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.

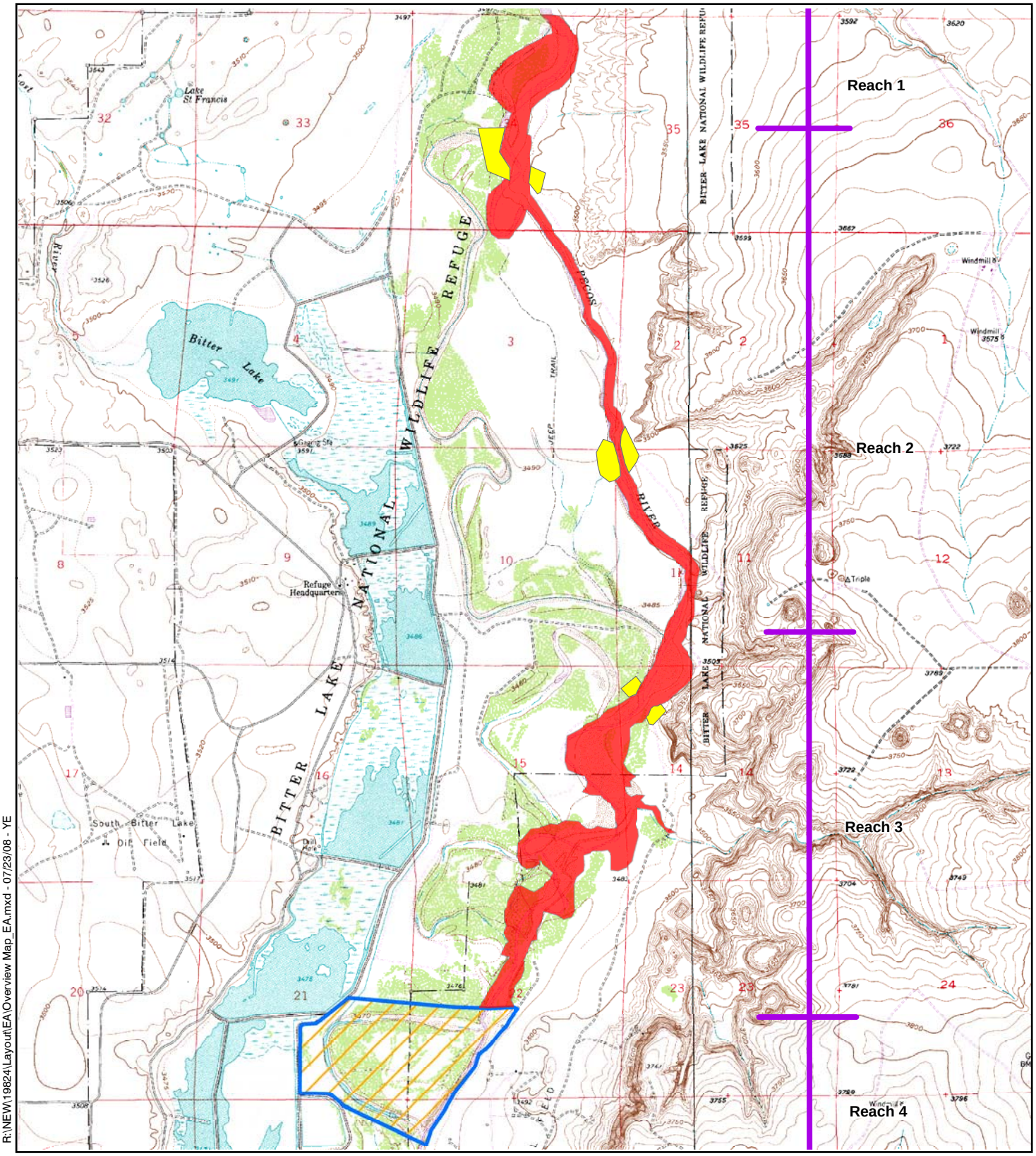
2.1 Background

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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Tetra Tech, Inc

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.

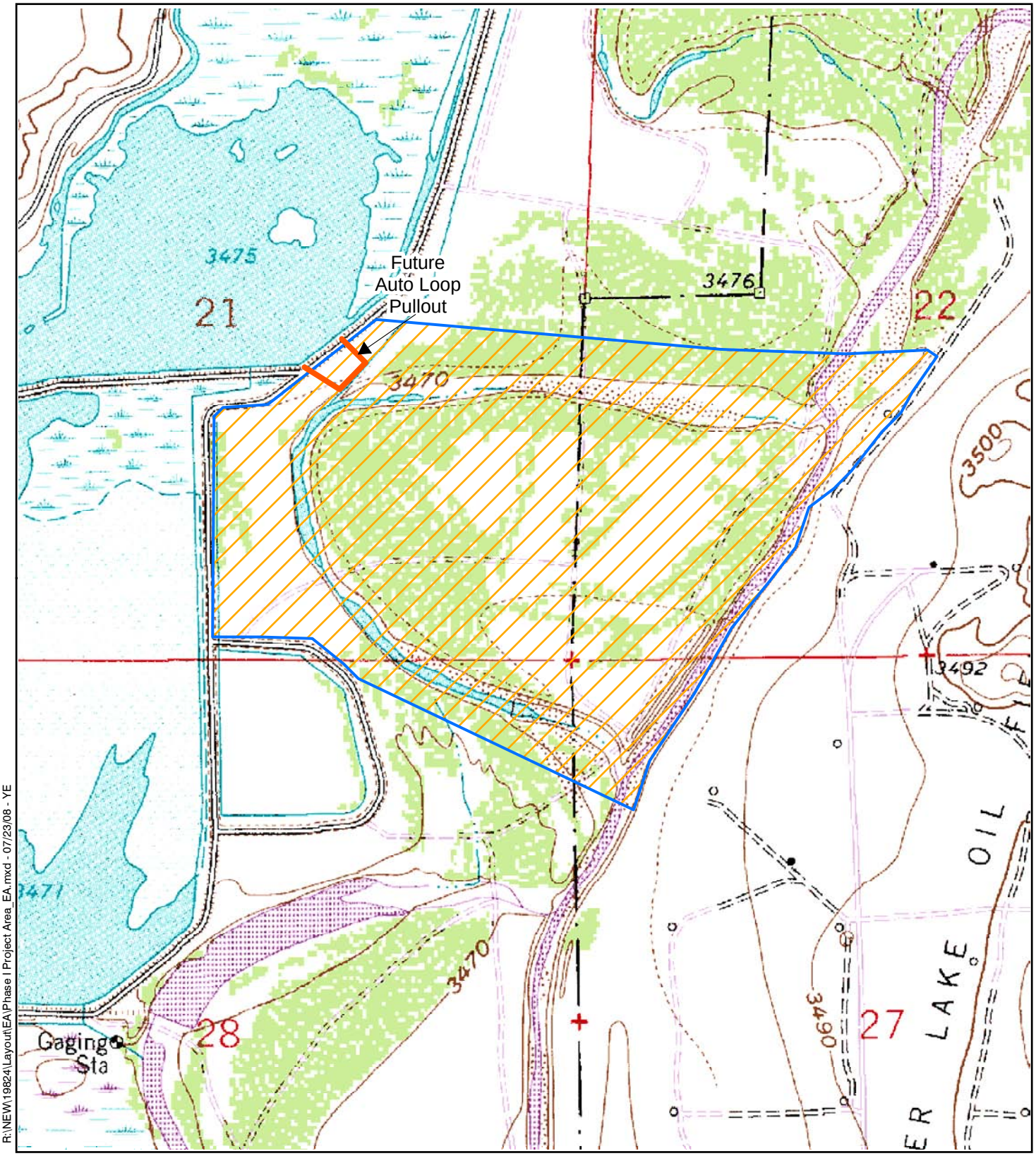
2.3.1 Phase I Restoration

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

Phase I Project Area - Bitter Lake National Wildlife Refuge

Chaves County, New Mexico

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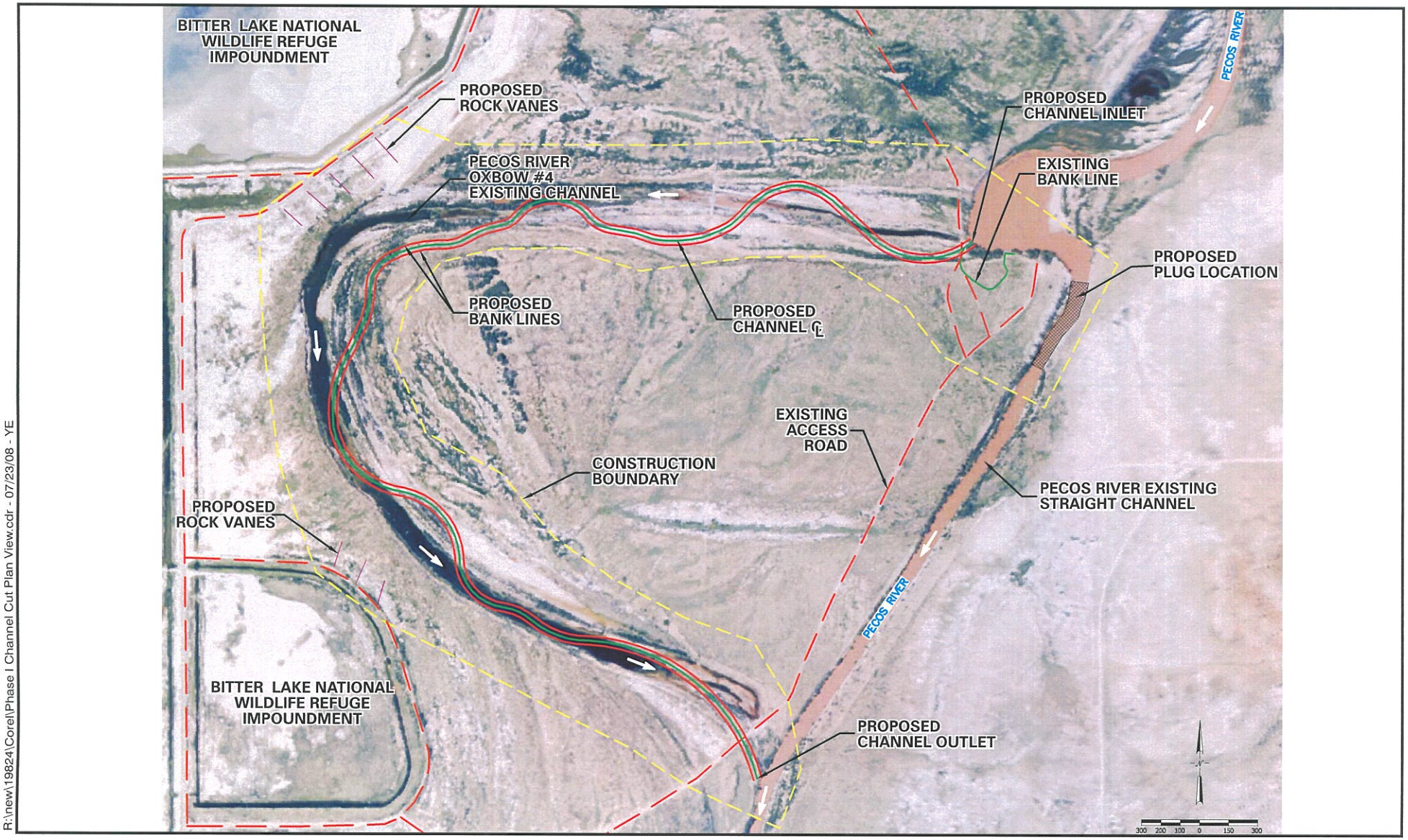
Tetra Tech, Inc

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.