current channel surface area that contains the Pecos River along this reach (SA_{ch}). The result of this equation is a monthly evaporation volume ($E_{m)}$.

E_{mp} (feet) * (SA_{mo} (acres) + SA_{ch} (acres)) = E_m (acre-feet) Equation 1

Then each monthly evaporation volume ($E_{m(i)}$) is summed to provide a total annual evaporation value (E_t).

$\Sigma E_{m(i)} = E_t$ Equation 2

The sum (E_t) of 89.9 acre-feet/year of evaporation is calculated for the present river condition. The sum (E_t) of 91.8 acre-feet/year of evaporation is calculated for the future river condition. The smallest value, the present condition, is subtracted from the largest, the future condition, with a result of 1.9 acre-feet/year of evaporation.

The ISC does not recognize any credit for water salvage activities. While the current science surrounding evapotranspiration measurement continues to evolve, the salvage of water through vegetation management has yet to be defensibly quantified. Thus such activities have not been evaluated here.

The ISC was asked by USFWS to review possible increases in stream flow due to geomorphic changes that will likely result in a lowering of the stream bed and cause a temporary increase in ground water contribution to the Pecos River. The movement of water from one source to another does not constitute new water and therefore cannot be considered a credit against depletions caused by the project.

Whereas it is the responsibility of the State Engineer to be concerned about any depletions greater than 0.1 acre-feet/year in the Pecos River Basin; and

Whereas it is the policy of the State Engineer to manage the waters of New Mexico for the benefit of the public and has the authority to permit any and all beneficial use of the state's waters; and

Whereas any increase in depletions in the Pecos River Basin is a concern for interstate compact delivery obligations; and

Whereas the dynamic nature of rivers and the uncertainties surrounding the geomorphic and hydrologic response of the Pecos River channel to the aforementioned project makes future river conditions difficult to predict.

It is therefore recommended that:

1) A depletion value of 1.9 acre-feet/year should be assessed the Oxbow #4 river restoration project and that appropriate water rights be designated or obtained for the project; and

2) An evaluation of the effects on depletions by this project be revisited five (5) years from the project completion date to determine if unforeseen circumstances have created a larger than expected surface area and if so, that a larger depletion assessment be required to keep the Pecos River system whole.

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Bitter Lake National Wildlife Refuge Oxbow #4 River Restoration Evaporation calculation tables
Adapted by F.Emile Sawyer from tables submitted to ISC by Paul Tashjian, USFWS.

Current Condition					Future Condition				
Month	Avg Pan Evaporation *0.78 (feet)	Channel Surface Area Avg (acres)	Oxbow #4 Surface Area Avg (acres)	Total Monthly Evaporation (acre-feet)	Month	Avg Pan Evaporation *0.78 (feet)	Channel Surface Area Avg (acres)	Oxbow #4 Surface Area Avg (acres)	Total Monthly Evaporation (acre-feet)
January	0.17	6	13	3.2	January	0.17	4	14	3.0
Feb	0.23	6	13	4.5	Feb	0.23	4	14	4.2
March	0.41	6	12	7.4	March	0.41	4	14	7.4
April	0.56	6	12	10.1	April	0.56	4	14	10.1
May	0.66	6	11	11.2	May	0.66	4	14	11.8
June	0.72	6	11	12.3	June	0.72	4	14	13.0
July	0.64	6	11	10.9	July	0.64	4	14	11.5
August	0.57	6	11	9.7	August	0.57	4	14	10.3
September	0.45	6	12	8.1	September	0.45	4	14	8.1
October	0.34	6	12	6.1	October	0.34	4	14	6.1
Nov	0.20	6	13	3.7	Nov	0.20	4	14	3.6
Dec	0.14	6	13	2.7	Dec	0.14	4	14	2.5
Annual Values	5.10	6	12	89.9	Annual Values	5.10	4	14	91.8

Memorandum

Date: October 20, 2008

To: Estevan Lopez, ISC Director

Through: Bhasker Rao, ISC Pecos Bureau Chief

From: Emile Sawyer, ISC Bottomless Lakes NWR Project Manager
Markus Malessa, ISC Pecos Bureau Staff

RE: Evaluation of Additional Net Depletions to the Pecos River as a result of the Bitter Lake National Wildlife Refuge Phase II Restoration

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Purpose

This memorandum presents an evaluation of additional net depletions to the Pecos River resulting from Phase II restorations at the Bitter Lake National Wildlife Refuge (**BLNWR**). The memorandum also makes recommendations to address these additional net depletions. The Phase I evaluation is contained in a similar memorandum dated May 7, 2007. The additional net depletions calculated for Phase I are noted at the end of this document.

Project

The BLNWR is located approximately seven miles east of Roswell, New Mexico and contains approximately 12 Pecos River miles. Between 1942 – 1953 five meanders were cut off from the Pecos River by a channelization project to prevent flooding of migratory water fowl constructed wetlands habitat.

The BLNWR restoration project is to be implemented over a 10-year period. The project area is divided into five reaches. Activities in Reaches 2, 3 and 4 will be completed, according to the proposed plan, during two separate phases (Bureau of Reclamation, 2008). This memorandum was prepared to specifically address additional net depletions (**AND**) that could result from the restoration activities presented during Phase II. Phase II includes three major activities in Reaches 2 and 3 only. Activity number one (**Act #1)** includes an area that stretches from the north end of Reach 2 to the south end of Reach 3. This activity includes bank levee lowering to encourage interaction between the river channel and the surrounding floodplain at flows greater than 1,200 cubic feet per second (**cfs**). Activity number two (**Act #2**) includes the reconnection of a small oxbow at the north end of Reach 2, which has been cut off, due to sediment build up at the entrance and exit. Activity number three (**Act #3**) includes the reconnection of a small oxbow lake at the mid section of Reach 3, which currently holds spring water year round (Bureau of Reclamation, 2008).

Method of Calculations

To determine an open surface water evaporation factor for this area, the average yearly pan evaporation data, as observed at BLNWR Station # 922 (NM Climate Center, 2008), was used. It was determined that the average yearly pan evaporation is 7.3 feet. The yearly evaporation of 7.3 feet was then multiplied by the pan to lake evaporation factor of 0.77 (Boroughs and Stockton, 2005). The result is an average annual evaporation (**E_a**) of 5.6 feet per year (**ft/yr**) (Calculation 1).

E_a = 7.3 ft/yr * 0.77 Calculation 1

= 5.6 ft/yr

Act #1 is expected to increase channel-floodplain interaction to create a total of 54 acres (**ac**) of open surface water during flows of 1,200 cfs or more (Bureau of Reclamation, 2008), as observed at the USGS Acme Gauge (# 8386000). An analysis of the USGS Acme Gauge record, including discharge data from 1938 – 2007, shows that flows of 1,200 cfs or more occur approximately 2.1% of the time. Calculating 54 ac times 5.6 feet/year times 2.1%, resulting in an estimated additional net depletion of 6.4 acre-feet per year (**ac-ft/yr**). (Calculation 2) See Exhibit 1 for yearly total and monthly weighted factor.

AND for Act #1 = 54 ac * 5.6 ft/yr * 0.021 Calculation 2

= 6.4 ac-ft/yr

Act #2 it is expected to expand the small oxbow to approximately 3 ac of open surface water with flows of 1,200 cfs or more. (Bureau of Reclamation, 2008). The result is determined by multiplying 3 ac times 5.6 ft/yr times 2.1% for a subtotal of 0.4 ac-ft/yr AND (Calculation 3). See Exhibit 2 for annual total and monthly weighted factors.

AND for Act #2 = 3 ac * 5.6 ft/yr * 0.021
Calculation 3

= 0.4 ac-ft/yr

Act #3 will increase open surface water area 1 ac, from 5 ac to 6 ac, during flows of 300 to 1,200 cfs (Bureau of Reclamation, 2008). An analysis of the USGS Acme Gauge record, including discharge data from 1938 – 2007, shows that flows between 300 to 1,200 cfs occur approximately 14.4% of the time. Calculating 1 ac times 5.6 ft/yr times 14.4% results in 0.8 ac-ft/yr AND (Calculation 4). See Exhibit 3 for yearly total and monthly weighted factor.

AND for Act #3 = 1 ac * 5.6 ft/yr * 0.144
Calculation 4
= 0.8 ac-ft/yr

The total estimated AND determined for all three activities are 7.6 ac-ft/yr.

Total AND for Phase II
Calculation 5

Act #1	6.4 ac-ft/yr
Act #2	0.4 ac-ft/yr
Act #3	+ 0.8 ac-ft/yr
	= 7.6 ac-ft/yr

Although the project includes Tamarix spp. removal, the ISC does not recognize any credit for this type of water salvage activity at this time. While the current science surrounding evapotranspiration measurement continues to evolve, the salvage of water through vegetation management has yet to be defensibly quantified. Thus such activities have not been evaluated in this memorandum.

1.1.1.1.1.1.1.1.1 Observations

Whereas it is the responsibility of the State Engineer to be concerned about any depletions greater than 0.1 acre-feet/year in the Pecos River Basin (§1-15.6.4, OSE/ISC, 2006); and

Whereas it is the policy of the State Engineer to manage the waters of New Mexico for the benefit of the public and has the authority to permit any and all beneficial use of the state's waters; and

Whereas any increase in depletions in the Pecos River Basin is a concern for interstate compact delivery obligations; and

Whereas the dynamic nature of rivers and the uncertainties surrounding the geomorphic and hydrologic response of the Pecos River channel to the aforementioned project makes future river conditions difficult to predict.

It is therefore recommended that:

1) A depletion value of 7.6 ac-ft/yr should be assessed to the Bitter Lake National Wildlife Refuge Phase II restoration project and that appropriate water rights be designated or obtained for the project; and

2) An evaluation of the effects on depletions by this project be revisited five years from the completion date to determine if unforeseen circumstances have created a larger than expected surface area and if so, that a larger depletion assessment be required.

Note: The Phase I evaluation for this project is contained in a memorandum dated May 7, 2007. AND calculated for Phase I are 1.9 ac-ft/yr. Adding the above quantity of 7.6 ac-ft/yr plus 1.9 ac-ft/yr is equivalent to a total of 9.5 ac-ft/yr AND estimated for the implementation of both Phases I and II of this project.

References

U.S. Department of the Interior, Bureau of Reclamation, Albuquerque Area Office, Environment Division; Pecos River Channel Restoration at the Bitter Lake National Wildlife Refuge, Chavez County, New Mexico, Draft Environmental Assessment; September 2008

OSE/ISC; Rules and Regulations Governing the Appropriation and Use of Ground Water in New Mexico; Revised August 15, 2006

NM Climate Center; NMSU Weather Data; Bitter Lake Weather Station; Last updated: July 5, 2005; Accessed: September 12, 2008; http://weather.nmsu.edu/Pan_Evaporation/bitter_lakes_refuge_evap.htm

Craig B. Boroughs, PHD, PE; Thomas B. Stockton, PE; Pecos River RiverWare Model Draft Report; September 2005

Exhibit 1 Table of Monthly Depletion Calculations for Activity # 1

TOTAL ESTIMATED NEW DEPLETIONS **6.4 AC-FT/YR**

Current vs Future Depletions

Acres

Current: Vegetated Dry Area

Acres of Dry Vegetation	
January	0
Feb	0
March	0
April	0
May	0
June	0
July	0
August	0
September	0
October	0
Nov	0
Dec	0

Future: Open Surface Water Area

Acres of Open Water	
January	54
Feb	54
March	54
April	54
May	54
June	54
July	54
August	54
September	54
October	54
Nov	54
Dec	54

Consumption

Current: Vegetated Dry Evap

Acre-feet from Dry Vegetation		
January	0	
Feb	0	
March	0	
April	0	
May	0	
June	0	
July	0	
August	0	
September	0	
October	0	
Nov	0	
Dec	0	
Total	0	0.0

Future: Open Surface Water Evap

Acre-feet from Open Water		
January	0.19282725	
Feb	0.28596645	
March	0.49698495	
April	0.69199515	
May	0.8033256	
June	0.89282655	
July	0.8455293	
August	0.73710945	
September	0.57266055	
October	0.4176711	
Nov	0.2575881	
Dec	0.18555075	
Total	6.38	6.4

Exhibit 2 Table of Monthly Depletion Calculations for Activity # 2

TOTAL ESTIMATED NEW DEPLETIONS **0.4 AC-FT/YR**

Current vs Future Depletions

Acres

Current: Vegetated Dry Area

Acres of Dry Vegetation	
January	0
Feb	0
March	0
April	0
May	0
June	0
July	0
August	0
September	0
October	0
Nov	0
Dec	0

Future: Open Surface Water Area

Acres of Open Water	
January	3
Feb	3
March	3
April	3
May	3
June	3
July	3
August	3
September	3
October	3
Nov	3
Dec	3

Consumption

Current: Vegetated Dry Evap

Acre-feet from Dry Vegetation		
January	0	
Feb	0	
March	0	
April	0	
May	0	
June	0	
July	0	
August	0	
September	0	
October	0	
Nov	0	
Dec	0	
Total	0	0.0

Future: Open Surface Water Evap

Acre-feet from Open Water		
January	0.010712625	
Feb	0.015887025	
March	0.027610275	
April	0.038444175	
May	0.0446292	
June	0.049601475	
July	0.04697385	
August	0.040950525	
September	0.031814475	
October	0.02320395	
Nov	0.01431045	
Dec	0.010308375	
Total	0.35	0.4

Exhibit 3 Table of Monthly Depletion Calculations for Activity # 3

TOTAL ESTIMATED NEW DEPLETIONS **0.8 AC-FT/YR**

Current vs Future Depletions

Acres

Current: Open Surface Water Area

Acres of Open Water	
January	5
Feb	5
March	5
April	5
May	5
June	5
July	5
August	5
September	5
October	5
Nov	5
Dec	5

Future: Open Surface Water Area

Acres of Open Water (14.4%)	(85.6%)	
January	6	5
Feb	6	5
March	6	5
April	6	5
May	6	5
June	6	5
July	6	5
August	6	5
September	6	5
October	6	5
Nov	6	5
Dec	6	5

Consumption

Current: Open Surface Water Area

Acre-feet from Open Water		
January	0.850208333	
Feb	1.260875	
March	2.191291667	
April	3.051125	
May	3.542	
June	3.936625	
July	3.728083333	
August	3.250041667	
September	2.524958333	
October	1.841583333	
Nov	1.13575	
Dec	0.818125	
Total	28.13066667	**28.1**

Future: Open Surface Water Evap

Acre-feet from Open Water (14.4%)	(85.6%)		
January	0.146916	0.727778333	
Feb	0.2178792	1.079309	
March	0.3786552	1.875745667	
April	0.5272344	2.611763	
May	0.6120576	3.031952	
June	0.6802488	3.369751	
July	0.6442128	3.191239333	
August	0.5616072	2.782035667	
September	0.4363128	2.161364333	
October	0.3182256	1.576395333	
Nov	0.1962576	0.972202	
Dec	0.141372	0.700315	
Total	4.86	24.08	**28.9**

APPENDIX D
WATER RESOURCES

D. Water Resources

D.1 Overview

The Bitter Lake NWR is at the juncture of the Roswell Artesian Basin of southeastern New Mexico and the Pecos River. The Roswell Artesian Basin is a natural hydrologic basin six to eighteen miles west of the Pecos River and twenty miles north of Roswell, in Chaves County, to twenty miles south of Artesia, in Eddy County, a distance of approximately eighty miles. The Pecos River runs through the eastern side of the basin from north to south through the refuge. Several large tributaries drain from the west to the east. These two systems and their interactions account for the diversity of water resources within the refuge, including sinkholes, springs, wetlands, oxbow lakes, and riverine habitat.

D.2 Surface Water Hydrology

The refuge has about 1,200 surface acres of water in the form of natural lakes, impoundments, sinkholes, and streams. The portion of the Pecos River being considered for the proposed river restoration is from the southern boundary of the refuge (Project River Mile 0) to the northern boundary (Project River Mile 16). The affected river reaches are described in detail in Section 2.1. These figures show the five reaches and cross sections referenced in this EA. For much of its length, the river is bordered by refuge-impounded wetlands on the west side and a 300-foot-high bluff running along the east side of the river valley. The proposed project is entirely within the boundaries of the Bitter Lake NWR. The confluence with the Rio Hondo, a major tributary, is approximately two miles south of the Highway 380 Bridge, near the southern refuge boundary. The Rio Hondo originates in the foothills of the Sacramento Mountains, at the junction of Rio Ruidoso and Rio Bonita. From this point, it flows eastward for approximately 85 miles.

D.2.1 Pecos River Hydrology

The hydrology of the Pecos River through the Bitter Lake NWR is controlled by reservoir releases from Sumner Reservoir and inflows from tributaries and agricultural return flows south of Sumner Reservoir and north of Roswell. Before Sumner Dam was built in 1938, floods were much more intense and base flows were higher than under post-dam conditions. Table D-1 shows the pre-dam and post-dam floods, and Table D-2 shows the pre-dam and post-dam flow duration. There are data for twenty-seven of the thirty-two years before 1938 and for fifty-seven years after 1938. Data from the USGS

Table D-1
Flood Frequency Statistics Associated with the USGS Artesia Gage

Flood Frequency: Artesia Gage		
Return Period (year)	**Pre-Sumner Dam (27 years)**	**Post-Sumner Dam (57 years)**
2	10,100 cfs	2,700 cfs
5	21,000 cfs	6,000 cfs
10	31,500 cfs	9,700 cfs
50	66,900 cfs	25,900 cfs
100	88,400 cfs	38,200 cfs

(cfs = cubic feet per second)
Source: FLO Engineering 1999

Table D-2
Flow Duration Statistics Associated with the USGS Artesia Gage

Flow Duration: Artesia Gage		
% of time flows exceed	**Pre-Sumner Dam (27 years)**	**Post-Sumner Dam (57 years)**
1	2800 cfs	1900 cfs
2	1800 cfs	1400 cfs
5	1070 cfs	870 cfs
10	670 cfs	672 cfs
20	391 cfs	233 cfs
30	296 cfs	132 cfs
40	246 cfs	97 cfs
50	200 cfs	76 cfs
60	167 cfs	57 cfs
70	134 cfs	44 cfs
80	103 cfs	31 cfs
90	72 cfs	16 cfs
95	44 cfs	6 cfs
98	32 cfs	<5 cfs
99	24 cfs	<5 cfs

Source: FLO Engineering 1999

Gage, Pecos River Near Artesia, New Mexico (08396500, the Artesia Gage), located south of the Bitter Lake NWR, is used to compare the pre-dam to post-dam hydrology because the record goes back to 1906. The USGS Gage, Pecos River Near Acme (08386000, the Acme Gage) is in the reach proposed for restoration but does not have as long a record (FLO Engineering 1999).

Table D-1 shows how Sumner Dam has substantially decreased the intensity of floods for all return periods. There is a decrease in quantity and height of the spikes. Table D-2

compares the pre- and post-dam flow duration values. The post-dam flows are consistently lower, especially at the lower flows due to the policy of moving water in larger block releases.

Since 1937 the quantity of water released from Sumner Reservoir has been determined by the irrigation needs of the Carlsbad Irrigation District (CID) and state line water delivery requirements. Brantley Reservoir is the delivery point for Carlsbad Project water. Water is transported most efficiently to Brantley Reservoir using larger block releases. The maximum release through the gates at the reservoir at typical reservoir levels is 1,400 cubic feet per second (cfs), which typically results in a flow of approximately 1,200 cfs at the Acme Gage. The frequency of these block releases depends on downstream irrigation needs, water availability, and river conditions. Releases usually begin in March, and there can be several each year, lasting up to two weeks. Storms during a block release, or at other times, can cause peak flows above 1,200 cfs at the Acme Gage (FLO Engineering 1999).

As a result of a jeopardy determination in 1992 for the Pecos bluntnose shiner (shiner) on water operations on the Pecos River, the Bureau of Reclamation (Reclamation) is working to maintain a minimum discharge to support fish populations in the river and to avoid block releases at periods in the shiner's life cycle where the release could be harmful. Current Pecos River operations are governed by the 2006 – 2016 Biological Opinion, which sets a year-round target flow of 35 cfs as measured at the Taiban Gage (Pecos River Below Taiban Creek Ft. Sumner, NM, USGS gage number 08385522) and to keep the river continuous.

Actual flows through the Bitter Lake NWR are variable. A base flow of 35 cfs at Acme Gage has been used for planning restoration actions, although the target is not expected to be met consistently during the irrigation season (Service 2003). The portion of the Pecos River being considered for the proposed river restoration is a gaining reach due to groundwater inflows and is not subject to the same concerns about intermittency as the reach above the Acme Gage.

D.2.2 Pecos River Channel Morphology

The construction of Sumner Dam and the excavation of the channels in the Bitter Lake NWR in the 1940s have altered the channel morphology of the Pecos River. The original meanders had greater sinuosity or curving and meander length, meander amplitude, and mean radius of curvature. Current Reaches 2 and 4 are now straight excavated channels, so their morphology cannot be compared to the original meanders. Reaches 1, 3, and 5 have developed a new morphology, which is characterized by lower sinuosity, as a result of the present hydrology. Table D-3 presents the morphology characteristics of the current reaches. Information on the characteristics of Reach 5 is based on information from 1975, before the current Highway 380 Bridge was built. The rest of the reaches are based on 1991 aerial photos (FLO Engineering 1999).

Table D-3
Characteristics of Current Channel Reaches

Reach	Length (feet) River	Length (feet) Valley	Sinuosity	Slope (feet/mile)	Average Channel Width	Mean Radius of Curve (feet)	Meander length (feet)	Meander Amplitude (feet)
1	23,800	18,200	1.31	4.4	144	560	3,380	1,555
2	15,000	14,000	1.07	3.5	111	0	0	0
3	20,900	10,400	2.01	4.9	129	460	2,184	2,141
4	8,200	8,000	1.03	2.8	86	0	0	0
5*	16,200	14,000	1.16	3.4	120	360	2,440	1,500

*Before the Highway 380 Bridge
Source: FLO Engineering 1999

Table D-4 presents the morphology characteristics of the original meanders in 1940. The reach through Oxbow 1 was not a meandering river, so the mean radius of curvature, meander length, and meander amplitude are not applicable. The information for these tables was derived from USGS quadrangle maps and aerial photos (FLO Engineering 1999).

Table D-4
Characteristics of Original Oxbows

Oxbows	Length (feet) Meander	Length (feet) Valley	Sinuosity	Slope (feet/mile)	Average Channel Width	Mean Radius of Curve (feet)	Meander length (feet)	Meander Amplitude (feet)
1	22,200	14,000	1.63	2.2	154	NA	NA	NA
2	9,800	3,400	2.88	2.4	108	611	4,420	3,780
3	7,400	3,000	2.47	2.8	No Info	671	4,130	2,790
4	8,000	3,000	2.67	0.5	169	706	4,430	3,600
5	8,000	3,800	2.11	1.1	379	866	4,930	2,740

Source: FLO Engineering 1999

Each reach of the river has adapted to the lower flows associated with post-dam hydrology and to the straightening of the meanders. Reach 1 did not have any diversions and has remained dynamic, particularly around the bends, where new floodplain continues to be created. The channel that was excavated at the north end of Reach 2 was bypassed by a small meander by 1975. The channel was excavated again and has remained a straight section. The rest of Reach 2 has also remained straight. Reach 3 became a straight run of river following the excavation of the southern channel, which is downstream in Reach 4. The river in Reach 3 immediately began to reform, progressively increasing the meander length and amplitude and decreasing the radius of curvature of the meanders. Reach 3 is a good example of the morphology created by the post-dam hydrology (FLO Engineering 1999). Reach 4 has remained straight and unchanged.

Reach 5 is difficult to interpret due to the confinement of the river in this reach, caused by the construction of the Highway 380 Bridge.

The section of the Pecos River in Reach 3 has a meandering pattern that can be used as a template for the restored areas. This section has been developing within the context of the post-dam hydrology since the southern channel was dug in the 1940s. The sinuosity in this section is 2.01, the mean radius of curvature is 460 feet, the meander length is 2,184 feet, and the meander amplitude is 2,141 feet.

The river also was examined for ten miles upstream and twenty miles downstream of the restoration area for sections where a new morphology had developed with the post-dam hydrology. Two sections, one upstream and one downstream, were observed to have changed substantially since 1940. Table D-5 lists the slope, sinuosity, mean radius of curvature, meander length, and meander amplitude of these two sections. A comparison of these characteristics to Reach 3 in the Bitter Lake NWR shows a lower sinuosity, greater radius of curvature, and greater meander length in the upstream and downstream sections. However, the meander amplitudes of the three sections are similar.

Table D-5
Pecos River Characteristics Upstream and Downstream of the Bitter Lake NWR

	Slope (feet/mile)	Sinuosity	Mean Radius of Curve (feet)	Meander length (feet)	Meander Amplitude (feet)
Upstream	4.6	1.45	1,438	6,578	2,485
Downstream	2.4	1.34	817	3,599	1,553

FLO Engineering 1999

D.2.3 Other Surface Water Features

The Bitter Lake NWR includes a large variety of surface water types, including arroyos, spring-fed streams, isolated oxbow lakes, large and small playa lakes, developed impoundments, artesian springs, and sixty sinkholes throughout the refuge. These surface water features depend highly on local groundwater flows, which in turn depend on precipitation and water use to the north and west.

In the North Tract, major features include the Arroyo del Macho and Salt Creek. Arroyo del Macho is an ephemeral stream that drains in to Salt Creek. Salt Creek is also fed from groundwater sources and drains into the Pecos River from the west. The North Tract also includes at least 21 gypsum sinkholes, which were formed by the dissolving of underlying strata and subsequent collapse of the surface dome. These sinks vary in surface diameter from 60 to 200 feet and in depth from 20 to over 100 feet. Most of the shallow sinks are now dry due to the general lowering of the water table, but some of the deeper sinks are connected with the artesian system and hold water year-round. The Inkpot is a vertical-walled sinkhole 150 feet in diameter and 90 feet deep. In 1937 this sinkhole overflowed, feeding another sink and 60-acre playa lake.

Major surface water features of the Middle Tract include Bitter Lake playa, Bitter Creek, Lost River, Dragonfly Spring, Sago Spring, Lake St. Francis, Hunter Marsh, and numerous sinkholes, streams, and springs. The Middle Tract also includes the oxbow lakes created naturally or by river channelization and a series of water impoundments west of the Pecos River that are filled and drained seasonally for the benefit of bird populations. The surface water features of the Middle Tract provide habitat for several unique species, including some that are threatened or endangered. The Bitter Lake playa basin is thought to be the result of subsidence caused by an underground stream. The depth of the playa ranges from 0 to 4 feet. Bitter Creek and the Lost River are intermittent streams that drain into Bitter Lake. Lake St. Francis is the largest sinkhole in the refuge, measuring 200 feet across and 60 feet deep. Hunter Marsh is a natural wetland at the south end of the Middle Tract. The South Tract includes some human-made water impoundments.

D.3 Groundwater Hydrology

The Bitter Lake NWR is in the discharge zone for the Roswell Groundwater Basin. The basin encompasses 10,779 square miles and includes most of Chaves County and portions of Torrance, Guadalupe, and Roosevelt Counties. Groundwater supplies are derived from several geological formations, including the Yeso and San Andres Formations, the Artesia Group, the Glorieta Sandstone, and alluvium and terrace deposits. The two major aquifers that provide the largest supplies of water are the Permian artesian aquifer and the shallow-water aquifer, located in the alluvium deposits and terraces. These two aquifers provide water for the cities of Roswell, Artesia, Dexter, Lake Arthur, and Hagerman. Irrigation wells have been developed throughout the basin, with the largest concentration located in the Pecos River Valley between Roswell and Seven Rivers.

Groundwater from the artesian zone flows from west to east into the sinkholes, springs, and seeps of the refuge and maintains the wetlands and surface water impoundments. Groundwater also preserves perennial flows in the Pecos River through the proposed project area. Artesian flows historically maintained groundwater levels that were 80 feet above the mean topographic surface (mts, 3,500 feet) of the refuge. This level dropped to 20 feet above mts in the 1970s and since then has been on the rise toward the current level of 40 feet above mts. Trends suggest that spring flows will continue to increase, and sinkhole levels will continue to rise.

D.4 Water Rights

The Bitter Lake NWR has a water right associated with the North Tract for 4,393.2 acre-feet per year, with a priority date of 1916. As part of the adjudication of its federally reserved water rights by the State of New Mexico, the Service agreed not to use this

water right because it wished to enhance natural hydrologic conditions within this wilderness unit. The stipulation states that the refuge shall not use this water right unless the State Engineer would allow for the change in purpose of use from agriculture to instream flow.

The refuge has received recognition from the State of New Mexico for their federally reserved water right. This right allows for the refuge to manage wetlands on the Middle Tract of the Refuge and protects spring resources from impairment. Since the mid-1990s the Service has changed how the impounded wetlands of the Middle Tract are managed. Formerly, water levels in these wetlands were kept high year-round. Now lake levels are left low during the summer when evaporation is highest and are allowed to rise during the colder months. While the primary reason for this change was to mimic natural conditions and improve wetland habitat, this change may also have reduced losses due to evaporation.. These actions protect groundwater levels of the Roswell Basin in the refuge vicinity and preserve Pecos River flows.

D.5 Water Quality

Potential contaminant sources in the area include natural salinity, irrigated agriculture, grazing, feedlots, oil and gas production wells and pipelines, septic tanks, and historic municipal wastewater discharges to Hunter Marsh.

Upstream of the refuge, the Pecos River enters a basin dominated by evaporitic sedimentary rock. Natural salinity in the Pecos River and refuge water bodies greatly increases below this point due to geologic-based salt-loading and high evaporation rates. Water quality in the river is also affected by return flows from upstream agricultural diversion. Return flows are usually more saline than native river waters because salts are concentrated when water is removed through transpiration. The river also carries runoff from fertilizer application and other upstream contaminants. For many years during the last century, salts, selenium, and other contaminants were further concentrated in the water of refuge sinkholes due to dramatic declines in water levels. Reduced groundwater withdrawal in recent years has led to higher water levels in the sinkholes and probable decreases in salt concentrations. Change in the management of the impounded lakes may have reduced the salinity of these waters, and the removal of saltcedar may have helped remove surface salt and mineral encrustations.

There are three active oil wells and three active natural gas wells on the refuge that were included in lands acquired from the BLM in the late 1960s. The BLM continues to permit extensive natural gas development in the Pecos River floodplain just north of the boundary of the refuge Middle Tract, and leasing activity has accelerated throughout the region, including on the mesa immediately to the east of refuge. The refuge does not control subsurface mineral rights, and additional development could occur. Oil spills have occurred in the past within the holding berm of the oil tanks, and there is an area that has crusted oil in spots and is void of vegetation. In 1997, a gathering system was

installed to transport produced water and oil from leases on the refuge onto private property to the south. Fluids are now pumped to a central battery located off-refuge, which greatly reduces the chance of any future spills and associated habitat damage. An old abandoned delivery line and three produced water storage tanks were also removed.

The BLM administers a habitat protection zone (HPZ) within the 500-year source water capture zone for the refuge. All oil and gas activities within the primary area of the HPZ must incorporate groundwater protection features, including steel tanks instead of earthen pits and a stringent casing protocol (US BLM 2002).

Other water contaminant pathways include the following:

- Arroyo del Macho—Irrigated agriculture, grazing, oil, and natural gas wastes drain to Salt Creek;
- Salt Creek—Natural gas pipeline, power line, and gas well;
- Bitter Creek—Lowered water tables and subsequent increases in salinity, selenium, and arsenic;
- Lost River—Lowered water tables and subsequent increases in salinity, selenium, and arsenic, plus nutrient inputs from septic tanks and feedlots;
- Rio Hondo—Wastewater treatment point-source inputs, and agricultural, grazing, and oil and gas;
- Feedlot/dairy farms—Adjacent to South Tract of the refuge; and
- Industrial/commercial—Point sources in Roswell.

Since 1996, temperature, salinity, and conductivity have been measured monthly at 14 refuge wetland locations. Data from monitoring at the refuge showed that aluminum, cadmium, lead, selenium, and mercury concentrations were elevated in water samples when compared to regional averages. Aluminum, boron, mercury, selenium, and zinc were the only elements in plants, invertebrates, fish, or eggs that exceeded literature-based thresholds for adverse health effects. Lake St. Francis contained biota that had greater concentrations of copper, selenium, and zinc than at other sites, although sediment metal concentrations were low. Hunter Marsh, which historically received municipal wastewater, contained sediment and biota with elevated concentrations of lead and mercury.

No organic chemicals were detected in water, but several organics were found in sediments from the mouth of Lost River at Bitter Creek and in Hunter Marsh and in fish collected at Hunter Marsh. The remaining areas of the refuge were relatively contaminant free. Although polychlorinated biphenyls (PCBs) and organochlorine insecticides were not measured in Lost River sediments, fish contained only trace concentrations of these compounds. Several polycyclic aromatic hydrocarbons were measured in sediments in Hunter Marsh at concentrations as high as 20 milligrams per kilogram (mg/kg) dry weight parts per million (ppm), which could adversely affect invertebrate communities and wildlife that forage there regularly. Fish from Hunter Marsh also contained total PCBs at concentrations up to 5 ppm dry weight. A diet that contains greater than 0.1 ppm

total PCBs can have adverse effects on wildlife. Hunter Marsh contains contaminated sediments, invertebrates, and fish that, when consumed regularly by local wildlife, could result in adverse health effects (Service 2000, 2001).

Sediment and water samples were collected from Oxbow 4 in March of 2008. The samples were analyzed for PCBs, pesticides, and metals in order to assess any potential water quality impact of the reconnection of Oxbow 4 to the Pecos River mainstem channel. All samples were clear of PCBs and pesticides. The water sample had trace amounts of arsenic (0.090 micrograms per liter [μg/l] of water) and barium (0.021 μg/L). The sediment samples had concentrations of arsenic (~10 mg/kg), barium (~100 mg/kg), and chromium (~9 mg/kg). These concentrations are at or below average New Mexico background concentrations for these elements (AALI 2008, Tashjian 2008).

APPENDIX E
Coordination

JUN 2 2 2007

ALB-186
ENV-1.10

Honorable Raymond Gachupin
Governor, Pueblo of Jemez
P.O. Box 100
Jemez Pueblo, NM 87024

Subject: Invitation of Government-to-Government Consultation Regarding the Bureau of Reclamation's Environmental Assessment (EA) for the Pecos River Habitat Restoration Project (Project)

Dear Governor Gachupin:

The Bureau of Reclamation is preparing an EA for the Project and requests government to government consultation to identify any potentially affected Indian Trusts Assets or other concerns the Pueblo may have regarding tribal resources. The Project would be entirely within the boundaries of the Bitter Lake National Wildlife Refuge (BLNWR) near Roswell, New Mexico, which is managed by the US Fish and Wildlife Service (Service). The purpose of the proposed Project is to improve riparian and in-channel habitat, extending the reach of connected good quality habitat for the benefit of native aquatic and riparian plant and animal communities. Reclamation and the Service would improve habitat for the Pecos bluntnose shiner (shiner) by restoring parts of the river to more natural flow conditions within the context of the modern hydrologic regime, including reconnecting the river to the floodplain. A variety of restoration techniques may be used such as removing vegetation, lowering banks, changing the channel morphology, and restoring flow into historic meanders. Some or all of these techniques may be implemented, and work may be conducted in phases by agencies and entities other than Reclamation.

As part of the consultation process under the Endangered Species Act, the Service issued a Biological Opinion (2006 – 2016) (BO) on the selected alternative from the Carlsbad Project Water Operations Environmental Impact Statement. One of the provisions of the BO was for Reclamation to partner with Federal, state, and private entities to participate and assist in the completion of ongoing habitat improvement projects on the Pecos River and to restore 1-1.5 miles of quality habitat within the Farmlands reach by 2009 and another 1-1.5 miles by 2014. According to the BO, activities that restore and optimize the interaction of river channel and floodplain habitats with available flows will be most successful in mitigating the observed displacement of shiner eggs. The reach that would provide the most benefit for the shiner is from the BLNWR south to Hagerman where flows are perennial due to inflow from the Roswell Basin and habitat is degraded.

The need for restoration actions is to correct or improve degraded ecological conditions within the BLNWR section of the Pecos River caused by excavating straight channels, encroaching nonnative vegetation, and reservoir control of flows. The Project would support Reclamation's need to satisfy Federal requirements under the BO to restore quality habitat on the Pecos River and to participate and assist in the completion of ongoing habitat improvement projects. The Project would also support the need of the Service to implement BLNWR Comprehensive Conservation Plan goals and objectives, and would support broad Service mandates to restore, preserve, and enhance riparian habitat and the overall mission of the National Wildlife Refuge System.

The EA will evaluate the potential environmental and socioeconomic impacts from the project, from taking no action, and from any alternatives that may be identified. Reclamation is in the planning stage

A

for the proposed Project.

Reclamation requests government-to-government consultation and invites your participation to identify any potentially affected Indian Trust Assets, other tribal resources or sacred sites. Reclamation wants to ensure that you have an opportunity to express any concerns. For any additional information you need or to request a meeting, please call Ms. Marsha Carra, Environmental Protection Specialist at 505-462-3602.

Sincerely,

Steve Hanson

for Connie L. Rupp
Area Manager

Identical letter sent to persons on next page.

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United States Department of the Interior

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Albuquerque Area Office
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Ms. Lisa Meyer
New Mexico State Historic Preservation Office
Historic Preservation Division, Bataan Memorial Building
407 Galisteo Street, Suite 236
Santa Fe, NM 87501

Subject: Section 106 Consultation for the Pecos River Channel Restoration at the Bitter Lake National Wildlife Refuge, Chaves County, New Mexico

Dear Ms. Meyer:

In accordance with 36 CFR Part 800, Section 106 of the National Historic Preservation Act, the Department of the Interior, the Bureau of Reclamation, and the U.S. Fish and Wildlife Service (Service) are consulting with you regarding the above-referenced project. Reclamation and the Service are proposing to restore portions of the river channel at the Bitter Lake National Wildlife Refuge (NWR) in phases. Reclamation and the Service are joint lead federal agencies for this undertaking. The Bitter Lake NWR is approximately nine miles northeast of Roswell, New Mexico, in Chaves County, and consists of 24,536 acres in three noncontiguous units along the Pecos River (Figure 1).

Through phased proposals funded by Reclamation, the Service, the World Wildlife Fund-Chihuahuan Desert Program, (WWF) and the New Mexico Interstate Stream Commission, (NMISC) over the next ten years Reclamation and the Service seek to improve the riparian and in-channel habitat along approximately seven river miles of the Pecos River in the Middle Tract of the Bitter Lake NWR by restoring the river flows to dynamic conditions. The undertaking is a combination of restoration techniques which include removing vegetation, lowering banks, changing the channel morphology, restoring flow into historic oxbows, and revegetation. These techniques would be designed to work within the changed physical context of the river that includes lower peak flood flows, irrigation withdrawals, channelized river segments, non-native plant incursions, and protection of farmland and floodplain infrastructure. The undertaking will improve riparian and in-channel habitat, extending the reach of connected good quality habitat for the benefit of native aquatic and riparian plant and animal communities. The restoration would improve habitat by restoring parts of the river to more natural flow conditions within the context of the modern hydrologic regime, including reconnecting the river to the floodplain. Additionally, the undertaking will satisfy federal requirements under a Biological Opinion to restore quality habitat on the Pecos River and to participate and assist in the completion of ongoing habitat improvement projects. The project would also support the need of the Service to implement the Bitter Lake NWR Comprehensive Conservation Plan goals and objectives and would support broad Service mandates to restore, preserve, and enhance riparian habitat and the overall mission of the National Wildlife Refuge System.

Two phases of the restoration have been defined in detail and are considered ready for Section 106 consultations as undertakings. Phase I would be conducted in Reach 4 by Reclamation in collaboration with the Service. Restoration techniques proposed for Phase I include plugging and diverting the river into a historic oxbow, excavating a meandering channel within the oxbow, removal of non-native vegetation, lowering banks, and revegetation. The anticipated restoration disturbance footprint and staging areas would total approximately 270 acres. Primary site access would be through refuge roads

and include an existing unimproved parking area. There would be some off-road travel within the restoration footprint. As a future action, the Service is also proposing to develop an auto loop pullout, viewing platform, and interpretive site within the disturbance footprint. The viewing platform and interpretive signage would afford the public the opportunity to observe the oxbow lake and learn about the river restoration. The proposed location and maximum disturbance footprint is shown on Figure 2. It is anticipated that parking would be provided for up to ten vehicles. The design would be similar to existing facilities elsewhere on Bitter Lake NWR. No final design, timetable for construction, or funding is in place for this project.

Phase II of the restoration seeks to repair floodplain connectivity in Reaches 2 and 3. The Service, in its role of refuge manager, is leading a collaborative partnership with the WWF and the NMISC to conduct this work as the managers of the refuge. Restoration actions proposed for Phase II include bank lowering, removal of non-native vegetation from bank levees and bars, reconnection of a small oxbow lake, and revegetation. The anticipated maximum disturbance footprint and river access/staging areas are defined in Figure 3. Primary site access would be through refuge roads, although there would be some off-road travel within the project footprint. The Service will determine priorities for staging the restoration within the Phase II project area based on refuge needs, resource protection, and efficient use of available funds, staffing, and equipment. Tentative actions planned would include experimental work with combinations of restoration techniques on 50 acres within Reaches 2 and 3. It is anticipated that later restoration based on the experimental work would include a minimum of 100 acres of active restoration on the floodplain and 75 acres on point bars, encouraging passive restoration improvements within Reaches 2 and 3. Additional restoration actions, primarily mechanical non-native vegetation removal, are planned as funding becomes available. The anticipated maximum disturbance footprint for staging and river access would total approximately 40 acres and the river channel and active floodplain restoration area could total up to 450 acres.

Restoration techniques may be applied in the future in the refuge portions of Reaches 1-4. These are not fully developed as proposals and undertakings. Additional consultation with your office would be needed for full implementation as these projects are developed.

An Environmental Assessment is being prepared by Reclamation to address the environmental effects of this proposed action, including those on cultural resources. To assist your office in the evaluation of this project, I have enclosed a map of the Area of Potential Effect (APE) (Figure 2). Reclamation and the Service would not conduct any ground disturbing activities beyond the level analyzed in this document without additional environmental review.

A records search through the New Mexico Cultural Resource Information System identified no sites within the APE. There are two old records (LA 8834, LA 8835) with poor locational information of lithic and lithic/ceramic scatters approximately 1400 and 1900 meters to the west of the APE. Lithics and ceramics have also been recorded as close as two miles away on top of a large mesa above the floodplain. This mesa has been extensively surveyed for cultural resources as a result of oil exploration and development. Federally recognized tribes and pueblos with potential ties to the project area were notified via letter of the proposed project. The only responses received requested notification should archaeological resources or human remains be found during restoration. No concerns or traditional cultural properties were identified by the parties consulted. Potentially affected tribes and pueblos will be contacted again and invited to consult during the EA process.

With the exception of the staging and river access locations, work would be conducted in active or recently active floodplains, channels, or oxbows. The APE has experienced episodic flooding, refuge maintenance actions, channel diversion and shaping, parking, and associated earthmoving activities over the years resulting in a highly disturbed setting. Portions of the APE are inaccessible due to dense vegetation and/or perennial water. The APE for restoration staging and river access locations is enlarged so that sensitive plant resources and wet locations can be avoided, if necessary. The staging and river

access would total approximately 40 acres. Reclamation will have an archaeologist on site to monitor Phase I of construction on the staging and the river access areas.

Based on the above, Reclamation and the Service have determined that a pedestrian survey of the APE would not be needed or be useful for this undertaking and one has not been conducted. However, should unforeseen cultural resources be discovered during the course of restoration, provisions for halting work in the vicinity of any unanticipated discoveries have been incorporated into the proposed project. Maps of the restoration footprint and the following stipulations would be included in materials provided to restoration personnel:

> **Archaeological Discoveries.** Should evidence of possible scientific, prehistoric, historic, or archeological data be discovered during the course of this action, work shall cease at that location and the Refuge Manager and Service archaeologist shall be notified by phone immediately with the location and nature of the findings. Care shall be exercised so as not to disturb or damage artifacts or fossils uncovered during operations, and the proponents shall provide such cooperation and assistance as may be necessary to protect the location and to preserve the findings for removal or other disposition by the Government.
>
> **Discovery of Human Remains**. Any person who knows or has reason to know that he or she has inadvertently discovered human remains on Federal lands must provide immediate telephone notification of the inadvertent discovery, with written confirmation, to the Refuge Manager and Service archaeologist who will report to the responsible agency official. The requirement is prescribed under the Native American Graves Protection and Repatriation Act (P.L. 101 601; 104 Stat. 3042) of November 1990, and National Historic Preservation Act, Section 110(a)(2)(E)(iii) (P.L. 102 575, 106 Stat. 4753) of October 1992. Should evidence of suspected human remains be discovered during the course of this action, work shall cease in the vicinity and the location protected until a decision is made regarding removal or other disposition by the Government.

Based on this analysis, Reclamation and the Service seek your concurrence of our finding of "No Historic Properties Affected" (36 CFR §800.4) by the proposed undertaking. If you have any questions or require any additional information regarding this proposed action, please contact Mark Hungerford at 505-462-3644. Thank you for your assistance and we look forward to your response within the next 30 days.

Sincerely,

John R. Poland

John R. Poland
Area Manager

Enclosures – 2

No Historic Properties Affected.

Laura Meyer 8/20/08
for NM State Historic Preservation Officer

ORIGINAL

DEPARTMENT OF THE ARMY
ALBUQUERQUE DISTRICT, CORPS OF ENGINEERS
4101 JEFFERSON PLAZA NE
ALBUQUERQUE NM 87109-3435

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June 17, 2008

Regulatory Division
New Mexico/Texas Branch

Mr. Jeff Howland
Refuge Manager
USFWS-Bitter Lake National Wildlife
Refuge
4605 Bitter Lake Road
Roswell, New Mexico 88201

Dear Mr. Howland:

This is in reference to your application dated May 22, 2008, for the proposed Pecos River Restoration Project on the Pecos River east of Roswell, Chaves County, New Mexico, Action No. SPA-2007-00653-ABQ.

By a letter dated June 6, 2008, the Albuquerque District, U.S. Army Corps of Engineers (Corps), notified you that we were evaluating this project under the terms of Section 404 Nationwide Permit No. 27 for aquatic habitat, restoration, establishment, and enhancement activities.

After reviewing the project in accordance with the Nationwide Permit pre-construction notification procedures (General Condition No. 27), the Corps has determined that the proposed work will not result in more than minimal individual or cumulative adverse environmental effects. The public interest would best be served by allowing the work to proceed under Nationwide Permit No. 27. A summary of this permit (including regional conditions) can be found at our website at www.spa.usace.army.mil/reg/. If you are unable to access this website, please notify our office for a hardcopy of these documents.

The U.S. Fish and Wildlife Service (USFWS)-Bitter Lake National Wildlife Refuge is therefore authorized to proceed under authority of Nationwide Permit No. 27 for aquatic habitat, restoration, establishment, and enhancement activities. You must insure compliance with all conditions of the permit, including submittal of the enclosed Compliance Certification required by General Condition No. 26.

In addition to the General Conditions of Nationwide Permit No. 27, the following special condition must also be satisfied:

a. The USFWS must comply with any measures to avoid impacts to endangered and threatened species that result from coordination of the Pecos River Restoration Project under Section 7 of the Endangered Species Act.

b. The USFWS must comply with any measures required to minimize or avoid impacts to cultural resources that are developed as a result of the Pecos River Restoration Project's cultural resource coordination under the requirements of Section 106 of the National Historic Preservation Act.

The proposed project is located within the Pecos River, a perennial river. The New Mexico Environment Department (NMED) must issue a Section 401 water quality certification for the project prior to the commencement of work. The NMED is currently reviewing the project for compliance with the appropriate water quality standards for this portion of the Pecos River.

General Condition No. 17 requires that no activity is authorized under any Nationwide Permit which is likely to jeopardize the continued existence of a listed or proposed threatened or endangered species, as identified under the Federal Endangered Species Act, or which is likely to destroy or adversely modify the critical habitat of such species. As stated above in Special Condition a., the USFWS must comply with any measures to avoid impacts to endangered and threatened species that result from coordination of the Pecos River Restoration Project under Section 7 of the Endangered Species Act.

Please note under Further Information in the nationwide permit that this verification does not grant any property rights or privileges. The USFWS must possess the authority, including property rights, to undertake the work described in his application.

This verification will be valid for 2 years unless the nationwide permit is modified, reissued or revoked. The verification will remain valid if, during that time, the nationwide permit is reissued without modification or the activity complies with any subsequent modification of the nationwide permit authorization. If the nationwide permit authorization expires, is suspended, revoked, or modified such that the activity would no longer comply with the terms and conditions of the nationwide permit, the provisions of 33 CFR 330.6(b) will apply.

If you have any questions regarding this verification or these regulations, please feel free to contact Mr. James Wood at (505) 342-3280 or by e-mail at james.a.wood@usace.army.mil. Also, please complete and return the attached Customer Service Survey at your convenience.

Sincerely,

Donald Borda
Chief, Regulatory Division

2 Enclosures
1. Compliance Certification form
2. Customer Service Survey

Copies furnished:

Mr. Christopher M. Canavan
NMED-Surface Water Quality Bureau
Las Cruces Field Division
1170 N. Solano Drive, Suite M
Las Cruces, NM 88001

Mr. Paul Tashjian
Hydrologist
USFWS-Resource Management Branch
P.O. Box 1306
Albuquerque, NM 87103-1306

Ms. Marsha Carra
Bureau of Reclamation-Albuquerque
Area Office
555 Broadway Blvd. NE, Suite 100
Albuquerque, NM 87102-2352

NEW MEXICO
ENVIRONMENT DEPARTMENT

Surface Water Quality Bureau

BILL RICHARDSON
Governor
DIANE DENISH
Lieutenant Governor

Harold Runnels Building, N2050
1190 South St. Francis Drive (87505)
P.O. Box 26110, Santa Fe, NM 87502
Phone (505) 827-0187 Fax (505) 827-0160
www.nmenv.state.nm.us

RON CURRY
Secretary
JON GOLDSTEIN
Deputy Secretary

November 10, 2008 CERTIFIED MAIL NO. 7004 0750 0001 3214 3531

Mr. Jeff Howland
Refuge Manager
U.S. Fish and Wildlife Service
Bitter Lake National Wildlife Refuge
4065 Bitter Lakes Drive
Roswell, New Mexico 88201

Subject: Clean Water Act Section 401 Water Quality Certification for ***NMED SWQB File 2008-LC007:*** Pecos River Restoration Project, Chaves County, New Mexico.

Dear Mr. Howland,

The Surface Water Quality Bureau (SWQB) of the New Mexico Environment Department has examined the application for the project indicated above under Sections 404 and 401 of the federal Clean Water Act. The project is located in Townships 9 and 10 South, Range 25 East , Sections 2, 3, 10, 11, 14, 15, 21, 22, 23, 26, 27, 28, and 34 . According to the application, this project involves the re-connection of an oxbow lake to the main stem of the Pecos River, and the removal of tamarisk, floodplain levees, lowering floodplains, re-connecting historic river sections, and establishing native plants.

The U.S. Army Corps of Engineers (USACE) will regulate this project under Nationwide Permit No. 27 for Aquatic Habitat Restoration, Establishment, and Enhancement Activities (USACE Action #2007-00653-ABQ). A state Water Quality Certification is required by Section 401 of the federal Clean Water Act to ensure that the project complies with the State of New Mexico water quality standards (State of New Mexico, Standards for Interstate & Intrastate Surface Waters, New Mexico Water Quality Control Commission, 20.6.4 New Mexico Administrative Code (NMAC) as amended August 1, 2007). A Section 401 Water Quality Certification is also required to comply with General Condition 21 (Water Quality) and General Condition 13 (regional and Case-By-Case Conditions) of the Nationwide Permits. According to the water quality standards this segment of Pecos River is designated for the following uses:

- Secondary contact
- Irrigation
- Wildlife habitat
- Warmwater aquatic life
- Livestock watering

Standards and applicable criteria for this segment of the Pecos River and relevant to your project include:

20.6.4.8 Antidegradation Policy and Implementation Plan
20.6.4.13 General Criteria

A. Bottom Deposits and Suspended or Settleable Solids: Surface waters of the state shall be free of water contaminants including fine sediment particles (less than two millimeters in diameter), precipitates or organic or inorganic solids from other than natural causes that have settled to form layers on or fill the interstices of the natural or dominant substrate in quantities that damage or impair the normal growth, function or reproduction of aquatic life or significantly alter the physical or chemical properties of the bottom.

B. Floating Solids, Oil and Grease: Surface waters of the state shall be free of oils, scum, grease and other floating materials resulting from other than natural causes that would cause the formation of a visible sheen or visible deposits on the bottom or shoreline, or would damage or impair the normal growth, function or reproduction of human, animal, plant or aquatic life.

F. Toxic Pollutants: Surface waters of the state shall be free of toxic pollutants from other than natural causes in amounts, concentrations or combinations that affect the propagation of fish or that are toxic to humans, livestock or other animals, fish or other aquatic organisms, wildlife using aquatic environments for habitation or aquatic organisms for food, or that will or can reasonably be expected to bioaccumulate in tissues of fish, shellfish and other aquatic organisms to levels that will impair the health of aquatic organisms or wildlife or result in unacceptable tastes, odors or other health risks to human consumers of aquatic organisms.

I. Temperature: Maximum temperatures for each classified water of the state have been specified in 20.6.4.101 through 20.6.4.899 NMAC. However, the introduction of heat by other than natural causes shall not increase the temperature, as measured from above the point of introduction, by more than 2.7°C (5°F) in a stream, or more than 1.7°C (3°F) in a lake or reservoir. In no case will the introduction of heat be permitted when the maximum temperature specified for the reach would thereby be exceeded. These temperature criteria shall not apply to impoundments constructed off stream for the purpose of heat disposal. High water temperatures caused by unusually high ambient air temperatures are not violations of these standards.

J. Turbidity: Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water. Turbidity shall not exceed 10 NTU over background turbidity when the background turbidity is 50 NTU or less, or increase more than 20 percent when background turbidity is more than 50 NTU. Background turbidity shall be measured at a point immediately upstream from the turbidity causing activity. However, limited-duration activities necessary to accommodate dredging, construction or other similar activities and that cause criterion to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and all appropriate permits and approvals have been obtained.

20.6.4.206 PECOS RIVER BASIN – The main stem of the Pecos River from the headwaters of Brantley Reservoir upstream to Salt Creek (near Acme), perennial reaches of the Rio Peñasco downstream from State Highway 24 near Dunken, perennial reaches of the Rio Hondo and its tributaries below Bonney Canyon and perennial reaches of the Rio Felix.
20.6.4.900 Standards Applicable to Attainable or Designated Uses

This is only a partial list of standards for the Pecos River. For a complete list of the water quality standards that apply to your project, refer to the following sections of the Standards for Interstate & Intrastate Surface Waters, New Mexico Water Quality Control Commission, 20.6.4 NMAC (as amended August 1, 2007). These standards are available on the web at:

http://www.nmcpr.state.nm.us/nmac/parts/title20/20.006.0004.pdf.

401 Water Quality Certification with Conditions:

Pursuant to Section 401 of the Clean Water Act and 40 Code of Federal Regulations Part 121, the SWQB hereby issues a conditional Section 401 Water Quality Certification for USACE Action #2007-00653-ABQ: Pecos River Restoration Project. This certification is subject to conditions to reasonably assure that the activity is consistent with state law, will be conducted in a manner that will not violate applicable State of New Mexico water quality standards, and implements the Water Quality Management Plan, including Total Maximum Daily Loads (TMDLs), the Continuing Planning Process, and the Antidegradation Policy and Implementation Plan.

Therefore, this Certification is not valid unless the following conditions are adhered to:

1. Erosion control measures for all portions of the project area that drain toward surface water must be properly selected, installed, inspected, repaired, and maintained. Erosion and sediment control structures (e.g., silt fences, sediment basins, etc.) must be inspected after significant storm events and repaired as necessary. Sediment must be removed from erosion control structures when the sediment reaches one-half the height of the structure or wet storage volume is reduced by one-half.

2. Fuel, oil, hydraulic fluid, lubricants, and other petrochemicals must not be stored within the 100-year floodplain and must have a secondary containment system to prevent spills. Appropriate spill clean-up materials such as booms and absorbent pads must be available on-site at all times during construction. Report all spills immediately to the SWQB as required by the New Mexico Water Quality Control Commission regulations (20.6.2.1203 NMAC). For non-emergencies during normal business hours, call 505-428-2500. For non-emergencies, call 866-428-6535 (voice mail, twenty-four hours a day). For emergencies only, call 505-827-9329 twenty-four hours a day (NM Dept of Public Safety).

3. All heavy equipment used in the project area must be pressure washed and/or steam cleaned before the start of the project and inspected daily for leaks. A written log of inspections and maintenance must be completed. Leaking equipment must not be used in or near surface water. Refuel equipment at least 100 feet from surface water.

4. Avoid working within the channel during spring runoff season or summer thunderstorm flows. Local weather forecasts must be monitored to avoid working in high water. Releases from dams must be incorporated into the work schedule to avoid working in high water. Work in the stream channel should be limited to periods of no flow when practicable, and must be limited to periods of low flow.

5. Temporary protective mats are required for heavy equipment working in wetlands to minimize impacts to soil and vegetation and are to be removed when no longer necessary. Wetland crossings must be restricted to a single location and constructed perpendicular to and at a narrow point of the wetland. Flows to wetlands must not be permanently disrupted. Permeable fills should be designed and installed, when practicable. Fill materials must be clean and consist of coarse material with minimal fines. Ditches or culverts in wetlands must have properly designed, installed and maintained siltation or sedimentation structures at the outfall.

6. Excavated trenches must be backfilled and compacted to match the bulk density and elevation of the adjacent undisturbed soil.

7. All areas adjacent to the watercourse that are disturbed because of the project, including temporary access roads, stockpiles and staging areas, must be restored to pre-project conditions. Disturbed areas outside the channel that are not otherwise physically protected from erosion must be reseeded or planted with native vegetation. Stabilization measures including vegetation are required at the earliest practicable date, but by the end of first full growing season following construction. Native woody riparian and/or wetland species must be used in areas that support such vegetation. Measures to prevent damage by beavers, wildlife, or livestock are required until trees are established. Plantings must be monitored and replaced for an overall survival rate of at least 80 percent. Once established, native plants adapted to the site must be able to thrive with no supplemental water or treatment.

8. A copy of this Section 401 Water Quality Certification must be kept at the project site during all phases of construction. All contractors involved in the project must be provided a copy of this certification and made aware of the conditions prior to starting construction.

9. The SWQB must be notified at least five days before starting construction, to allow time to schedule monitoring or inspections.

Violations of State of New Mexico water quality standards could lead to penalties under the New Mexico Water Quality Act. Section 74-6-10.1 B of the Act states, "Any person who violates any provision of the New Mexico Water Quality Act other than Section 74-6-5 NMSA 1978 or any person who violates any regulation, water quality standard, or compliance order adopted pursuant to that act shall be assessed civil penalties up to the amount of ten thousand dollars ($10,000) per day for each violation."

The SWQB specifically reserves the right to amend or revoke this conditional Section 401 Certification at any time to ensure compliance with the State of New Mexico water quality standards. If you have any questions regarding this Section 401 Water Quality Certification please feel free to contact Chris Canavan of my staff at (575) 647-7926. Thank you for your cooperation.

Sincerely,

Glenn Saums, Acting Bureau Chief
Surface Water Quality Bureau

GS: cmc

xc: NMED District IV Manager, Roswell
Edward L. Paulsgrove, U.S. Army Corps of Engineers
Tom Nystrom, Wetlands, Region 6, USEPA
Matthew Wunder, NM Department of Game and Fish
Brian Millsap, U.S. Fish and Wildlife Service
401 Certification File 2008-LC007

INTRA-SERVICE SECTION 7 BIOLOGICAL EVALUATION FORM

Originating Person: Jeffrey Sanchez
Telephone Number: 575-625-4018
Date: 9/23/2008

I. Region: 2

II. Service Activity (Program): Refuges and Wildlife

III. Pertinent Species and Habitat:

A. Listed species and/or their critical habitat within the action area:
Interior least tern *(Sterna antillarum)*
Koster's springsnail *(Juturnia kosteri)*
Noel's amphipod *(Gammarus desparatus)*
Pecos assiminea *(Assiminea pecosensis)*
Pecos bluntnose shiner *(Notropis simus pecosensis)*
Pecos gambusia *(Gambusia nobilis)*
Pecos sunflower *(Helianthus paradoxus)*
Roswell springsnail *(Pyrgulopsis roswellensis)*
Southwestern Willow Flycatcher *(Empidonax traillii extimus)*

B. Proposed species and/or proposed critical habitat within the action area:

C. Candidate species within the action area:
Lesser Prairie Chicken *(Tympanuchus pallidicinctus)*

D. Include species/habitat occurrence on a map: see attachments 1-4

IV. Geographic area or station name and action:

Restore portions of functioning Pecos River channel at Bitter Lake National Wildlife Refuge in Chaves County, New Mexico.

V. Location (attach map):

A. Ecoregion Number and Name: 6, Pecos

B County and state: Chaves County, New Mexico

C. Section, township, and range (or latitude and longitude): Parts of sections 14, 22, 23, 26, 27, and 34 of T9S, R25E and sections 2, 3, 10, 11, 14, 15, 21, 22, 27, and 28 of T10S, R25E.

D. Distance (miles) and direction to nearest town: Approximately 10 miles west to Roswell

E. Species/habitat occurrence:

Southwestern willow flycatcher *(Empidonax traillii extimus)* is restricted to dense riparian association of willow, cottonwood, buttonbush, tamarisk, baccharis, and other deciduous shrubs and trees. This habitat occurs in riparian areas along rivers, streams, or other wetlands that are often small and/or linear, and widely separated by expanses of arid lands (USDA, *et al.* 2005). The breeding range of the southwestern willow flycatcher (SWIFL) includes parts of southern California, southern Nevada, southern Utah, Arizona, New Mexico, western Texas, southwestern Colorado, and extreme northwestern Mexico. The wintering grounds of this species are not well known, but the most likely areas are in Mexico, Central America, and perhaps northern South America (Oberholser, 1974; Wauer, 1985).

Southwestern willow flycatchers are rarely observed at Bitter Lake National Wildlife Refuge (BLNWR) and the Pecos River system. They migrate through saltcedar infested areas along the Pecos River but do not breed there and historically breeding has never been recorded there (De Loach, *et al., 2003).* The nearest southwestern willow flycatcher territory exists approximately 150 miles to the west along the Rio Grande riparian zone near San Marcial, New Mexico.

Interior least terns *(Sterna antillarum)* nest on large, bare river sandbars, beaches and islands of large reservoirs and alkali flats near water in the central and northern Great Plains. Bare substrate is essential for nesting upon, within which they dig a small scrape to hold a clutch of 2 or 3 eggs. The semi-precocial chicks leave the nest within 24 hours of hatching and seek isolated clumps of vegetation for concealment and protection from the sun/predators. The parents feed their chick's small fish and invertebrates.

Least terns begin arriving at BLNWR in early May and initiate nesting a few weeks after arrival. They usually nest in small numbers (usually 10-12 pairs), primarily utilizing Unit 16 and the Bitter Lake Playa. After fledging, the young may be observed on shorelines or islands of Bitter Lake and wetlands where foraging is favorable. By mid-August most fledglings and adults have departed the refuge.

Pecos gambusia *(Gambusia nobilis)* inhabits shallow, alkaline waters with aquatic vegetation for cover. It occurs near spring-heads exhibiting flowing water, and near the shorelines of sinkholes. The species feeds on the surface and at mid-water, primarily on Culicidae and Corixidae (Sublette, 1990). It appears to have a fairly narrow temperature tolerance, inhabiting waters between 21° and 30° C (Gehlbach et al. 1978). Although it inhabits sites with a wide range of salinities (low at spring heads, high in sinkholes), a level of 30 ppt may be the upper limit for the species (Echelle and Echelle, 1980).

Historically, Pecos gambusia occurred in springs and other isolated habitats within the Pecos River Valley, and utilized the Pecos River primarily for dispersal. As a result of habitat loss associated with the lowering of the water table and reduced flows along the Pecos River Valley, its range has been restricted. It currently occurs only on the refuge (Bitter Creek, Sago Springs, Dragonfly Springs, and several other sinkholes), at Blue Springs in Eddy County, New Mexico,

and at two sites in Texas (Toyah Creek and Leon Creek). A few Pecos gambusia and western mosquitofish *(G. affinis)*/Pecos gambusia hybrids have been found in Units 3 and 5 (Echelle and Echelle, 1980). It is unlikely that pure Pecos gambusia reside there today. Additionally, Pecos gambusias are thought to inhabit the Unit 6 spring ditch and several other spring ditches throughout the refuge. Further presence/absence investigation is required.

Pecos bluntnose shiner *(Notropis simus pecosensis)* prefers open river channels with limited aquatic vegetation, sandy substrates, and low velocity laminar flows within healthy meandering river systems. It is most common below obstructions in the river, but not in stagnant pools. Spawning is believed to peak during summer in response to high flows following storm events, but may also occur in the fall (Sublette, 1990). This species is apparently carnivorous-omnivorous, utilizing a wide range of organisms. Habitat alterations resulting from dams and other dewatering projects have been the primary reason for its decline.

Historically, *N. s. pecosensis* was found in the Pecos River and lower reaches of its major tributaries from Santa Rosa, NM south to just north of Carlsbad, NM. Its distribution is currently restricted at the northern and southern extremes of its historical range (Sublette, 1990). BLNWR currently harbors Pecos bluntnose shiners along the Pecos River (none of which is included in the Critical Habitat designation for the Pecos bluntnose shiner).

Pecos puzzle sunflowers *(Helianthus paradoxus)* grow in moist, saline soils adjacent to permanent water or in areas seasonally flooded. It is an annual which sets seed in September, and is believed to germinate mostly in February and March. Seedlings have been found as early as the first week in March. Pecos sunflowers have six known major areas of occurrence; five in New Mexico and one in Texas. Within the Pecos Valley, it occurs near Santa Rosa and east/southeast of Roswell within Bottomless Lakes State Park, Dexter National Fish Hatchery, and BLNWR. The refuge population occurs along Bitter Creek, south to hunter marsh, and on the refuge farm, mostly around the small wetland complex west of the Hondo River.

Since first discovered on the refuge in 1991, the estimated area of Pecos sunflower occupancy has increased by more than three-fold due to water and fire management prescriptions (Annual Narrative Report, 1996). The refuge Pecos sunflower population fluctuates from year to year due to climatic factors, though the Pecos sunflower appears to be ever-increasing. Drawing down wetlands in the spring has provided additional sites for sunflower seed germination, while at the same time lowering soil salinity levels. Fall and winter burning has apparently provided a favorable environment for seed germination and plant growth by removing litter and providing a flush of nutrients. The removal of saltcedar over-story, by burning or cutting, has also led to the establishment of sunflowers beneath the former canopy.

Koster's springsnail *(Juturnia kosteri)* is an extremely small gastropod (family: Hydrobiidae) endemic to Chaves County, New Mexico. The snail is totally aquatic, living in low-velocity springs and streams with soft, organic substrates. It presumably feeds on the fine film associated with the substrate (NMDGF, 1988). The Koster's springsnail currently persists only within scattered sites on the refuge. It is believed to be extirpated from the Roswell Country Club where an off-refuge population existed at one time. Population density estimates range from 704-89,472/meter-squared for Bitter Creek (including Dragonfly Springs) and from 75-512/meter-squared for Sago Springs (Lang, 1998). In the summer of 1998, Dr. Mark Gordon

discovered several isolated populations on the western shoreline of the refuge impoundments extending from unit 3 to hunter marsh (Gordon, 1998, pers. com.). He also found a population in Lake St. Francis which is a relatively freshwater sinkhole (Gordon, 2001, pers. com.).

Noel's amphipod *(Gammarus desparatus)* is a small shrimp-like crustacean that is generally active at night, and endemic to Chaves County, New Mexico. They inhabit cool, unpolluted waters with an abundance of oxygen (NMDGF, 1988). They are omnivorous, feeding on algae and organic debris (NMDGF, 1988). The last known populations occur within the refuge, on Bitter Creek, Sago Springs, the ditch on the west side of Units 6 and 7, in Hunter Marsh and the adjacent City of Roswell property (discovered in 2004). The population from the Roswell Country Club could not be located in 1988 or 2004 and the Lander Spring population is apparently extinct. Lang (1998) estimated densities of 64-8768/meter-squared in Bitter Creek and 26-575/meter-squared in Sago Springs. Density estimates have not been made for the more recently discovered populations.

Roswell springsnail *(Pyrgulopsis roswellensis)* is a tiny, aquatic gastropod (family: Hydrobiidae) endemic only to Chaves County, New Mexico (NMDGF, 1988). It requires perennially flowing water where it feeds on algae and organic detritus (NMDGF, 1988). Until the summer of 1998 it was known only to occur within North Spring at the Roswell Country Club, Bitter Creek, and Sago Springs. However, Dr. Gordon found it persisting in the ditch west of Unit 6 (1998, pers. com.), and Lang found it in the ditch on the west side of Unit 7 (2002, pers. com). A survey of the Roswell Country Club spring-head during the summer of 2004, found no rare invertebrates (2004, pers. com). Lang (1998) estimated densities in Sago Springs at 1,125-27,924/meter-squared and in Bitter Creek at 64-512/meter-squared.

Pecos assiminea snail *(Assiminea pecosensis)* is a very small, amphibious gastropod (family: Assimineidae) occurring only at one site in Texas and in Bitter Creek (NMDGF, 1998). These snails reside mostly in moist substrate or vegetation within a few inches of flowing water. They presumably consume bacteria, fungi, algae, and associated items (NMDGF, 1988). Lang (2000) collected a few individuals from the ditch on the west side of Unit 7, Bitter Creek, and numerous individuals from the edge of Sinkhole 32, which is hydrologically connected to Sago Springs. Additionally, Dr. Gordon (2001) identified Pecos assiminea snails within the southwest corner of Unit 15. Populations at one time existed within the Roswell Country Club, and a seepage area along Unit 6 (Lang, 1998), but have since been extirpated from both sites. It is believed that additional isolated populations exist on the west side of BLNWR wetland units among spring habitats.

Lesser prairie chickens *(Tympanuchus pallidicinctus)* currently occupy western Kansas, western Oklahoma (panhandle), north and northwestern Texas, southeastern New Mexico, and southeastern Colorado. They require native rangeland in different stages of plant succession, consisting of a diversity of native, short to mid-height grasses and forbes interspersed with low-growing shrubby cover (USDA 1999). They nest in shallow depressions lined with grass usually concealed in grass or shrubs among open habitats. Lesser prairie chickens feed on seeds, catkins, acorns, leaves, buds of forbes, waste grain and insects seemingly preferring grasshoppers.

The current populations occupy <10% of the range occupied prior to the 1900s (Ehrlich 1988). At one time, the birds range likely extended throughout BLNWR and neighboring grasslands.

There have been only 2 documented prairie chicken observations within the refuge, one in May, 1977, and more recently in October, 2005, by refuge manager J. Howland (photographed).

VI. Description of proposed action (attach additional pages as needed):

The proposed actions are to restore portions of the Pecos River channel in separate phases (I and II) within the middle tract of BLNWR, starting in 2008. Phase I (reach 4 only) would probably be conducted first, followed by Phase II (reaches 1, 2, and 3). These actions are an effort to restore a more natural stream morphology and floodplain geometry to the reach of the Pecos River within the refuge in order to benefit native aquatic and riparian plant and animal communities (Comprehensive Conservation Plan, 1998). Additionally, this effort should enhance diversity and productivity of the Pecos River, promoting a dynamic native system for the benefit of the Pecos bluntnose shiner and other native fishes and riparian species. To accomplish this, management prescriptions include the lowering of river banks, removal of vegetation, and restoration of flow into several historic oxbows and floodplain backwaters in conjunction with re-vegetation of native plants. Refuge personnel and/or anyone involved with these projects will not utilize heavy equipment within the current active Pecos River channel (including all phases). The only activity that will occur within the current active channel is the placement of a sediment plug downstream of the Oxbow 4 inlet (refer to section VII-Pecos bluntnose shiner).

This proposed project is broken up into 5 reaches (see attachment 5) which require separate management actions due to current and past morphology/geometry of the floodplain. Detailed management actions for all reaches include:

Reach 1 (parts of sections14, 22, 23, 26, 27 and 34 of T9s, R25E). The proposed action within reach 1 (see attachment 6) includes the lowering of river banks/levees and removal of vegetation thus allowing natural interaction between the river and its floodplain.

With the use of excavators and other heavy equipment, most levees/banks would be lowered allowing for natural movement of an estimated 150 foot wide Pecos river channel. Levees/banks would not be lowered in areas where natural terrace erosion is occurring. These actions would re-connect the restored area during flows greater than 1,200 cfs, as a result enhancing the dynamics of this system. Additionally, non-native vegetation would be removed by use of bulldozers and other heavy equipment by exposing/cutting off root crowns and eliminating trunks from banks/levees. Excess excavated material would be spread throughout the upland area. Saltcedar brush piles would be burned after completion of this project.

Reach 2 (parts of sections 3, 2, 10, and11 of T10s, R25E). The proposed action within Reach 2 includes the lowering of river banks/levees, removal of vegetation, and diversion of the Pecos river into a historic meander, thus restoring approximately 160 acres of Pecos River valley.

With the use of excavators and other heavy equipment, the levees/banks would be lowered allowing for natural movement of an estimated 150 foot wide Pecos river channel. As in reach 1, this action would re-connect the restored area during flows greater than 1,200 cfs, as a result enhancing the dynamics of this system. Non-native vegetation would be removed by use of bulldozers and other heavy equipment by exposing/cutting off root crowns and eliminating trunks from banks/levees.

Additionally (if funding becomes available), a small meander located at the north end of reach 2 (see attachment 7) would be re-connected with the Pecos river channel. Non-native vegetation would be removed by use of bulldozers and other heavy equipment by exposing/cutting off root crowns and eliminating trunks. A 40 foot wide (estimate) pilot channel would be excavated (capable of maintaining flows of 300cfs) prior to removal of the current sediment plug at north end of the meander.

Additional actions pertaining to all projects within reach 2 include the burning of saltcedar brush piles and the spread of excess excavated material taken from banks, levees, and plugs throughout the surrounding uplands.

Reach 3 (parts of sections 14, 15, 21, and 22 of T10s, R25E). The proposed actions within reach 3 includes the lowering of banks/levees, removal of vegetation, and re-connection of oxbow 1999, thus restoring approximately 260 acres of Pecos River valley.

The activities outlined within reach 2 would be conducted simultaneously with this action in order to maximize funding/resources. Non-native vegetation would be removed by use of bulldozers and other heavy equipment thus exposing/cutting off root crowns and eliminating trunks from banks/levees. These levees/banks would also be lowered allowing for natural movement of the estimated 150 foot wide Pecos river channel. Use of heavy equipment would not occur within the current river channel. Excess excavated material from the levees/banks would be spread throughout the upland area or used as additional buffer against erosion events (block releases) which could scour toward areas of refuge concern.

Additionally, oxbow 1999 (see attachment 8) would be reconnected as back water habitat at flows greater than 100 cfs. Non-native vegetation would be removed by use of bulldozers and other heavy equipment thus exposing/cutting off root crowns and eliminating trunks. An estimated 40 foot wide pilot channel would be excavated (capable of maintaining flows of 300cfs) prior to removal of the current sediment plug at the north end of oxbow 1999.

Additional actions pertaining to all projects within reach 3 include the burning of saltcedar brush piles and the spread of excess excavated material taken from banks, levees, and plugs throughout the surrounding uplands.

Reach 4 (parts of sections 27 and 28 of T9s, R25E). The proposed action within reach 4 (see attachment 9) includes the plugging and diversion of the Pecos river into a portion of an historic oxbow (meander 4) thus excavating a new oxbow channel, removing non-native vegetation, lowering banks/levees, and re-vegetating native flora.

With the use of bulldozers, excavators, and other heavy equipment, a ditch would be excavated amid select areas of the historic oxbow in order to drain spring/seep water currently held within meander 4. When the oxbow dries enough for safe entry of heavy equipment, a pilot channel (approximately 12 feet bottom width and 44 feet top width, between 3-8 feet in depth) within meander 4 would be excavated either through or slightly east of the historic channel eventually re-connecting with the current main stem of the river at the historic (meander 4) outflow location. As outlined within the Draft E.A. (2007), the combined width of the channel and floodplain

would be excavated to be at least 350 feet. This minimum width provides room for a 150-foot-wide channel and adequate floodplain. The terrace may need to be excavated in some spots to create a 350-foot-wide floodplain. The new channel would replace approximately 3000 feet of the current incised channel with approximately 7000 feet of new channel within or adjacent to the historic oxbow.

Since the oxbows within reach 4 were formed prior to upstream/downstream dam construction, the banks and levees would be lowered by means of bulldozers, excavators, and other heavy equipment. This action would compliment the current river hydrology corresponding to a water surface elevation of 1,200 cfs. Non-native vegetation such as salt cedar and Russian olive *(Elaegnus angustifolia)* would be removed up to 2,500 feet from the oxbow channel and river banks. Non-native invasive plants would be removed utilizing a bulldozer by exposing/cutting off its root crowns, and eliminating trunks. Native vegetation would be left in place, and brush piles burned. Some dead brush may be used to create slow water habitat and shelter for fish species such as the Pecos bluntnose shiner.

With the use of heavy equipment, the incised section of the river would then be plugged approximately 250 meters down river of the meander 4 historic oxbow entrance. At the same time, the oxbow entrance would be opened in order to connect the current river channel with the excavated pilot channel. Material excavated from the meander 4 pilot channel and/or taken from the dredge piles adjacent to the current incised river channel would be used as plug material. Excess excavated material would be spread throughout the upland area or used as additional buffer against erosion events (block releases) which could scour toward areas of refuge concern. In addition, rip-rap would be buried by use of backhoe, dump truck, and other heavy equipment at the northwestern and southwestern most bend of meander 4, in order to protect the refuge tour loop road, wetland impoundments, and a population of Pecos puzzle sunflowers. This action requires the digging of three ditches (up to 300 feet long and 15 feet wide, as directed by engineers) radiating eastward from the tour road, and two ditches (up to 300 feet long by 15 feet wide, as directed by engineers) extending northeast from the sunflower population. These ditches would be filled with rip-rap and re-covered with earth. Additionally, native plant species such as honey mesquite *(Prosopis glandulosa)* would be planted along buried rip-rap beds in order to provide an aesthetically pleasing buffer against erosion.

The result of these actions would also create backwater habitat within the current incised river channel that should benefit native fishes, waterfowl, and insects/invertebrates.

After completion of this project, the Service is proposing to develop an auto loop pullout, trail, viewing platform, and interpretive site on the west side of meander 4 when funding becomes available. This trail would be created along the buried rip-rap jetties extending up to the rivers edge where a viewing platform would be constructed. Interpretive signs would be set in place for public use.

Reach 5 (parts of sections 33 and 34 of T10s, R25E, and sections 4 and 3 of T11s, R25E). There are no actions proposed for this reach (attachment 10). Monitoring of effects from upstream restoration actions may occur.

VII. Determination of Effects:

A. Explanation of effects of the action on species and critical habitat in items III A, B, and C (attach additional pages as needed):

Southwestern willow flycatchers are not known to nest along the Pecos River drainage in New Mexico, though they have been observed migrating through BLNWR. This action may benefit SWIFL's during migration, thus providing an increased diversity of prey items throughout the Pecos River after saltcedar has been successfully removed from the system, and native vegetation persists and recovers. The effort should benefit this species due to increased available acreages of native riparian habitat, providing additional willow baccharis *(Baccharis salicina)* and sandbar willow *(Salix exigua)* stands that should harbor flycatcher prey items. There are no nesting SWIFL pairs within 150 miles of any proposed action, therefore only positive effects are expected from this action.

Interior least terns may benefit from this action. Dead saltcedar stands (including brush piles), once burned, will not harbor striped skunks or raccoons, which are potential predators of nesting terns. The action should enhance tern prey (fish and invertebrate) abundance and/or accessibility. It is hoped that saltcedar removal and increased floodplain habitat will ultimately increase native fish populations by improving the quantity and quality of refuge waters. There are no nesting tern colonies within 330 yards of any proposed action, therefore no negative affects are expected from this action.

The areas to be restored along the Pecos River may provide additional feeding/loafing areas for the interior least tern among backwater areas and small sandbars (sandbars usually do not extend beyond 20 feet from rivers edge). Since interior least terns here at Bitter Lake Refuge nest primarily on large vegetatively challenged playa lake/salt flats, it is highly unlikely that they will relocate to additional small sandbars (unsuitable for least tern nesting) along the Pecos River which should occur as a result of this project. These additional sandbars should be similar to the existing sandbars currently located along nearby stretches of river, in which no tern nesting activity has been documented. In order to monitor least tern activity along the Pecos River within these restored areas, Refuge personnel/volunteers will conduct a weekly tern survey to document tern use of the restored river channel during their active breeding season (May - August).

Pecos gambusia may benefit from this action. Further removal of saltcedar from the Pecos River drainage should increase spring flow and quantity and quality of fish habitat within surrounding systems. Since Pecos gambusia requires unique clear spring-head and/or sinkhole habitats and there is no suitable habitat within the action area, these actions should not negatively affect this species.

Pecos bluntnose shiners should benefit from this action. The Pecos River is a very dynamic, disturbance prone system that the shiner is adapted to. Such restoration actions would allow these reaches of river to progress into a continuous meandering system exhibiting sandy substrates, and low velocity laminar flows favorable to the Pecos bluntnose shiner.

The actions within reach 4 would create additional shiner habitat (approximately 7,000 feet) that is far more favorable for shiner use than that of the current incised channel. After re-connection

of meander 4, the incised channel would likely be utilized as a nursery/breeding backwater for the shiner during high flows. Alterations of reaches 1, 2, and 3 would also influence the ever-changing river to create plunge-pools, backwater, and open water areas providing optimal shiner habitat.

Additionally, this fish species is adapted to block releases and storm events culminating in flows greater than 3,500 cfs in which the increased turbulence results in additional sediment loads carried throughout the water column. It is believed that increased sediment loads due to disturbances created by these actions would not negatively affect shiners currently residing downstream of the proposed action area. In support of this, sediment and water samples were taken from several locations within Oxbow 4 in order to screen for PCBs, pesticides or toxic metals. (Refer to attachment 11-*certificate of analysis*). All sample results exhibited no PCBs or pesticides present. The water sample had trace amounts of arsenic (0.090ug/L) and barium (0.021ug/L). The sediment samples had concentrations of arsenic (~100mg/kg), and chromium (~9mg/kg). These concentrations are at or below average New Mexican background concentrations for these elements (Refer to attachment 12). As stated by contaminants biologists of the U.S. Fish and Wildlife Service Ecological Services Field Office, "the sediments that these samples represent would NOT likely pose a risk to aquatic life, nor to any endangered species should they be disturbed during proposed restoration efforts in Oxbow 4" (see attachment 13).

Additional efforts will be implemented in order to limit negative effects to the Pecos bluntnose shiner. Service personnel will set up nets (barriers) approximately 200 feet upstream and downstream of the sediment plug site (approximately 250 meters downstream of the meander 4 inlet), during a time when the river flow is below 50 cfs. Personnel will then seine the enclosed site in order to remove fish from that area. Native fish (including bluntnose shiners) will then be quickly identified and measured prior to being placed into buckets where they will only remain for a few minutes during transport upstream of the enclosed area. This effort will ensure that Pecos shiners do not get buried beneath the sediment plug.

After the plug is in place and water is diverted into the oxbow 4 (meander 4) channel, service personnel will search the river below the plug to locate and seine isolated pockets/holes occupied by shiners that may become stranded due to these actions. Any Pecos bluntnose shiners captured will again be quickly transported and released upstream of the sediment plug. Since the section of river channel below the plug will still be connected to the outflow of oxbow 4 (i.e. the new location of the Pecos River), we do not anticipate complete drainage of this section of the former channel. In fact, it is believed that a backwater area will be created thus providing a nursery for native fish species including the shiner.

Pecos puzzle sunflower should benefit from this action. Saltcedar competes with the sunflower for space, light, moisture and nutrients. Sunflowers often establish themselves beneath the former canopy of saltcedars once it has been top-killed by fire or otherwise removed. Gradually reduced soil salinities, as a result of saltcedar removal, should also promote the germination and growth of sunflowers.

Currently there is one population of Pecos sunflowers (including critical habitat) bordering unit 17, located southwest of the Oxbow 4 channel reconnection project. This population is in line with the projected erosion footprint of meander 4 if/when restoration efforts are completed. In

order to avoid negative impacts to these Pecos sunflowers, two or three 150 foot by 4 foot (estimate) jetty structures will be set in place in order to block and re-route the river away from this sunflower stand. Construction of these jetties will occur outside of the designated Pecos sunflower critical habitat. Prior to use of heavy equipment near sunflower critical habitat, refuge staff will search for and flag any individual sunflower plants that could be affected by such work. Equipment operators will then be notified of sunflower locations and instructed to avoid any disturbance to the marked plants/areas.

Koster's springsnail, Noel's amphipod, Roswell springsnail, and Pecos assiminea may benefit from this action. The removal of saltcedar along the river should increase water quantity and quality in the springs/ditches in surrounding areas, upon which all four species depend. Increasing spring flows to more historic levels may allow populations to expand into presently unoccupied habitat.

Since none of these species occur within 833 yards of any proposed action, it is believed that no adverse effects would occur to any of the four species above.

Lesser prairie chickens occur rarely at BLNWR. In most cases, refuge habitat does not correlate to desirable prairie chicken habitat due to a taller grassland component and lack of desirable seed, acorn, catkin, forbe, and grain sources. Prairie chickens are not associated with riparian habitats within the refuge, and are not expected to be affected at all by these actions.

B. Explanation of actions to be implemented to reduce adverse effects:

A jetty (up to300 feet long and 15 feet wide) would be buried beneath the ground, buffering potential erosion of the unit 17 Pecos sunflower critical habitat from the effects of phase I (meander 4) restoration project. Individual sunflower plants will be flagged and avoided during construction of jetty structures near unit 17 critical habitat.

The burning of saltcedar brush piles/standing dead trees will be conducted during the winter (November– February), prior to germination of Pecos puzzle sunflowers and after plants have dried/dropped seeds.

No human activity (including this action) will take place near least tern nesting colonies or populations of Koster's springsnails, Noel's amphipods, Roswell springsnails, and/or Pecos assimineas.

Personnel will enclose the area of Pecos River that will be filled with sediment, in order to remove Pecos bluntnose shiners from harm by relocating them upstream, outside of the action area. Personnel will search out and seine Pecos bluntnose shiners from river pockets that become isolated due to the Oxbow 4 diversion plug and relocate seined fish upstream of the sediment plug.

VIII. Effect determination and response requested: [* = optional]

A. Listed species/designated critical habitat:

Determination	Response Requested
No effect: **Southwestern willow flycatcher**	✓ Concurrence
May affect: not likely to adversely affect species: **Interior least tern**	✓ Concurrence PZ
No effect: **Pecos gambusia**	✓ Concurrence MTM
May affect: not likely to adversely affect species: **Pecos bluntnose shiner**	✓ Concurrence MTM
May affect: not likely to adversely affect species/critical habitat: **Pecos sunflower**	✓ Concurrence PZ
No effect: **Koster's springsnail**	✓ Concurrence MTM
No effect: **Noel's amphipod**	✓ Concurrence MTM
No effect: **Roswell springsnail**	✓ Concurrence MTM
No effect: **Pecos assiminea**	✓ Concurrence MTM

B. Proposed species/proposed critical habitat:

C. Candidate species:

No effect: **Lesser prairie chicken**	✓ Concurrence

Amy M. Howland 9/23/08

Signature Date
Refuge Manager, Bitter Lake NWR

IX. Reviewing ESFO Evaluations:

A. Concurrence: ✓ Nonconcurrence: _____

B. Formal consultation required: _____

C. Conference required _____

D. Informal conference required _____

E. Remarks (attach additional pages as needed): Consultation # 22420-2008-I-0100

E. W. A. 10/21/08

Acting Field Supervisor

Signature Date
[Title/office of reviewing official]

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