FINAL

DETAILED PROJECT REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

SECTION 1135

LAS CRUCES DAM ENVIRONMENTAL RESTORATION PROJECT

JUNE 2011

US Army Corps
of Engineers

Albuquerque District
South Pacific Division

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U.S. ARMY CORPS OF ENGINEERS
ALBUQUERQUE DISTRICT

FINDING OF NO SIGNIFICANT IMPACT
for the

LAS CRUCES DAM ENVIRONMENTAL RESTORATION PROJECT
LAS CRUCES, NEW MEXICO

Under the authority of Section 1135 of the Water Resources Development Act of 1986, the U.S. Army Corps of Engineers (Corps) proposed to implement the Las Cruces Dam Environmental Restoration Project (Project). The Project would include the restoration of 72 acres of Chihuahuan Desert Arroyo Riparian habitat, 3.6 acres of playa habitat, 6.35 acres of Cottonwood-Willow Riparian habitat, and the construction of two one-acre emergent wetland cells. The proposed action also includes the implementation of recreational features such as new trail systems, improvements to existing trails, pedestrian crossings, interpretative signage, and wildlife viewing blinds.

Studies for the Project began in 2009, and a scoping letter was sent in November 2009 to all relevant Federal, State and local agencies, as well as a number of non-governmental organizations and miscellaneous other stakeholders with ongoing studies in the Las Cruces Dam flood pool area. A public meeting was held on May 19, 2010.

Alternatives considered include a number of solutions throughout this geographic area. Each solution consisted of a variety of measures. The proposed restoration measures were combined into alternative restoration plans (or "project alternatives") for subsequent comparison, evaluation, and decision making. Alternative plans range from doing nothing (the No Action Plan) to the Do All Plan, which includes all measures. Project alternatives were analyzed for cost-effectiveness and incremental benefits gained. The Tentatively Selected Plan was the first efficient plan that met the study objectives.

If the planned action did not occur, long-term restoration of the ecosystem functions of this area could not be achieved. Future without-project conditions would reflect the opposing trends of vegetation recruitment and habitat degradation. Overall, there would be a slight increase in the quantity of native arroyo and cottonwood riparian habitat. However, the expected increase in arroyo riparian would not occur in all areas, and would not occur as quickly as it would if the project were implemented.

The proposed project is regulated under the provisions of Section 404 of the Clean Water Act (CWA) and is authorized under Nationwide Permit No. 27 for Aquatic Habitat Restoration, Establishment and Enhancement Activities and Nationwide Permit 12 for Utility Line Activities. Because the proposed action meets the conditions of these Nationwide Permits, the 404(b)(1) analyses have already been completed and additional 404(b)(1) analysis is not required. All conditions under the permits would be adhered to during construction. A Water Quality Certification Permit under Section 401 would be

obtained prior to any proposed work and all conditions would be followed. All Best Management Practices described throughout the document would be adhered to during project implementation.

The planned action would result in only minor and temporary adverse impacts on air quality, land use, soils, aesthetics, vegetation, wildlife, recreational resources, and noise levels during implementation. The long-term benefits of the proposed project would outweigh these short-term adverse impacts. The following elements have been analyzed and would not be significantly affected by the planned action: socioeconomic environment, hydrology and hydraulics, climate change, water quality, noise levels, floodplains, wetlands, waters of the United States, biological resources, endangered and threatened species, prime and unique farmland, and cultural resources.

The proposed action has been fully coordinated with Federal, Tribal, and local governments with jurisdiction over the ecological, cultural, and hydrological resources of the study area. Based upon these factors and others discussed in detail in the Detailed Project Report/ Environmental Assessment, the proposed action would not have a significant effect on the human environment. Therefore, an Environmental Impact Statement will not be prepared for the conduct of the subject project.

12 JUL 2011
Date

Jason Williams
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***SECTIONS THAT FULFILL NEPA REQUIREMENTS FOR AN EA.**

ADDENDUMS

1. INTRODUCTION

1.1. *Study Authority

This study is being conducted under the authority of Section 1135 of the Water Resources Development Act (WRDA) of 1986 as amended by Section 204 of WRDA of 1996, (Public Law 104-303), which reads in part:

> *(1) IN GENERAL- if the Secretary determines that construction of a water resources project by the Secretary or operation of a water resources project constructed by the Secretary has contributed to the degradation of the quality of the environment, the Secretary may undertake measures for restoration of environmental quality and measures for enhancement of environmental quality that are associated with the restoration, through modifications either at the project site or at other locations that have been affected by the construction or operation of the project, if such measures do not conflict with the authorized project purposes.*

Las Cruces Dam was constructed by the U.S. Army Corps of Engineers (USACE) in 1975 to reduce flood damage to structures in the City of Las Cruces from several arroyos draining the foothills of the Organ Mountains. The flood reduction project was authorized under the Flood Control Act of 1962, Public Law 87-874, Section 203. The dam is owned and operated by the City of Las Cruces.

In July 2005, USACE completed an initial Preliminary Restoration Plan to evaluate the Federal interest in pursuing an ecosystem restoration study in the flood pool of the Las Cruces Dam. The feasibility phase was started in 2006 and continues to present.

1.2. *Study Purpose and Scope

The Las Cruces Dam Environmental Restoration Study is being conducted by the USACE, Albuquerque District, and the City of Las Cruces. The purpose of the study is to determine the Federal interest in the implementation of an ecosystem restoration project in the flood pool area of Las Cruces Dam. This study will identify ecosystem restoration and incidental recreation alternatives that are technically feasible, economically practicable, environmentally sound, and publicly acceptable. The study focuses on environmental restoration measures to improve structure and function of the Chihuahuan Desert riparian ecosystem within the study area. Degradation of the riparian habitats within the study was caused in part by construction and operation of the Las Cruces Dam as described in section 1.3, below. The City of Las Cruces, as the non-Federal sponsor, supports the proposed project purposes.

1.3. *Study Area

The study area is located on approximately 500 acres in the flood pool behind the Las Cruces Dam (Figure 1.2). Las Cruces Dam is located along the east side of Interstate 25 (I-25) in the northeast quadrant of the City of Las Cruces in southern New Mexico. The Las Cruces Dam

itself is approximately 15,570 feet long, with a maximum height of 67 feet. The dam is designed to pass all flows, through a single, non-gated outlet structure.

The drainage area upstream from Las Cruces Dam is approximately 29 square miles, and the watershed extends upstream in a northeasterly direction approximately 11 miles into the foothills of the Organ Mountains. The watershed elevations range from 4,100 feet in the vicinity of Las Cruces Dam to 8,400 feet in the Organ Mountains. The dam currently terminates the paths of four primary arroyos that historically passed through the existing reservoir pool area. Alameda Arroyo is the largest and northernmost arroyo. The North and South Fork Arroyos enter the south side of the reservoir pool immediately upstream of the point where the arroyos formerly converged to form the main branch of Las Cruces Arroyo. The Little Arroyo enters the reservoir pool at its southern edge. Figure 1.1 displays the Las Cruces Dam watershed and the four arroyos that contribute to the reservoir pool area. Figure 1.2 shows the Las Cruces Dam reservoir pool.

The Las Cruces Dam is designed and operated as a 'dry dam', that is, the dam does not impound water permanently and remains dry except during large rain events. Under New Mexico water law, all detention structures are required to pass all detained water within 96 hours of capture or are subject to the need to acquire water rights. Flood water is detained in the pool and released slowly through a single ungated outlet structure into Alameda Arroyo. Alameda Arroyo, the Las Cruces Arroyos, and Little Arroyo are connected through the reservoir basin by a 50-foot-wide conveyance channel. Water entering the basin from the Las Cruces Arroyos and Little Arroyo flows north along this channel to the outflow structure.

The project area is located within the Chihuahuan Desert ecoregion. Vegetation communities vary with altitude, soil type and moisture, slope aspect, and topographic position. The typical upland plant community matrix in the study area consists of Chihuahuan Desert scrub species such as creosote bush, white-thorn acacia, honey mesquite, soaptree yucca, and prickly pear cactus. Riparian species found along ephemeral streams or arroyos include upland species growing in a larger, more vigorous form as well as species dependent on the arroyo hydrology. At the elevation of Las Cruces Dam, these species include four-wing saltbush, desert willow, little-leaf sumac, brickellia, burrobrush, and apache plume. Riparian species associated with permanent water courses such as the Rio Grande include cottonwood, coyote and black willow, New Mexico olive, wolfberry and screwbean mesquite. Permanent water sources such as springs and seeps, supporting herbaceous wetland plant communities, are rare in the Chihuahuan Desert and do not currently exist within the project area. The proposed project goal is to increase the amount and quality of these riparian and wetland plant communities and the animals they would support. Small mammal species currently in the study area include several species of pocket mice, deer rats, woodrats, kangaroo rats, jackrabbits, ground squirrels, and skunks. Historically, larger mammals such as mule deer, javelina, and mountain lion traveled the riparian corridors associated with the arroyos from the Rio Grande to the Organ Mountains. More than 80 species of birds have been observed in the area, and many of the birds are migrants. A Federal species of concern, the Western Burrowing Owl, is known to live and breed in the study area.

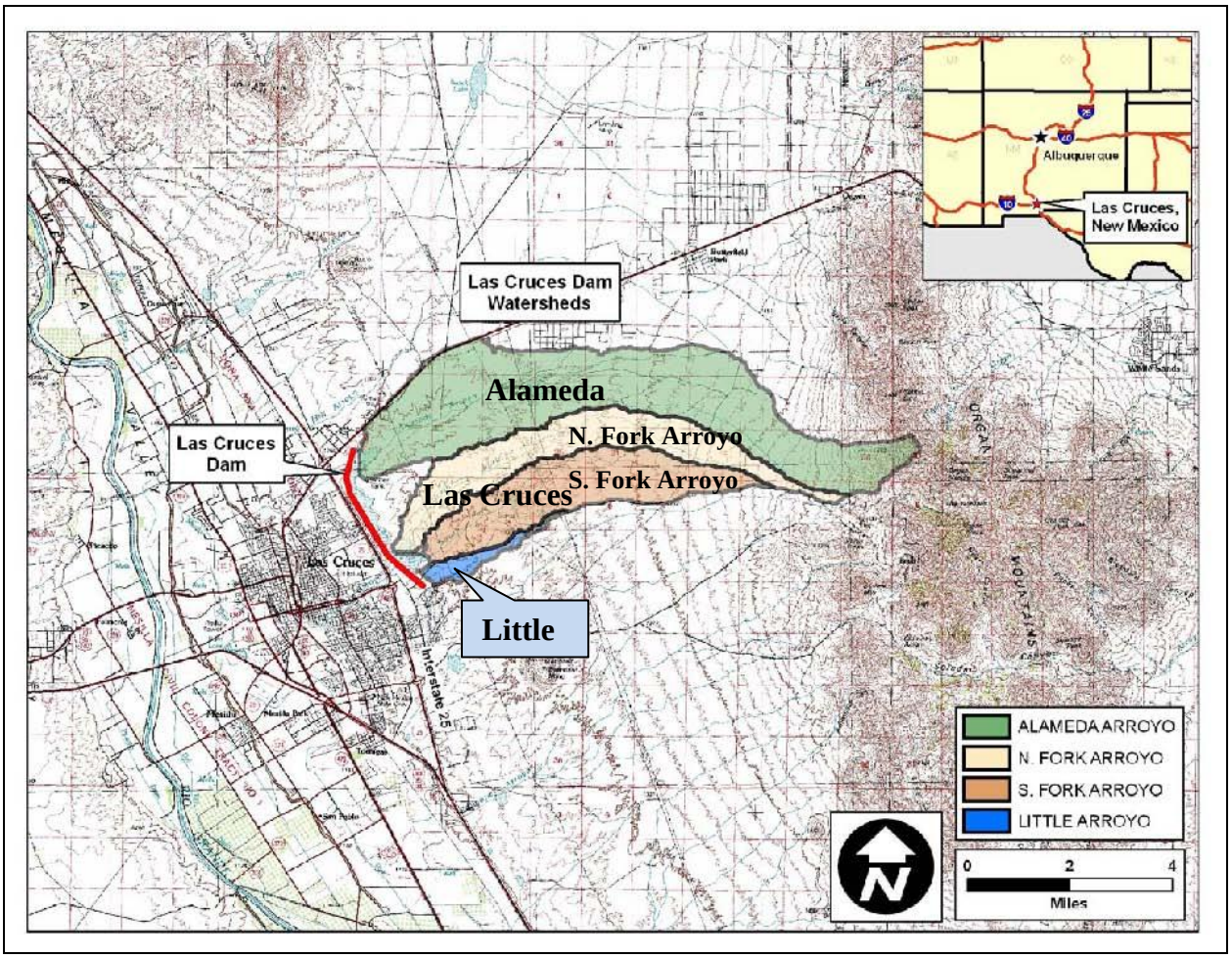

Figure 1.1 - Las Cruces Dam Watershed

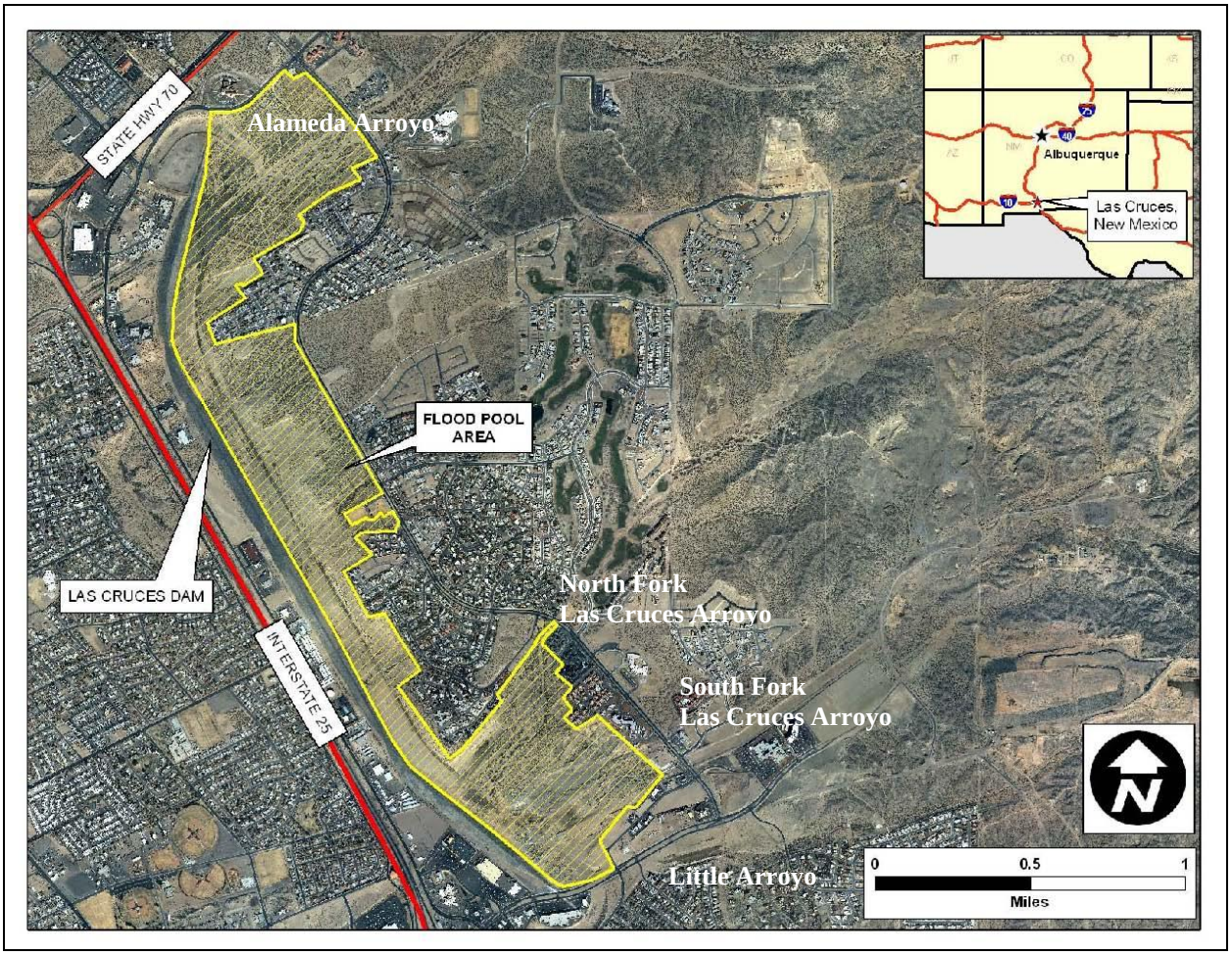

Figure 1.2 - Las Cruces Dam and Reservoir Pool

1.4. *Need for the Project/Proposed Action

The Chihuahuan Desert is recognized as one of the most biologically diverse ecoregions in the world (Dinerstein et al., 2000; Pronatura Noreste et al., 2004). The riparian habitats found within the Chihuahuan Desert contribute greatly to this diversity. Wetlands along the Rio Grande consist of marshes, wet meadows, and seasonal ponds that typically support hydrophytic plants such as cattails, sedges, and rushes (Stotz, 2000). Historical descriptions of the lower Rio Grande in the reach including the Mesilla Valley indicate that the largest floodplain habitat type was wet meadow and floodplain grass communities. High groundwater and/or periodic inundation of the floodplain, processes that create and sustain wet meadows, would have been common throughout much of this reach prior to the installation of the river levee and agricultural drain systems (Fullerton and Batts, 2003).

Wetlands are an integral component of the Rio Grande ecosystem, not only increasing diversity but also enhancing the value of surrounding plant communities for wildlife. Wetlands have experienced the greatest historical decline of any Rio Grande floodplain plant community. From 1918 to present, wetland-associated habitats have undergone a 93% reduction (Hink and Ohmart, 1984; Scurlock, 1998). Among the greatest needs of the Rio Grande riparian ecosystem are the preservation of existing wetlands and expansion or creation of additional wetlands (Crawford *et al*., 1993). The proposed project would restore and create wetlands similar to those described here.

Other perennial wetlands found in southern New Mexico include marshes or ciénegas, springs, and seeps. Ciénegas occur as geographically isolated wet depressions or seeps that are hydrologically supported by seasonal discharge of shallow groundwater aquifers and springs. These areas collect and hold water, supporting marsh emergents (moisture-loving plants with growth emerging from the water), soils, and wildlife, including many Chihuahuan desert endemics (Dinerstein et al, 2000). Ciénegas, spring seeps and perched wetlands provide unusually persistent and long-lived wetlands (NMDGF, 2006). Little is known about the distribution and abundance of these habitats in New Mexico today; however, loss of these wetland habitats has been well documented (Sivinski, in press). Primary threats to these habitats include degradation from livestock or introduced species and groundwater withdrawal.

Among the greatest needs of the riparian ecosystem are the preservation of existing wetlands and expansion or creation of additional wetlands (Crawford *et al*., 1993). Within the Chihuahuan desert, restoration or creation of wetland habitats is especially important due to their scarcity. Likewise, availability of surface water and greater demands for both surface and groundwater make wetland restoration and creation especially challenging in the desert. Any opportunity to provide these critical habitats should be taken advantage of.

Arroyo riparian habitats are vegetatively diverse in structure and species assemblage (Kear, 1991; Jorgensen and Demarais, 1996). Shrub canopy cover along arroyos is more than twice that found on adjacent uplands (Jorgensen, 1996). This diversity supports a significantly more diverse bird assemblage than those associated with uplands (Johnson et al., 1977; Szaro and Jakle, 1985). Riparian habitat in Arizona contained twice as many breeding birds compared to the adjacent bajada (Stevens et al., 1977).

Based on floral characteristics, arroyos comprise only 2% to 4% of the landscape in the Chihuahuan Desert (Henrickson and Johnston, 1986). Historically, both forks of the Las Cruces Arroyo and Alameda Arroyo meandered across the landscape from the base of the Organ Mountains to the Rio Grande, providing valuable riparian habitats to the area.

Construction of Las Cruces Dam and urbanization of the watersheds of the Alameda and Las Cruces Arroyos have disrupted flow paths and riparian corridors, altered the hydrology, and directly removed or degraded habitats along these arroyos and tributaries. The dam terminates the paths of Alameda Arroyo, the North and South Forks of Las Cruces Arroyo, and Little Arroyo, which historically passed through the location of the existing reservoir pool. Prior to urbanization, arroyos flowed west past the current location of the dam and continued approximately 4.5 miles to the Rio Grande. Currently, Alameda Arroyo below the dam

functions as a stormwater drain consisting of an earthen or concrete trapezoidal channel with virtually no vegetation. For these reasons, the riparian corridors that these arroyos support are terminated at Las Cruces Dam.

Las Cruces Dam and encroaching development areas that cross the historic floodplain have also bisected wildlife corridors that once led from the Rio Grande into the Organ Mountains and connected several arroyo systems. Natural riparian corridors downstream of Las Cruces Dam are non-existent due to agriculture and urban development prior to the dam construction. Commercial and residential development upstream of Las Cruces Dam has occurred in the last 20 years and encompasses approximately 3.5 square miles of the Las Cruces and Alameda Arroyo watersheds. Through this area of development, Alameda Arroyo has remained largely unconstrained; however, various activities have impacted the riparian zone of both forks of Las Cruces Arroyo.

Urbanization of the surrounding area has had an adverse effect on this riparian corridor. The area of impermeable surfaces has increased dramatically and caused increased flows in the arroyos and downcutting of the channels, especially in areas where the native vegetation has been damaged or removed. Because the basin behind the Las Cruces Dam is relatively flat, sediment entering the basin from the major arroyos, as well as from small flow paths of stormwater outfalls, is trapped in the basin.

Soil used to construct the dam was excavated from what is now the flood pool, leaving nearly 400 acres of denuded landscape. Attempts to revegetate these areas with native seed have not been successful, and much of the disturbed area remains poorly vegetated 35 years later. Sand and gravel mining in one parcel within the flood pool basin has left nearly 30 acres of disturbance in the study area. Several shrub species have colonized new sediment deltas formed at the mouth of arroyos. These areas exhibit sufficient shrub density and complexity to provide functional wildlife habitat; however, the areas lack the diversity of shrub species found in high-quality arroyo riparian habitats.

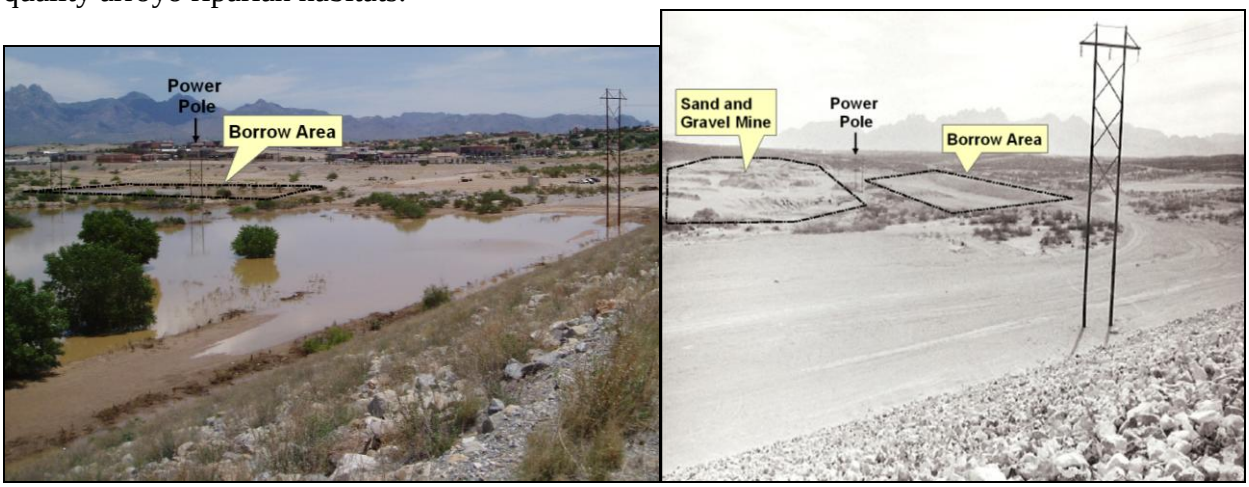

Figure 1.3 - Photos of the flood pool from 1975 at completion of dam construction (Black and white) and in 2005 (color). The borrow area designated in the photos in near the outlet of the south fork of the Las Cruces Arroyo.

Figure 1.4 - Photos taken of the flood pool basin near the outlet of the Alameda Arroyo from 1975 at completion of dam construction (Black and white) and in 2005 (color). The outlets structure seen in the 2005 photo is located out of picture to the right in the 1975 photo.

Due to the degradation of the riparian environment of the Las Cruces and Alameda arroyos caused by construction of the Las Cruces Dam the study is well suited for the restoration authority provided in Section 1135 of the Water Resources Development Act (WRDA) of 1986 (Public Law 99-662). The authority also provides the opportunity to remedy habitat degradation caused by nearby development.

1.5. Planning Process and Report Organization

The feasibility phase of the Las Cruces Dam Environmental Restoration Project follows the USACE six-step planning process specified in Engineering Regulation (ER) 1105-2-100, *Planning Guidance Notebook*. The process is used to identify and respond to problems and opportunities associated with the Federal objective and specific state and local stakeholder concerns. The process also provides a rational framework for problem solving and sound decision making.

The feasibility phase serves as the basis for approving a specific project for construction and, as such, documents the planning process followed to determine the Tentatively Selected Plan. This report is organized to follow the planning process. Chapter 1 includes problems and opportunities; Chapters 2 and 3 contain the inventory and forecast of the existing and future without-project resource conditions; Chapter 4 describes the formulation, evaluation, and comparison of alternative plans and the selection of the Tentatively Selected Plan; and Chapters 5 through 9 describe the Tentatively Selected Plan in greater detail.

2. *EXISTING ENVIRONMENTAL SETTING

2.1. Physiology, Geology and Soils

2.1.1. Regional Geology & Regional Structures Setting

The Organ and San Andres Mountains in south-central New Mexico are part of a 150-mile-long, west-tilted fault block extending from El Paso, Texas, northward to central New Mexico. During the mountain-building Laramide orogeny in the early Cenozoic Era, Precambrian, Paleozoic, and Cretaceous rocks were deformed along the faulted margins of a basement-cored block uplift, which was ancestral to the Organ-San Andres range. An early Tertiary Fanglomerate records the erosional "unroofing" of the Laramide uplift and was sharply deformed as uplift progressed. Block faulting is thought to persist through the late Tertiary. Subsequent uplift of the modern ranges involved an early stage of closely spaced faulting associated with moderate west tilting or locally east downwarping. Some faults, initially steep, were rotated into low-angle positions as tilting progressed. The more recent stage of uplift is distinguished by development of the modern, widely spaced range-boundary faults and their associated horsts, west-tilted blocks, and grabens. Movement on the eastern range-boundary fault of the Organ and southern San Andres fault block has persisted to within the last 4,000 to 5,000 years (Seager et. al., 1975).

2.1.2. Site Geology

The project site is underlain by alluvial fan and slope colluvium deposits. Up to several hundred feet of alluvium is likely present. These deposits are composed mostly of fine-to-coarse sand, silt, and gravel with some clay. Erosion of the coarse granite of the Organ Mountains has produced the large quantities of arkosic sand and gravel found in the alluvial fan deposits. In general, alluvial deposits closest to the mountains are coarse grained whereas deposits farther from the mountains are finer grained. However, due to the nature of erosion and deposition, fine- and coarse-grained materials are found interbedded in the project area.

2.1.3. Soils

Subsurface materials on site are almost entirely classified as silty sand (SM) in accordance with ASTM D 2487, *Standard Practices for Classification of Soils for Engineering*. Other materials found on site include poorly graded sand with silt (SP-SM) and low-plasticity clay (CL). Standard Penetration Test results varied widely, with values as low as four and as high as 50 reported. Generally, materials within five feet of the surface were moderately loose to loose, and

densities increased with depth where materials became moderately dense to very dense at approximately ten feet. Moisture contents were generally very low, ranging from 1.1% to 9.0% in the majority of samples. The only clay specimen found had a water content of 17%. No stratigraphic boundaries were identified, and materials, with the exception of density, were fairly homogenous throughout the area. Additional information, including a subsurface investigation plan and soils data, can be found in the Technical Appendix A (USACE, 2010).

Since the construction of Las Cruces Dam, sediments have accumulated at the mouth of the arroyos or flow paths where they empty into the bottom of the reservoir basin. At the mouth of the larger arroyos, larger sediments (sand and gravel) have reached as much as eight to ten feet in depth. Sediment deposits within the conveyance channel connecting the southern end of the basin to the outlet structure periodically obstruct the channel and back up water into the southern portions of the basin. Fine-grained soils carried by storm water have accumulated to form a layer of low-permeability soil in the lowest depressions of the basin. These sediments are of such low permeability that this area will hold surface water for periods of weeks or months depending on the volume of water that is trapped. Periodic maintenance is required to keep the conveyance channel clear of sediment.

2.1.4. Percolation Test Results

USACE performed percolation tests to measure the ability of the soil to absorb water. Results indicate that materials near the surface are fairly permeable, with percolation rates varying between 20 to 46 feet per day. This compares favorably with the permeability expected for the materials found. The high consistency in particle size found below the surface indicates that materials are likely of similar permeability at greater depths. These percolation rates would require some sort of soil treatment, such as mixing with clays or soil liner systems, to achieve an impermeable surface, which might be necessary for the proposed project. Technical Appendix A (USACE, 2010) presents percolation test results.

2.2. Climate

The climate in the Las Cruces area is classified as semiarid with hot summers, mild winters, and short temperate spring and fall seasons. The temperature occasionally reaches 100 degrees Fahrenheit or falls to zero or below. The average annual precipitation ranges from eight to ten inches, with 60% of the total annual precipitation accumulating during the summer and fall months. In general, summer storms are high intensity, localized thunderstorms of brief duration, whereas winter storms are low intensity, last several days, and cover large areas. Although an average of only one day per year has more than 1/2 inch of precipitation, these infrequent, brief, heavy summer showers may bring 1/2 to 1 inch of rain. Occasionally, hail accompanies summer thunderstorms. The average annual snowfall is less than four inches, seldom exceeds one or two inches, and generally melts within a few hours. The growing season is approximately six to seven months long. Relative humidity averages less than 50% and is generally less than 20% on hot sunny afternoons. In winter the prevailing winds are northerly, and in summer the prevailing winds are southerly. The information in this section was obtained from the online soil survey for Doña Ana County (USDA, 2010a).

2.2.1. Climate Change

Warming temperatures have produced observable changes in the hydrologic cycle and sea level. Impacts of warming temperatures are evident: (1) reservoir management in regions such as the mountainous West where snow pack is an important form of water storage and where snow packs are melting earlier in the spring; and (2) coastal design and management due to rising sea levels and potentially large storm surges from larger and more intense hurricanes. The potential exists for severe droughts and increasing flood risks in the future.

Predicting or quantifying the effects of various possible climate change conditions is difficult. USGS Circular 1331, *Climate Change and Water Resources Management: A Federal Perspective,* dated 2009, makes several key points regarding climate change. The first point is that the best available scientific evidence based on observations from long-term monitoring networks indicates that climate change is occurring, although the effects differ regionally. The second point is that both research and monitoring are needed to fill knowledge gaps and advance our planning capabilities. Although neither will eliminate uncertainties, research and monitoring will provide significant improvements to our understanding of the effects of climate change on water resources, including quantity and quality, and to our evaluation of associated uncertainties and risks required for a more informed decision-making process.

While good evidence exists to support the occurrence of climate change, study of how the change might affect the study region and the study area of the Las Cruces Dam has been limited. However, some references exist. Hurd and Coonrod performed a study in 2007 evaluating 'Climate change and its implications for New Mexico's water resources and economic opportunities.' This study supports the current trend of a degrading Chihuahuan arroyo riparian ecosystem.

2.3. Existing Without-Project Hydrologic Analysis

This section presents the hydrologic analysis developed by the USACE to support the ecosystem restoration study and the sediment transport and water supply analyses. The hydrologic analysis establishes peak discharge frequency relationships and flood hydrographs for the watershed above Las Cruces Dam under existing and future without-project conditions. Technical Appendix B (USACE, 2010) provides additional information regarding the hydrologic analysis.

2.3.1. Hydrologic Model Development

USACE developed a rainfall-runoff model and produced flood hydrographs and instantaneous peak discharges for 50.0%-, 10.0%-, 2.0%-, and 1.0%-chance (2-, 10-, 50-, and 100-year) events using the HEC-HMS computer software (USACE, 2008). USACE supplied the hydrologic analysis to Mussetter Engineering, Inc. (MEI), for use in the sediment transport analysis that MEI performed under contract to USACE, and MEI updated the hydrologic analysis to model the 20.0%- and 4.0%-chance (5-year and 25-year) events. Watershed and subarea boundaries were generated by the GEO-HEC-HMS computer software and based on 2004 topographic mapping obtained from the Doña Ana County Flood Commission (DACFC). USACE delineated the subbasins in the watershed and applied the Snyder's unit hydrograph method and a 24-hour storm duration with five-minute computation intervals to compute hydrographs. USACE developed hydrographs for each storm using the Frequency Storm Method based on rainfall

intensity-duration data obtained from NOAA Atlas 14, *Precipitation-Frequency Atlas of the United States, Semiarid Southwest* (NOAA, 2004). USACE used an initial loss rate of 0.9 inches and a constant loss rate of 0.2 inches per hour for undeveloped conditions. Hydrographs were routed throughout the basin using the Muskingum-Cunge method.

USACE calculated the percent of impervious cover for the existing conditions model from features that are visible on the 2004 DACFC aerial photography in conjunction with estimated land-use types. USACE assumed the percentage of impervious cover to be zero for most of the watershed with the exception of a few developed basins in the downstream portion of watershed near Las Cruces Dam. These basins were assigned impervious cover values that ranged between 1% and 24%.

In the 1930s, the Civilian Conservation Corps (CCC) constructed a series of earth-fill, flood detention dams in the watershed to control water and sediment runoff from the upper basin. Although other dams exist farther upstream, seven of the dams are of specific concern because they are closest to Las Cruces Dam and have subsequently been determined to be unsafe. USACE evaluated the hydrologic effect of the seven CCC dams. Figure 2.1 displays the location of the seven dams.

The hydrologic model incorporated the Las Cruces Dam and the seven historic dams built in the watershed by the CCC. USACE developed storage-elevation data and spillway dimensions for each of the dams using the 2004 DACFC topography. Discharge capacities of the low-level outlet structures were generated using the orifice equation with field-measured outlet dimensions and configurations, and emergency spillway discharges were computed assuming critical depth. Due to the sparse hydrologic data for the area, USACE based model calibration of previous studies primarily on comparisons with the results of USGS regional regression equations. The previous studies were performed using rainfall data from NOAA Atlas II, *Precipitation-Frequency Atlas of the Western United States*, Volume IV – New Mexico (Miller et al., 1973), and infiltration rates adjusted to produce reasonable peak values. NOAA Atlas 14 supersedes NOAA Atlas II and generally indicates higher rainfall values for the Las Cruces area. USACE adjusted regional parameters such as initial infiltration rates so that the combination of NOAA Atlas 14 rainfall and infiltration produced estimated peak discharges of similar magnitude to peaks produced and accepted in previous calibration analyses.

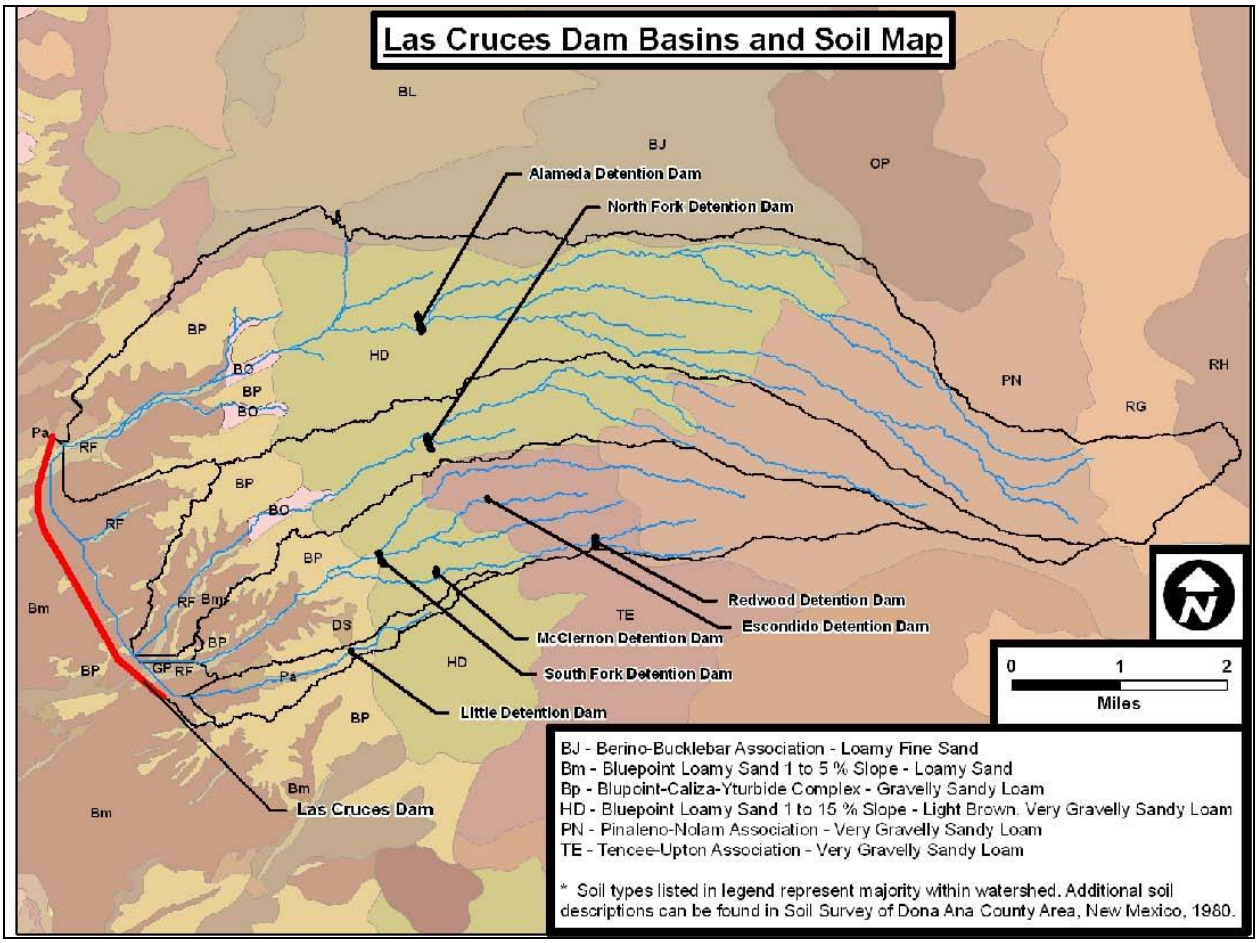

Figure 2.1 - Civilian Conservations Corps Dam in the Las Cruces Dam Watershed

2.3.2. Existing Without-Project Hydrologic Results

Modeled peak inflows entering the Las Cruces Dam reservoir pool from the four main arroyos, for the existing without project conditions, range from 86 cubic feet per second (cfs) from Little Arroyo to 504 cfs from Alameda Arroyo for the 50.0%-chance event and from 709 cfs (Little Arroyo) to 6,235 cfs (Alameda Arroyo) for the 1.0%-chance event. Inflow volumes associated with these storms range from two to 68 acre feet and from 20 to 900 acre feet for Little Arroyo and Alameda Arroyo, respectively. Table 2.1 summarizes the inflow peaks and volumes and the outflow peaks and volumes for the four main arroyos that contribute to Las Cruces Dam for existing without-project conditions. Results from the models indicate that the CCC dams cause significant attenuation of the flood peaks for most of the modeled storms. At all of the CCC dams, the largest relative reduction in peak discharges occurs for the mid-range events of 20.0%- to 4.0%-chance. Technical Appendix B (USACE, 2010) provides additional information about the CCC dams.

Table 2.1 – Summary of Peak Flows and Volumes under Existing Without-Project Conditions for the Four Primary Arroyos at Las Cruces Dam					
		Outflow from Upstream Dam		Inflow to Las Cruces Dam	
Arroyo	Percent Chance Event	Peak Discharge (cfs)	Volume (acre feet)	Peak Discharge (cfs)	Volume (acre feet)
Alameda	50	182	68	504	124
	20	557	232	1,475	399
	10	1,387	367	2,163	629
	4	2,672	559	3,190	956
	2	3,714	716	4,447	1,219
	1	4,912	900	6,235	1,532
North Fork	50	98	33	255	57
	20	125	103	710	167
	10	136	161	1,043	257
	4	593	242	1,494	386
	2	1,135	310	1,837	492
	1	1,721	382	2,179	605
South Fork	50	66	25	145	49
	20	92	80	493	160
	10	104	125	762	251
	4	417	191	1,159	384
	2	934	245	1,533	492
	1	1,498	303	2,589	609
Little	50	6	2	86	12
	20	8	5	216	26
	10	9	8	321	38
	4	10	13	472	56
	2	10	16	593	71
	1	11	20	709	87

2.4. Existing Without-Project Hydraulic Analysis

The hydraulic analysis estimates the hydraulic conditions (e.g., velocity, depth, shear stress) in the arroyos to facilitate bed-material transport capacity calculations throughout the project area. The hydraulic analysis of the main arroyos in the watershed modeled flows for the 50.0%-, 20.0%-, 10.0%-, 4.0%-, 2,0%-, and 1.0%-chance events. Technical Appendix B (USACE, 2010) provides additional information regarding the hydraulic analysis.

2.4.1. Hydraulic Model Development

USACE developed models for 17 separate reaches using the HEC-RAS computer software. The channel geometry used in the models was developed from two-foot-contour-resolution Light Detection and Ranging (LIDAR) mapping data collected in February 2004. USACE determined downstream boundary conditions based on either normal depth or reservoir pool elevations from the HEC-HMS hydrologic model. Manning's 'n' roughness coefficients typically range from approximately 0.035 in natural arroyo channels to 0.04 in the arroyo overbanks. All models were set to run under subcritical conditions. Although slopes are sufficiently steep in many areas to cause supercritical flow under rigid-boundary conditions, supercritical flow is unlikely to be sustained for more than short periods and over short distances in the alluvial channels because of the interaction between the flow and the boundary material (Trieste, 1992; Mussetter et al., 1994). Ineffective flow boundaries were added to some of the models to ensure that flow remains in the active channel.

2.4.2. Hydraulic Results

Hydraulic conditions for each flow, including main-channel velocity, hydraulic depth, effective width, and energy slope, were extracted from each hydraulic model for use in the sediment-transport analysis performed by MEI under contract to USACE. To facilitate the sediment-transport analysis, each of the seven arroyos downstream from the CCC dams was subdivided into several subreaches based on similarity of hydraulic and geomorphic characteristics and the location of significant tributary inflows. Figure 2.2 displays the subreaches. Reach-averaged hydraulic parameters were computed for each subreach over the range of modeled discharges and can be found in Exhibit C of Technical Appendix B. In addition, hydraulic results are discussed in Technical Appendix B (USACE, 2010).

Based on the differences in peak flows, channel geometries, and gradients, the hydraulic characteristics vary considerably along each arroyo and among the arroyos. Reach-averaged results for all modeled arroyos were computed directly upstream of each of the seven CCC dams, and these results were used to define the hydraulic parameters for the inflow to the pool areas to develop supply-reach bed-material transport capacities.

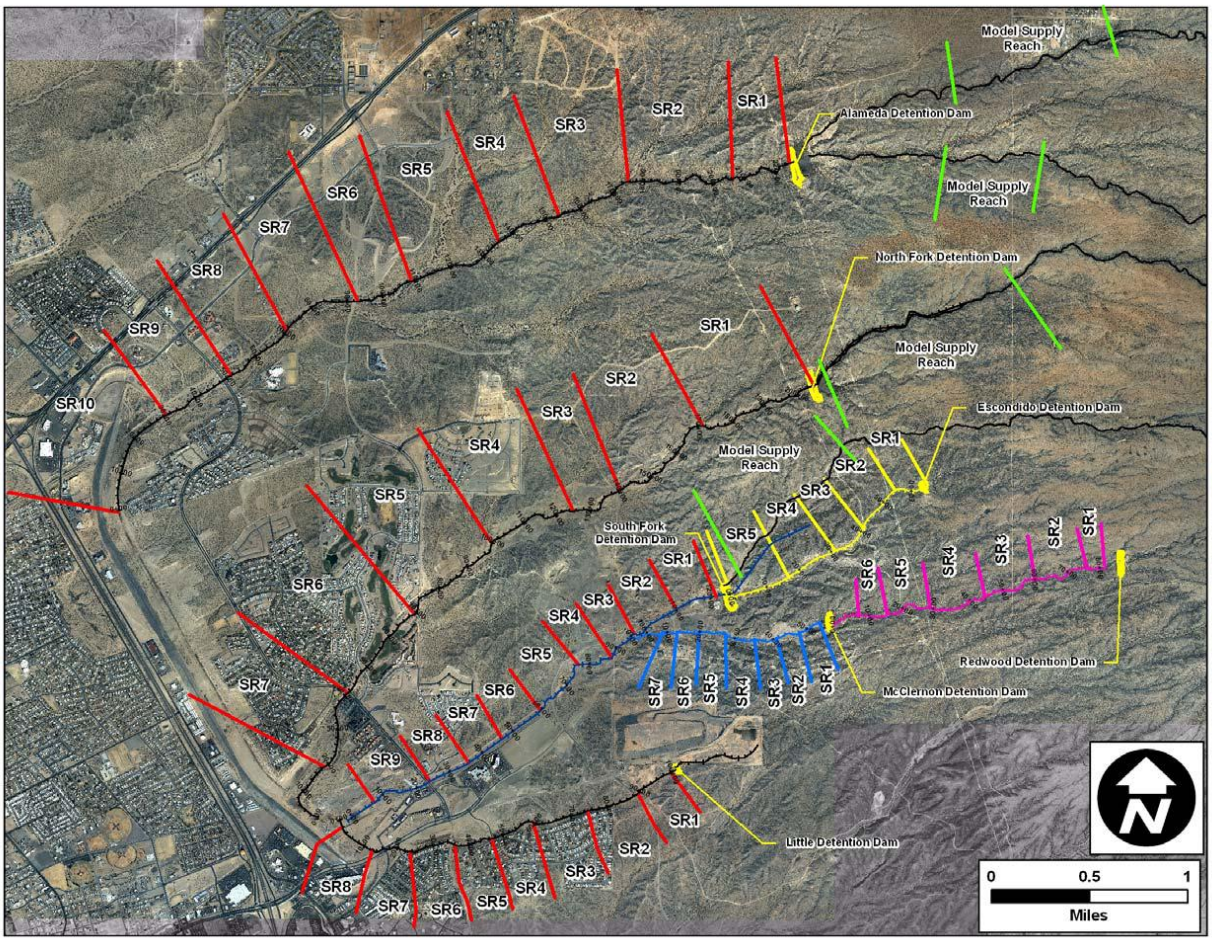

Figure 2.2 – Aerial Photograph Showing the Sediment-Transport Subreaches Along Each Arroyo Downstream from the Seven CCC Dams

2.4.3. Geomorphic Characteristics

The existing geomorphic characteristics of the four primary arroyos that drain into Las Cruces Dam and portions of the upstream tributary arroyos were evaluated based on a combination of field observations and information from the available mapping and other sources. The characteristics of upstream sediment deposits and historic detention were assessed. The geomorphic characteristics for the downstream portions of these arroyos are included in this report (downstream of Roadrunner Parkway for Alameda, North, and South Fork Arroyos and for Little Arroyo as it enters the Las Cruces Dam pool). MEI Exhibit B, contained in Technical Appendix B (USACE, 2010), provides descriptions of the geomorphic characteristics of the upstream reaches of the four major arroyos.

Alameda Arroyo crosses Roadrunner Parkway through a series of five 6-foot by 10-foot box culverts, twenty three 42-inch-diameter reinforced concrete pipes (RCP), and twenty two 48-inch-diameter RCPs. Both upstream and downstream from Roadrunner Parkway, the channel is relatively wide (200 feet to 250 feet). The bed material in the reach upstream from Roadrunner Parkway is primarily sand with 30% to 35% gravel. Some incision was observed in the channel

downstream from Roadrunner Parkway, and the bed material appears to be slightly coarser, probably due to the minor sediment-trapping effects caused by hydraulic losses and backwater through the culverts. Sediment that passes through Roadrunner Parkway and the downstream channel is ultimately delivered to the flood pool of Las Cruces Dam.

The North Fork Arroyo crosses Golf Club Road through six 10-foot-wide by 4-foot-high concrete box culverts that provide vertical base-level control for the upstream channel. The arroyo then crosses Roadrunner Parkway through six 60-inch RCPs approximately 700 feet downstream. The channel between the two crossings is relatively wide and flat, and the bed material is slightly coarser than in the upstream reach through the golf course. A sediment sample taken immediately upstream from Roadrunner Parkway had a D_{50} of about 1.3 mm and contained about 4% gravel. Significant incision has occurred downstream from Roadrunner Parkway due to increased runoff associated with the upstream development, channelization that has straightened and narrowed the channel, and a reduction in sediment supply due to the limited sediment transport capacity through the culverts at both Roadrunner Parkway and Golf Club Road. The total drop from the apron downstream from the RCPs is 5.5 to 6 feet, and the incision has undercut the grouted rock bank protection along the right bank. If left in its current state, the incision in the area will cause undercutting to continue, which will present a significant risk of damage to Roadrunner Parkway and the adjacent developments. The incised reach extends for approximately 750 feet downstream from Roadrunner Parkway. Near the downstream end of the incision, a concrete encased pipeline has been exposed by the downcutting. The drop across the encasement is currently about 1.0 to 1.25 feet, and the drop is likely to increase as additional runoff associated with the upstream urbanization passes through the reach. Downstream from this point, the arroyo empties into the Las Cruces Dam flood pool where the sediment carried by (and eroded from) the upstream reaches deposits. A stand of relatively young cottonwoods and other riparian species has colonized the area on the sediment delta at the downstream end of the North Fork channel.

The South Fork Arroyo crosses Roadrunner Parkway through a series of fifteen 10-foot-wide by 6-foot-high concrete box culverts that provide grade control for the upstream reach. Downstream from Roadrunner Parkway, the channel had incised by 4.5 to 5 feet at the time of the June 2006 field reconnaissance. An energy dissipater does not exist on the downstream side of the crossing, but a gabion mattress has been installed and undercut. Rock riprap has been placed at the head of the incision to limit further upstream migration of the headcut. Further incision is likely to continue to undercut the protection measures, which could endanger the stability of the Roadrunner Parkway crossing. The incision extends downstream through the channelized reach into the Las Cruces Dam flood pool, where it has undercut and exposed the outlets of some local storm drains and at least one pipeline crossing.

The channel of Little Arroyo is concrete lined from approximately 0.25 miles upstream from the Lowman Avenue crossing to the outlet in the Las Cruces Dam flood pool. The gradient of the portion of the lined reach upstream from Lowman Avenue is approximately the same as the upstream arroyo, and the portion downstream from Lowman Avenue steepens significantly to about 3.5%. Some incision is occurring at the outlet in the Las Cruces Dam flood pool.

2.4.4. Sediment Transport Analysis

The sediment yield from a watershed is composed of two primary components: (1) bed-material load, composed of material commonly found in the bed and controlled by the composition of the sediment and the hydraulic conditions in the channel, and (2) wash load, the fine sediment that that is not commonly found in the bed that originates from the erosion of the watershed soils, gullies, and channel banks. Bed-material load actively exchanges with the channel bed as it is transported downstream, whereas wash load typically remains in suspension once it reaches the channel. In addition, bed-material load is typically carried at the capacity of the stream in alluvial channels such as those in the study area, whereas wash load is controlled by the upstream supply and is generally carried at less than the capacity. Technical Appendix B (USACE, 2010) contains a copy of the report *Las Cruces Dam, Section 1135, Ecosystem Restoration Feasibility Study, Sediment Transport Analysis*, dated December 2006, prepared by MEI, under contract to USACE. The MEI report describes in detail the sediment transport analysis used to support the ecosystem restoration study for Las Cruces Dam.

MEI estimated the fine sediment yields (wash load) using the Modified Universal Soil Loss Equation (MUSLE) (Wischmeier and Smith, 1978), as modified by Mussetter, et al (1994) for the Albuquerque area. MEI estimated the bed-material loads by integrating sediment-transport rating curves developed using the Toffaleti-Meyer-Peter, Müller (MPM) sediment-transport function, as formulated in the USACE SAMwin software (USACE, 2003). Input for the SAMwin program were taken from the bed-material sediment data collected during June 2006 field reconnaissance and from the HEC-RAS hydraulic model results for the range of flows indicated by the HEC-HMS hydrographs generated by the hydrologic analysis.

Bed-material and total sediment loads were estimated for the 50.0%-, 20.0%-, 10.0%-, 4,0%-, 2.0%-, and 1.0%-chance events by integrating the bed-material rating curves over each respective hydrograph for each subarea and adding the estimated wash-load component. The long-term, average-annual loads were then estimated by considering the probability of occurrence of each flood event (Chang, 1988). Table 2.3 of Technical Appendix B displays the bed material yields and Table 2.4 displays the total sediment yields, including the addition of wash load, entering Las Cruces Dam from each of the four main arroyos for each respective storm event.

2.4.5. Sediment Delivery to Las Cruces Dam

Using topographic mapping, USACE identified areas within the study area that are prone to sediment deposition. These sediment-prone areas include low-lying areas, areas at the mouths of arroyos, and areas where the topography would allow flood-flow velocities to decrease and deposit sediment.

Taking the list of average-annual bed-material sediment yields and average-annual total sediment yields contributed from each of the arroyos as provided by MEI (see Technical Appendix B), USACE performed additional analyses in critical areas to determine the current rate and depth of sediment deposits. For these analyses, USACE used the assumptions that the bed material load is deposited within the Las Cruces Dam pool and the wash load portion of the sediment passes through the dam. Topographic mapping and field observations determined the depth of sediment

deposition at the mouth of South Fork Arroyo to be approximately four feet. Using the rate of sediment delivery from the South Fork Arroyo listed in Table 2.9, USACE estimated the rate of creep of the sediment fan at the mouth of South Fork Arroyo to be 0.7 acres per year on average. Additional discussion of sediment deposition trends can be found in sections 3.4.2 and 3.4.3.

2.5. Water Quantity

2.5.1. Precipitation and Stormwater Runoff

The primary source of water to the flood pool of Las Cruces Dam is likely to be from precipitation directly in the vicinity of the pool and from storm runoff from nearby portions of the upstream watershed. Technical Appendix B (USACE, 2010) contains a copy of the report *Las Cruces Dam, Section 1135, Ecosystem Restoration Feasibility Study, Water Supply Study*, dated December 2006, and prepared by MEI under contract to USACE. The only existing flow measurements that are relevant in assessing this water source are from a stream gage that was operated by the U.S. Geological Service (USGS) on the main branch of Las Cruces Arroyo just downstream from the confluence of the North and South Las Cruces Arroyos and Little Arroyo. Data are available for Water Years (WY) 1959 to 1966 (MEI, 2006b). This location is immediately downstream from the current location of Las Cruces Dam, which diverts all flows from Las Cruces to Alameda Arroyo. The reported mean daily flow data for this gage indicate non-zero runoff for only 42 days during the eight-year period of record, and all of these days occurred between June and October. The total runoff during these years ranged from about eight acre feet in WY 1962 to 111 acre feet in 1959 and averaged about 33 acre feet. Peak discharges ranged from 120 cfs in WY 1961 to 2,170 cfs in WY 1965 (peak discharges were not reported for WY 1959 and WY 1960). Due to the amount of urbanization that has occurred since this gage was discontinued, the runoff under existing conditions is most likely significantly greater than is indicated in the data above.

Based on precipitation frequency estimates from NOAA Atlas 14, the 2-year, 24-hour storm produces approximately 1.5 inches of rain. An initial abstraction (or loss) rate of 0.9 inches and a constant loss rate of 0.2 inches per hour were used in the hydrologic model for both existing and future conditions (USACE, 2006), indicating that a minimum of about one inch of precipitation would be required to produce measurable runoff from natural areas in the watershed. Extrapolation of the trend indicated by the runoff volumes predicted by the existing conditions model for the 0.50%- and 0.20%-chance storms indicates that a storm of at least 1.25 inches is required to produce measurable runoff into the pool area from the main arroyos (USACE, 2006).

In the developed areas in the downstream portion of the watershed, there is currently a significant amount of impervious cover due to roads, parking lots, and roofs that prevents infiltration; therefore, the area is likely to experience measurable runoff from local areas during less intense storms. Ongoing development in the lower portion of the basin will continue to increase this tendency.

Water evaporation rates in the study area vary from a low of 1.8 inches per month in December and January to nine inches per month in June (Mussetter, 2006b). The average annual evaporation rate is 5.2 inches per month. These evaporation rates translate to 1,600 gallons per

acre per day (gal/ac/d), 8,100 gal/ac/d, and 4,600 gal/ac/d for the low, high, and average evaporation rates.

2.5.2. Groundwater

USACE conducted a records search of groundwater wells in the vicinity of Las Cruces Dam to assess the typical depth to the water table below the study area. A total of 30 wells were identified that were both near the study area and contained water level information. Comparison of the flood-pool elevation with the well levels indicates that the water table is typically 30 to 300 feet below the minimum elevation of the basin.

2.6. Water Quality

Based on the above information, the only reliable source of surface water under existing conditions is from storm runoff. Storm-water runoff from urbanized areas can contain inorganic contaminants such as salts and metals, chemical contaminants that are by-products of industrial production, or other chemicals that originate from such facilities as fuel stations and septic tanks (City of Las Cruces, 2010). Detailed water quality data are not available to specifically assess the potential magnitudes of these contaminants into the study area.

As reported in the sediment transport study, storm runoff from the unlined arroyos will deliver significant quantities of both fine-grained (silts and clays) and coarse-grained (sands and gravels) sediments to the restoration area. The sediment transport study indicates that wash-load concentration entering the flood pool during the 50.0%-chance peak flow event could range from about 4,000 parts per million (ppm) along Alameda Arroyo to over 6,000 ppm along North Fork Arroyo under existing conditions.

2.7. Air Quality and Noise

Doña Ana County borders the El Paso, Texas, and Cuidad Juarez, Mexico, area as part of the Paso del Norte air shed and resides within New Mexico's Air Quality Control Region No. 153, which encompasses Doña Ana, Sierra, Otero, and Lincoln Counties. This region historically has air quality problems, including particulate matter and ozone pollution. There are high levels of particulate matter in Doña Ana County caused by natural events such as high wind speeds, ambient dry conditions, and man-made dust sources. Doña Ana County currently contains two nonattainment areas. There is a small marginal ozone nonattainment area located approximately 25 miles south of Las Cruces in the southeastern-most part of the state that borders El Paso, Texas, to the east and Ciudad Juárez, Mexico, to the south. The nonattainment area includes the City of Sunland Park and the communities of Santa Teresa and La Unión. The area was designated by the Environmental Protection Agency (EPA) in 1995. A small PM_{10} (particulate matter; less than 10 microns in diameter) nonattainment area is located in Anthony, a community in the southeastern part of Doña Ana County. The area was designated nonattainment for PM_{10} in 1991. Although this is the only PM_{10} nonattainment area in Doña Ana County, the entire county has experienced high concentrations of PM_{10} and has exceeded the National Ambient Air Quality Standards (NAAQS) for PM_{10} on numerous occasions. In response to Doña Ana County's exceedances of the PM_{10} NAAQS, the New Mexico Air Quality Bureau, in conjunction with the City of Las Cruces Planning Department, the Doña Ana County Community Development Department, community stakeholders, and other agencies, have prepared a Natural

Events Action Plan (NEAP) to minimize the public's exposure to PM_{10}. The plan is designed to protect public health, educate the public about high wind events, mitigate health impacts on the community during future events, and identify and implement Best Available Control Measures for man-made sources of windblown dust. The Las Cruces area in Doña Ana County is "in attainment" (does not exceed State and Federal Environmental Protection Agency air quality standards) for all criteria pollutants (NMED, 2010).

The closest Class I areas are White Sands National Monument, 40 miles to the northeast, and the Gila Wilderness, approximately 88 miles to the northwest of the project area. Class I areas are special areas of natural wonder and scenic beauty, such as national parks, national monuments, and wilderness areas, where air quality should be given special protection. Class I areas are subject to maximum limits on air quality degradation.

Existing land uses within the immediate project area include undeveloped open space and recreation areas within the pool area of Las Cruces Dam. These areas typically experience relatively low-level ambient noise levels and existing traffic noise. Areas of development that contribute to the ambient noise levels include I-25, which is located immediately west of the Las Cruces Dam, and residential houses and parks, which are located east of the pool area.

2.8. Ecological Resources

2.8.1. Vegetation Communities

The study area is located within the Chihuahuan Desert ecoregion (Dinerstein et al., 2000; Pronatura Noreste et al., 2004) or biotic community as described by Brown (1982). Of all the ecoregions in New Mexico, the Chihuahuan Desert Ecoregion is the third highest in regard to the number of Species of Greatest Conservation Need (SGCN) according to the New Mexico Comprehensive Wildlife Conservation Strategy. Vegetation was observed in the study area by USACE biologists, NRCS soil scientists, and members of the Las Cruces Chapter of the New Mexico Native Plant Society while conducting plant inventories (2005, 2006, and 2009). There are five vegetation communities that exist within the study area. These communities include arroyo riparian, cottonwood, upland desert shrub, playa, and grassland.

Chihuahuan desert arroyo riparian vegetation within the relatively undisturbed Alameda and Las Cruces arroyos in the study area matches descriptions of this plant community by Dick-Peddie (1975) and Henrickson and Johnston (1986). This community is dominated by the small tree desert willow (*Chilopsis linearis)*, which forms mottes or islands within the arroyo channels, with the shrubs brickell bush (*Brickellia laciniata*), Apache plume *(Fallugia paradoxa)*, and burrobrush (*Ambrosia monogyra*). Four-wing saltbush (*Atriplex canescens*) and Honey mesquite *(Prosopsis glandulosa)* were also found in arroyos. Little-leaf sumac (*Rhus microphylla*) is rare in the study area but more common upstream. Forbs are uncommon in the arroyos, but the perennials sacred datura *(Datura wrightii)* and crownbeard *(Verbisina encelioides)* are robust enough to withstand the flooding, sediment and scour of this environment. Texas virgin's bower *(Clematis drummondii)* was the only vine found in the study area.

The upland desert shrub community is dominated by Creosote bush *(Larrea tridentata)*, generally with few other species. This plant community at Las Cruces Dam is disturbed and

impoverished compared to its description by Henrickson and Johnston (1986). Slopes between the creosote uplands and arroyos support Honey mesquite *(Prosopsis glandulosa),* Soaptree yucca (*Yucca elata*), and sparse forbs and grasses.

The playa communities within the study area support little or no vegetation, unlike typical Chihuahuan Desert playas which typically support forbs and grasses such as vine mesquite and tobosa (Jornada Basin LTER, 2007). Vegetation observed within or near the playa basins includes the non-native species cocklebur *(Xanthium strumarium),* Watermelon (*Citrullus lanatus*), and Chaste tree (*Vitex agnus-castus).*

A small tall grassland community exists in the sediment fan at the lower ends of the arroyos. Vegetation observed within the grassland community includes: Johnsongrass *(Sorghum halepense),* crownbeard *(Verbesina encelioides)* and Nutgrass *(Cyperus esculentus).* The Johnsongrass, a non-native invasive plant, forms a monoculture but appears to be limited to the sediment fan. There are no native Chihuahuan Desert grasslands within the study area. Giant sacaton *(Sporobulus wrightii),* a native tall bunchgrass, was observed during a site visit but only as isolated plants rather than a stand or community.

A stand of Rio Grande cottonwood (*Populus deltoides* var. *wislizenii*) is growing in the southern portion of the flood pool basin and within the sediment delta of the Las Cruces Arroyo in the southern portion of the basin. Cottonwoods also grow along the southern end of the conveyance channel that connects Las Cruces Arroyo to the dam outlet. This community lacks diversity, as no understory shrubs are present.

A variety of other vegetation was observed within various areas of the study site, including along the service road, toe of the dam, and conveyance channel, but not within a specific vegetation community. Additional species are listed in Addendum B of this report.

The relative scarcity of perennial grasses and forbs that would be expected to occur in the study area, mainly in the upland areas, is a cause for some concern. Species like sideoats grama, black grama, fluffgrass, vine mesquite (*Panicum obtusum*), tobosa (*Pleuraphis mutica*), burro grass (*Scleropogon brevifolia*), alkali mallow (*Sida leprosa*) and cane bluestem are very rare or absent altogether within the study area. Earth moving, excavation during dam construction, and other soil disturbances likely have contributed to the absence of these species. Decline or absence of desert grasses and forbs of the Chihuahuan Desert could also be partially attributed to climate change, fire suppression, and rodent competition (Dick-Peddie, 1993).

The clumped dispersion of riparian shrubs adjacent to the Alameda and Las Cruces Arroyos provides some of the best avian breeding habitat available in the entire project area. Rare plant species that could potentially occur in the study area in Chihuahuan Desert arroyo riparian areas of Doña Ana County, New Mexico, but have not been observed within the study area are listed in Addendum B of this report.

2.8.2. Invasive Species

The majority of non-native species within the project area are plants. Though some non-native wildlife may exist, they are not of major concern.

2.8.2.a. Invasive Plants

Within the study area, there are several invasive plant species that exist. These include Salt cedar *(Tamarix chinensis),* Chaste tree (*Vitex agnus-castus),* and Johnsongrass (*Sorghum halepense*). Currently, only Salt cedar and Chaste tree are at a level of concern. The Johnsongrass currently is providing an ecosystem function and is not likely to spread beyond the specific area of the flood pool basin where conditions are appropriate for its existence. However, Salt cedar and Chaste tree can out compete the native species and can convert native arroyo riparian habitat to a drier, more upland habitat. Left unchecked, these invasive species would become more problematic. This shift would pose a threat to the native arroyo riparian habitat that the goals of this project aim to protect and restore. Salt cedar and Chaste tree opportunistically would be removed as a part of the implementation of restoration measures.

2.8.2.b. Noxious Weeds

Executive Order 13112 directs Federal agencies to prevent the introduction of invasive (exotic) species; minimizes the economic, ecological, and human health impacts that they cause, and provides for their control. In addition, the State of New Mexico, under administration of the United States Department of Agriculture, designates and lists certain weed species as noxious. "Noxious" in this context means plants not native to New Mexico that have a negative impact on the economy or environment and are targeted for management or control. Class C listed weeds are common, widespread species that are fairly well established within the state. Management and suppression of Class C weeds is at the discretion of the lead agency. Class B weeds are considered common within certain regions of the state but are not widespread. Control objectives for Class B weeds are to prevent new infestations, and in areas where they are already abundant, to contain the infestations and prevent their further spread. Class A weeds have limited distributions within the state. Preventing new infestations and eliminating existing infestations is the priority for Class A weeds. One species identified as a Class C weed that occurs within the study area is Salt cedar (USDA, 2010b). Salt cedar is common in several areas within the study area and is at a level that needs to be controlled before their population further xpands.

2.8.3. Wildlife

An estimated 772 species of vertebrates may occur in aquatic, semi-aquatic, or arroyo riparian habitat in Doña Ana County, based on a query of the Biota Information System of New Mexico (BISON-M), accessed July 2010. This estimate includes 20 species of fish, 12 species of amphibian taxa, 59 species of reptiles, 292 species of birds, and 78 mammalian taxa. Birds are the most important group, based on number of taxa, comprising 39% of all vertebrate species in the estimate.

Currently, no permanent surface water exists in the location of the study area. However, areas within the study area are subject to periodic inundation and prolonged ponding following large or frequent rainfall events. Although fish do not occur in these playa-like areas, tadpole shrimp and fairy shrimp have been observed (personal communication, R. Sallenave). Two species of fairy shrimp have been identified as Beavertail Fairy Shrimp (*Thamnocephalus platyurus*) and Great Plains Fairy Shrimp (*Streptocephalus texanus*). The tadpole shrimp and both species of fairy shrimp are listed as SGCN in the Wildlife Conservation Strategy.

Examples of amphibian and reptile species that occur within Doña Ana County are located in Addendum B. Formal inventories of amphibians and reptiles were not conducted, and incidental observation of these animals was nearly non-existent. Absence of many amphibian and reptile species that were predicted to occur by the BISON-M but were not detected is likely explained by habitat degradation, where a particular niche is no longer available, or competition pressure by more generalist species or predation has resulted in extirpation from the study area.

An active birding community exists in Las Cruces, and their records for the past several years indicate that over 80 species of birds have been observed in the study area. Many of these birds are migratory birds using the study area as a resting spot in this portion of the Central Flyway. Christmas Bird Counts (CBC) have been conducted for the entire High Range territory since 1999. This High Range territory includes the entire study area and several nearby areas on the east side of Las Cruces. CBC is a winter count with a standardized procedure that happens in thousands of locations around the world. Each count occurs in a count circle that is 15 miles in diameter. The High Range territory CBC is held in mid-December every year, and the coverage of the area is as consistent as possible (the same amount of time spent birding the same routes each year). Within the last several years (2006-2008), data have been separated to include bird counts from the study area alone (personal communication, N. Stotz). Avian census surveys also were conducted in May and June of 2006 by USACE biologists. See Addendum B of this report for the complete list of the CBC and avian census surveys.

The following is a list of bird species that are common to the Las Cruces Flood Control Dam during the breeding season: Pyrrhuloxia (*Cardinalis sinuatus)* Great-tailed Grackle (*Quiscalus mexicanus)*, House Finch (*Carpodacus mexicanus)*, House Sparrow (*Passer domesticus*), Gambel's Quail (*Callipepla gambelii)*, White-winged Dove (*Zenaida asiatica)*, Mourning Dove (*Zenaida macroura)*, Greater Roadrunner (*Geococcyx californianus)*, Burrowing Owl (*Athene cunicularia*), Black-chinned Hummingbird (*Archilochus alexandri)*, Say's Phoebe (*Sayornis saya)*, Western Kingbird (*Tyrannus verticalis)*, Chihuahuan Raven (*Corvus cryptoleucus)*, Barn Swallow (*Hirundo rustica*), Cactus Wren (*Campylorhynchus brunneicapillus)*, Rock Wren (*Salpinctes obsoletus)*, Northern Mockingbird (*Mimus polyglottos)*, Curve-billed Trasher (*Toxostoma curvirostre)*, and Spotted Towhee (*Pipilo maculatus)*.

Migratory birds that are common to the Las Cruces Flood Control Dam during migration and winter include the following: Fox Sparrow (*Passerella iliaca)*, Savannah Sparrow (*Passerculus sandwichensis)*, White-throated Sparrow (*Zonotrichia albicollis*), White-crowned Sparrow (*Zonotrichia leucophrys)*, American Wigeon (*Anas americana*), Blue-winged Teal (*Anas discors*), Green-winged Teal (*Anas carolinensis*), Long-eared Owl (*Asio otus*), Red-naped Sapsucker (*Sphyrapicus nuchalis*), Western Scrub Jay (*Aphelocoma californica*), American Crow (*Corvus brachyrhynchos*), Horned Lark (*Eremophila alpestris*), Hermit Thrush (*Catharus guttatus*), American Pipit (*Anthus rubescens*), Phainopepla (*Phainopepla nitens*), Spotted Towhee (*Pipilo maculatus)*, and Canyon Towhee (*Pipilo fuscus mesoleucus*).

Mammals in the Chihuahuan Desert biotic community that are known to occur within the study area include the following: American badger (*Taxidea taxus*), Pale Townsend's big-eared bat (*Corynorhinus townsendii*), California myotis bat (*Myotis californicus*), big free-tailed bat

(*Nyctinomops macrotis*), long-legged myotis bat (*Myotis volans)*, spotted bat (*Euderma maculatum*), American beaver (*Castor canadensis*), bobcat (*Lynx rufus*), common gray fox (*Urocyon cinereoargenteus*), mule deer (*Odocoileus hemionus*), desert pocket gopher (*Geomys arenarius*), cactus mouse (*Peromyscus eremicus*), lion mountain (*Puma concolor*), rock pocket mouse (*Chaetodipus intermedius*), common muskrat (*Ondatra zibethicus*), oryx (*Oryx gazelle*), common raccoon (*Procyon lotor*), ringtail (*Bassariscus astutus*), striped skunk (*Mephitis mephitis*), and long-tailed weasel (*Mustela frenata*).

In May of 2006, USACE biologists conducted small-mammal live-trap lines by habitat type (Las Cruces Dam sediment pool area only) and incidental observations of mammals during all site visits. Small mammals observed during site visits to the area include: coyote (*Canis latrans lestes*), deer mouse (*Peromyscus maniculatus*), white-footed mouse (*Peromyscus leucopus*), desert cottontail rabbit (*Sylvilagus audubonii*), black-tailed jackrabbit (*Lepus californicus*), Ord's kangaroo rat (*Dipodomys ordii*), southern plains wood rat (*Neotoma micropus*), and spotted ground squirrel (*Spermophilus spilosoma*).

2.9. Special Status Species

Three agencies have primary responsibility for protecting and conserving plant and animal species within the proposed project area. The United States Fish and Wildlife Service (USFWS), under authority of the Endangered Species Act of 1973 (16 U.S.C. 1531), as amended, has the responsibility for Federal-listed species. The New Mexico Department of Game and Fish (NMDGF) has the responsibility for state-listed wildlife species. The New Mexico State Forestry Division (Energy, Minerals, and Natural Resources Department) has the responsibility for state-listed plant species. Each agency maintains a continually updated list of species that are classified, or are candidates for classification, as protected based on their present status and potential threats to future survival and recruitment into viable breeding populations. These types of status rankings represent an expression of threat level to a given species survival as a whole and/or within local or discrete populations. Special status species listed by USFWS (USFWS, 2010) and NMDGF (NMDGF, 2010) for Doña Ana County that could be present within the project area are listed in Table 2.11 and discussed below. The entire list of special status species for Doña Ana County can be found in Addendum B of this report.

The Peregrine Falcon, a state-threatened species and a USFWS species of concern, was observed during the 2005 CBC but has not been recorded in the area since that time. Neither the study area nor surrounding lands contain the bird's preferred breeding habitat, which consists of isolated wooded areas with cliffs that create "gulfs" of air in which the bird might forage. The Peregrine Falcon may fly over the study area during migration.

The Burrowing Owl, a USFWS species of concern, has been observed within the study area for many years and was recorded as being present during the CBC since 2000. The Burrowing Owl raises broods in the eroded rills and gullies of cutbanks and the embankment of the diversion ditch that runs northwest to southeast parallel to the Las Cruces Dam face. Nine Burrowing Owls were recorded for the 2006 CBC, three for the 2007 CBC, and three for the 2008 CBC. The City of Las Cruces Public Works Department has been working with Dr. Martha Desmond (New Mexico State University) regarding the Burrowing Owls behind Las Cruces Dam, in the spillways of Las Cruces Dam, at the Munson Drainage Pond, and at the El Molino Drain. This

season, Dr. Desmond and her students installed a total of 16 pairs of burrows at 16 nest sites. Burrowing Owls have already moved in and are using these artificial dens (personal communication, M. Johnson).

In addition, the New Mexico Department of Minerals, Natural Resources, Forestry Division has the responsibility for maintaining the list of rare plant species that occur in New Mexico. The state species list indicates that there are 21 status plant species that occur in Doña Ana County (Addendum B of this report). They are listed by the New Mexico State Forestry Division as either a species of concern or an endangered plant on the New Mexico Rare Plants Technical Council 1999 Website (last update 23 April 2010). Although these plants are known to exist in Doña Ana County, they are not likely to be found within the study area since their preferred site conditions do not occur within or near the study area and none were observed during any of the site visits.

Table 2.11 - Special status species listed for Doña Ana County, New Mexico that could be present within the project area.

Common Name	Scientific Name	Federal Status (USFWS[a])	State of New Mexico status (NMDGF)[b]
Animals			
Peregrine Falcon	*Falco peregrinus anatum*	SC	T
Burrowing Owl	*Athene cunicularia hypugaea*	SC	---

[a] **Endangered Species Act (ESA)** (as prepared by U.S. Fish and Wildlife Services) **status:** Only Endangered and Threatened species are protected by the ESA.

SC= Species of Concern: taxa for which information now in the possession of the Service indicates that proposing to list as endangered or threatened is possible appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support proposed rules.

[b] **State of New Mexico status:**

T= Threatened Animal species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.

2.10. Cultural Resources

The Las Cruces Dam Environmental Restoration project is in compliance with the National Historic Preservation Act of 1966. The area of potential effects (APE) initially considered for planning purposes consisted of approximately 516 acres of flood pool, maintenance roads, and right-of-way for the outfall channel upstream of the Las Cruces Dam. Approximately two-thirds of the project area were completely disturbed by original dam construction or erosion and do not have the potential to contain historic properties. The remaining one third was surveyed by either Human Systems Research (HSR) (166 acres) or the USACE (13 acres).

HSR conducted a survey of the proposed project area in October 2006, as documented in the report titled "An Archaeological Survey of 166 Ac (67.2 HA) for the Section 1135 Ecosystem Feasibility Study, Las Cruces Dam, Doña Ana County, New Mexico", prepared by David T. Kirkpatrick (NMCRIS No. 101844). HSR recorded six archaeological sites (Laboratory of Anthropology [LA] 154457, LA 154458, LA 154459, LA 154461, LA 154462, and LA 154463) and 77 isolated occurrences (IO) on their survey. HSR recommends that all six properties be considered eligible for listing to the National Register of Historic Places (NRHP) under Criterion D. Criterion D signifies a site that has yielded, or may be likely to yield, information important in history or prehistory. Table 2.12 lists the historic properties identified by the survey.

Table 2.12 – Historic Properties			
LA No.	**Site Type**	**HSR NRHP Eligibility**	**USACE NRHP Eligibility**
154457	Three FCR concentrations and 11 lithic artifacts.	Yes; Crit. D	Undetermined
154458	Two components: two ash stains and two lithic artifacts as well as 14 historic artifacts (mid-1960s).	Yes; Crit. D	Undetermined
154459	Artifact scatter containing 72 lithic artifacts and 16 sherds (AD 300-925).	Yes; Crit. D	Undetermined
154461	Artifact scatter containing 41 lithic artifacts.	Yes; Crit. D	Undetermined
154462	One eroded hearth, 98 lithic artifacts, 11 sherds (AD 200-1450).	Yes; Crit. D	Undetermined
154463	One hearth and 12 lithic artifacts.	Yes; Crit. D	Undetermined

The USACE reviewed the properties in terms of NRHP eligibility, and concluded that insufficient information exists to determine eligibility based on the information supplied in the report. The sites are all relatively small, and it is unclear if any of the thermal features retain dating potential. The USACE recommends further survey-level testing prior to any action that would have a potentially adverse effect on the site(s). Prehistoric IOs recorded by HSR include 60 lithic artifacts, one sherd, an isolated hearth, an isolated fire-cracked rock (FCR) scatter, and 14 IOs that could be dated to the historic period. None of the IOs are considered to be eligible for listing on the NRHP, and no further work is recommended.

Due to project changes, the USACE determined that an additional 13.05 acres of potentially undisturbed land could be affected by the project. USACE archaeologists surveyed this additional area in August 2009, as reported in the report titled "Addendum Survey to an Archaeological Survey of 166 Ac (67.20 HA) for the Section 1135 Ecosystem Feasibility Study, Las Cruces Dam, Las Cruces, Doña Ana County, New Mexico (NMCRIS 101844)", prepared by Lance Lundquist (NMCRIS No. 118285). Technical Appendix D (USACE, 2010) contains this report. During this survey, the USACE confirmed that an additional 128.49 acres had been disturbed during initial dam construction or by erosion and has no potential to contain historic properties. The USACE survey resulted in the identification of a single IO, which was an irregular biface. The USACE does not consider the IO to be eligible for listing on the NRHP, and no further work is recommended for this artifact. Due to changes to the proposed project area, after the archaeological surveys were completed, all six archaeological sites noted in this section are no longer within the project area. Therefore, the Tentatively Selected Plan would not affect any of the six archaeological sites.

Consistent with the Department of Defense's American Indian and Alaska Native Policy, signed by Secretary of Defense William S. Cohen on October 20, 1998, and based on the State of New Mexico Indian Affairs Department's 2010 Native American Consultations List, comments and concerns from American Indian Tribes that have indicated they have an interest in Doña Ana County have been, and will continue to be, considered regarding the proposed project. Technical Appendix D (USACE, 2010) contains copies of correspondence. To date, the USACE is unaware of, and has not received any indication of, tribal concerns that would impact this

project. The USACE has no knowledge of any Traditional Cultural Properties (TCPs) within the project area.

In summary, the existing conditions for the overall study area indicate the presence of historic properties, particularly in the undisturbed uplands. However, there are no historic properties in the disturbed lowlands.

2.11. Socioeconomic Considerations and Environmental Justice

The study area is located within the city limits of Las Cruces in Doña Ana County, New Mexico. The total estimated population of Las Cruces in 2009 was 93,570. The total estimated population of Doña Ana County in 2009 was 206,419. The ethnic background for the city of Las Cruces is: white (non-Hispanic), 69.0%; Hispanic (any race), 51.7%; black (non-Hispanic), 2.3%; American Indian and Alaska native, 1.7%; and Asian persons, 1.2% (Percentages add to more than 100% because individuals may report more than one race). In 1999, the median household income for the city of Las Cruces was $30,375. The median household income for Doña Ana County in 1999 was $29,808. Educational attainment (individuals over the age of 25 who are high school graduates) within the city of Las Cruces in 2000 was 80.3%. Educational attainment in Doña Ana County in 2000 was 70.0%. In the city of Las Cruces, 23.3% of individuals were below poverty in 2000 and 25.4% of individuals were below poverty in Doña Ana County. The information above was received from the U.S. Census Bureau website (accessed July 21, 2010).

The planning and decision-making process for actions proposed by Federal agencies involves a study of other relevant environmental statutes and regulations, including Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, which was issued by President Clinton on February 11, 1994. The essential purpose of EO 12898 is to ensure the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no groups of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, tribal, and local programs and policies. Also included with environmental justice are concerns pursuant to EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*. This EO directs Federal agencies to identify and assess environmental health and safety risks that may disproportionately affect children under the age of 18. These risks are defined as "risks to health or to safety that are attributable to products or substances that the child is likely to come into contact with or ingest."

Environmental justice considerations addressed in this assessment involve both population demographics, including ethnic, racial, or national origin characteristics, and persons in poverty, including children under age 18. In order to determine whether environmental impacts affect minority or low-income populations, it is necessary to establish a basis of comparison, referred to as the "region of comparison." This area consists of the geopolitical units that include the proposed project. Most environmental effects from the proposed action, in this instance, would be expected to occur in Doña Ana County.

EO 12898 (Environmental Justice) requires "to the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report of the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations…". Within a half of a mile, the study area is comprised of a mixture of income levels. Field investigation of the areas to be affected by the construction activities did not reveal the presence of community characteristics that would be considered disproportionately minority or low-income neighborhoods.

2.12. Land Use and Recreational Resources

As observed during site visits, the study area provides considerable recreational use to local residents in the form of walking, jogging, running, pet walking, bicycling, bird watching, and nature study. Two parallel 2.8-mile service road/trails run along the top and through the basin of the dam. Several informal trails also crisscross the interior of the site to access points in nearby neighborhoods. Two city parks, Veteran's Park and Sagecrest Park, are located adjacent to the study area. These are small neighborhood or community parks that provide playgrounds, picnic tables, and malls. Veterans Park also provides a monument to local veterans and a small grass playing field.

2.13. Environmental Engineering

The Las Cruces Dam site is an area of vacant, undeveloped land. There are no buildings present at the site nor are there any waste, hazardous materials, hazardous substances, or hazardous wastes known to be located at the site. A Phase I Environmental Site Assessment (ESA) was prepared for this project site (Appendix J) in accordance with the standards required by the American Society of Testing and Materials (ASTM E1527). The ESA was conducted in order to evaluate the potential for the existence of Recognized Environmental Concerns (RECs). Information gathered during the site visit, a review of readily available environmental records concerning the study area, and interviews with individuals familiar with the site revealed the presence of one REC and two de minimis conditions. The REC is the Griggs and Walnut Groundwater Plume National Priorities List (NPL) Site. This site has been the subject of a previous Remedial Investigation and a Record of Decision (ROD) has been issued by the U.S. Environmental Protection Agency. Further information regarding the Griggs and Walnut NPL Site is located in section 5.2.1 of the Phase I ESA (Appendix J). The two de minimis conditions are an empty gas can and a small region of stained soil observed at the site. Further environmental investigation in the form of a Phase II ESA is not recommended for the study area.

Neither the REC or two de minimis conditions prevent or detract from the proposed restoration or recreation measures a the Las Cruces Dam. Since restoration features do not change the hydrology of the dam and water losses from the wetland feature are primarily evaporative so that little to no water will infiltrate to groundwater the proposed restoration would not affect the groundwater plume.

2.14. Aesthetics

Aesthetically, the terrain of the study area is characterized by Las Cruces Dam to the west, which parallels Interstate 25. Two major arterial streets, Roadrunner Boulevard and Telshore Drive, border the site on the east and west, respectively. The study area is surrounded by a growing residential area to the east and by commercial areas and older residential neighborhoods to the north, west, and south. A significant node of commercial activity is located on the west side of the dam, along Interstate 25. The undeveloped land provides open views in all directions except to the west where the dam is located. However, the top of the dam provides dramatic views to the west of the surrounding city and countryside.

2.15. Floodplain and Wetlands

Historically, the Las Cruces and Alameda Arroyos meandered across the project site, providing valuable arroyo riparian habitat in the Chihuahuan landscape. The Las Cruces Dam effectively terminated the historic flow paths of the arroyos. The arroyo flows historically continued westward past the current location of the dam. The large meanders that are evident in the few undisturbed, upstream reaches of the arroyos are no longer possible in the project site. Currently, researchers estimate that 85% to 90% of riparian habitat has been adversely altered within the Chihuahuan Desert biotic community due to various human-induced disturbances. Urbanization of the surrounding area has had an adverse effect on this riparian corridor. The amount of impermeable surfaces has increased dramatically, which results in greater erosion within the arroyos, especially in areas where the native vegetation has been damaged or removed during construction of the dam or maintenance associated with the dam. The Las Cruces Dam and encroaching development across the historic floodplain have bisected wildlife corridors that once led into the Organ Mountains, east of the project area, and connected several arroyo systems.

3. *FUTURE WITHOUT-PROJECT CONDITIONS AND EFFECTS OF THE NO ACTION ALTERNATIVE

Future conditions without-project implementation were projected to characterize the "no action" alternative and its effects and to form a basis for comparison of restoration benefits. The following section summarizes future conditions for pertinent resources.

3.1. Physiography, Geology, and Soils

Soils within the project area would not change under future without-project conditions; however, percolation rates in the lowest depressions of the flood pool basin may change due to the sedimentation process. Fine sediments have settled out of stormwater while it is detained within the flood pool basin. This lining of fine sediments in the southern portion of the basin and the conveyance channel slows percolation as evidenced by the presence of water on the surface for periods of weeks or months. As the courser sediments fill the bottom of the flood pool basin, this layer of fine soils will continue to hold water, albeit below the soil surface as with a perched aquifer. Periods of water availability will be extended for plants whose roots can reach this layer.

3.2. Climate and climate change

While good evidence exists to support the occurrence of climate change, study of how the change might affect the study region and the study area of the Las Cruces Dam has been limited.. Under future without-project condition, measures to restore native Chihuahuan Desert arroyo riparian habitat and create permanent wetlands would not occur. Because climate change is unpredictable with unknown direct effects, no evidence currently exists to suggest a change in the current trend toward a declining quality of native habitat.

3.3. Future Without-Project Hydrologic Analysis

USACE computed flood peak discharges and volumes for both existing and future without-project watershed conditions. Hydrologic models developed for future conditions are essentially the same as the existing conditions models; however, USACE revised the percent of impervious cover for the entire basin to values ranging between 30% and 45% to reflect anticipated development conditions.

The hydrologic changes in peak discharge and runoff volume under future without-project conditions are significant in most cases. The 50.0%-chance peak inflow to Las Cruces Dam from Alameda Arroyo increases from about 500 cfs to nearly 1,100 cfs, and the hydrograph volume increases from 124 acre feet to about 420 acre feet. The increase in the 1.0%-chance flows on Alameda Arroyo is less on a relative basis; the peak discharge increases from 6,235 cfs to 7,166 cfs, and the hydrograph volume increases from 1,530 acre feet to 2,120 acre feet. Table 3.1 summarizes peak flows and hydrograph volumes for each of the main arroyos downstream from their respective CCC dams and their inflows to Las Cruces Dam.

Table 3.1 – Summary of Peak Flows and Volumes under Future Without-Project Conditions for the Four Primary Arroyos at Las Cruces Dam					
		Outflow from Upstream Dam		Inflow to Las Cruces Dam	
Arroyo	Percent Chance Event	Peak Discharge (cfs)	Volume (acre feet)	Peak Discharge (cfs)	Volume (acre feet)
Alameda	50	990	237	1,095	419
	20	1,453	472	2,167	819
	10	2,297	621	2,841	1,075
	4	3,458	838	4,886	837
	2	4,420	1,014	5,646	1,740
	1	5,529	1,234	7,166	2,116
North Fork	50	120	115	603	194
	20	136	190	989	311
	10	331	253	1,284	411
	4	956	343	1,679	552
	2	1,451	419	1,993	672
	1	2,020	501	2,492	802
South Fork	50	93	108	473	216
	20	109	168	786	338
	10	327	218	1,026	439
	4	876	293	1,430	590
	2	1,358	355	2,331	715
	1	1,849	424	3,253	854
Little	50	8	7	162	27
	20	9	11	284	42
	10	10	14	383	55
	4	10	19	522	75
	2	11	23	629	92
	1	12	28	734	110

3.4. Future Without-Project Hydraulic and Sediment Transport Analysis

3.4.1. Future Without-Project Hydraulic Analysis

No changes were made, or were necessary, to the existing without-project hydraulic analysis to represent future without-project conditions.

3.4.2. Future Without-Project Sediment Analysis

Urbanization can have a significant impact on natural channels because it causes the amount and frequency of runoff to increase due to the increase in impervious area and because it tends to cause a long-term decrease in the sediment supply. Arroyos in arid regions, such as the Las Cruces area, are particularly sensitive to changes in water and sediment supply. During the initial stages of urban development, runoff volumes and sediment yields can increase significantly due to disturbances associated with construction activities and erosion of unprotected areas that are subjected to the higher runoff. As time passes after completion of the major construction activities, the runoff volumes remain high, but the sediment yields tend to decline to pre-urbanization levels or less (Wolman, 1967; Wolman and Schick, 1967). Assessment of the effects of urbanization must, therefore, consider both short- and long-term adjustments to the changes in water and sediment yields.

Arroyos tend to erode and enlarge due to increased runoff following urbanization (Richards, 1982; Hammer, 1972; Park, 1977), and this situation can be amplified when the sediment supply is also reduced as a result of urban development. When stability thresholds are exceeded, systematic disequilibrium occurs, and recovery to a new state of equilibrium follows a complex, but predictable, sequence of adjustments. The most significant hazard to public safety along incised channel reaches is often related to lateral erosion into adjacent property and infrastructure rather than flooding, because the capacity of the incised channel is typically quite large. However, the sediment that is eroded during the incision process is carried downstream, where it can deposit in low energy zones, decreasing channel capacity and potentially increasing the flood hazard in the depositional zones. In addition, excessive incision can remove natural vegetation and destroy habitat adjacent to the channel.

The flows under future without-project conditions within the Las Cruces Dam watershed are substantially higher than those under existing conditions. As a result, the bed material transport capacities will also increase substantially in the short-term. For the condition in which the existing dams remain in place, the short-term aggradation and degradation trends are generally very similar to those under existing hydrologic conditions, but the magnitudes of the changes tend to be larger. The sediment load to the Las Cruces Dam reservoir pool will increase substantially under short-term future conditions.

Fine-sediment (wash-load) yields were computed based on future conditions hydrology and the corresponding changes in land use (percent of impervious cover). Combining wash loads with the estimated future conditions bed-material yields indicates that the total annual sediment load to Las Cruces Dam is estimated to be about 8.7 acre feet (18,700 tons) under existing conditions, increasing to about 16.4 acre feet (35,250 tons) under short-term future conditions.

The future conditions hydrology models were developed using the assumption that 30% to 45% of the watershed will be impervious. Coupled with small detention basins that are often used to control runoff from developed areas, the tributary sediment supply under future conditions will likely be 30% to 50% less than under existing conditions. In the long-term, the entire reach will adjust to accommodate the reduced sediment supply from upstream areas and local tributaries. With the existing CCC dams remaining in place, the long-term aggradation and degradation

trends associated with the greater runoff volumes and reduced sediment supplies will cause a significant degradational tendency throughout each arroyo.

Based on short-term and long-term future without-project estimates, the combined annual total sediment load to Las Cruces Dam is likely to increase from about 8.7 acre feet under existing conditions to about 16.3 acre feet in the short-term, and then decrease to about 2.6 acre feet under long-term future conditions.

3.4.3. Long Term Sediment Supply to Las Cruces Dam Reservoir Pool

Table 3.2 lists total average annual sediment yields. As part of the sediment transport analysis performed by MEI, investigators assessed potential downstream sedimentation impacts caused by failure or breaching, with and without erosion protection, of the CCC dams. Erosion protection assumed that a grade-control structure would be constructed with the sill at approximately the top of the existing reservoir sediment deposits with a notch cut in the dam to the elevation of the sill to prevent erosion of most, if not all, of the deposits. If the upstream dams were to fail, the load to the reservoir pool would increase to about 9.4 and 15.3 acre feet under existing and future hydrologic conditions, respectively. The additional sediment supply from the CCC dams under the intentional breaching with protection condition affects only the upstream subreaches along each arroyo and does not affect the total yield to Las Cruces Dam.

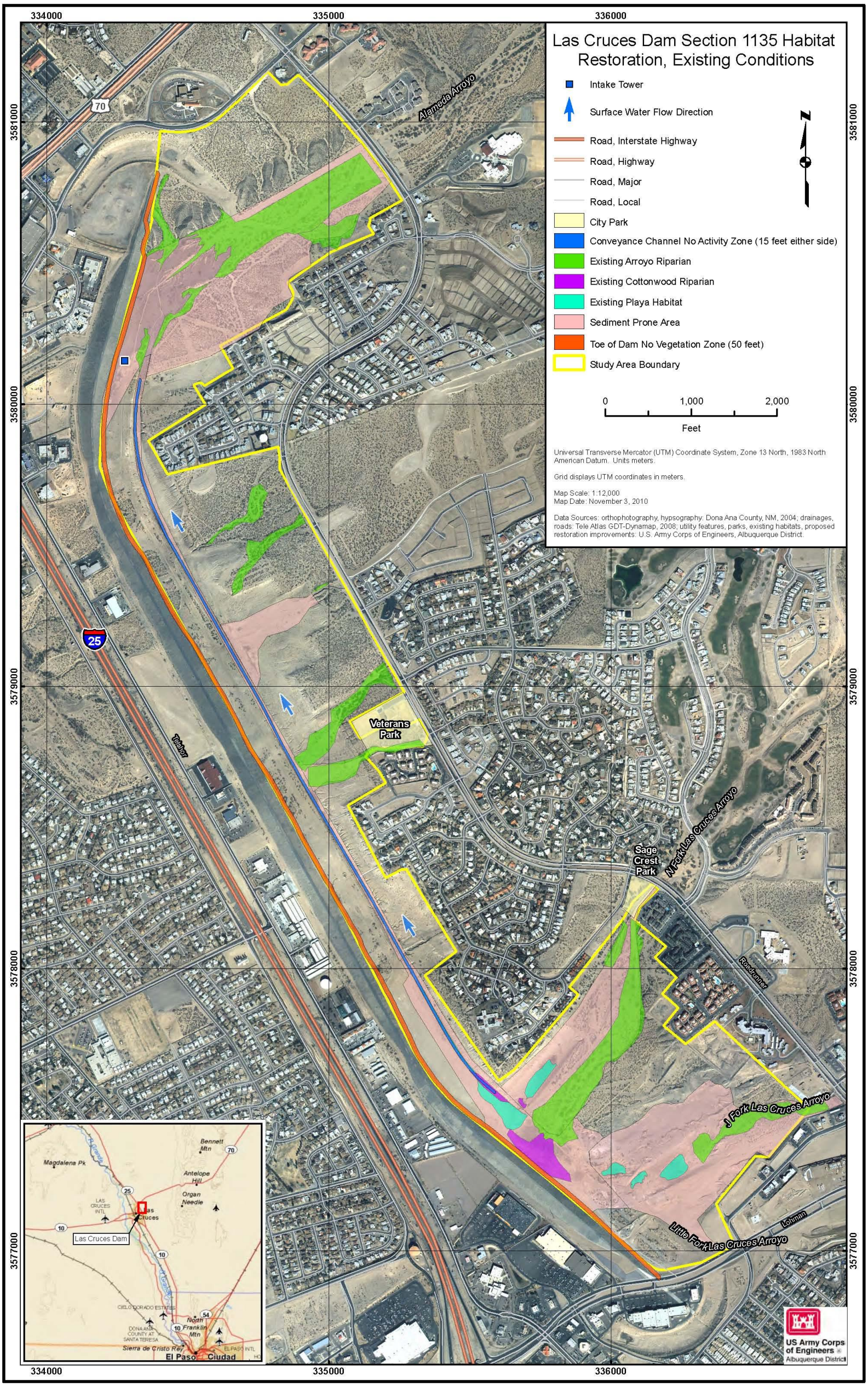

Figure 3.1 - Map showing existing habitat and sediment prone areas.

The four primary arroyos enter the reservoir pool at different locations, making deposition estimates within the pool difficult. Alameda Arroyo enters along the north end of the pool, and remains relatively channelized for a distance of at least 1.5 miles. The confluence of North Fork, South Fork, and Little Arroyos is located near the south end of the pool, and consists of many minor depressions. Assuming a depositional area of about 20 acres near the inlet from Alameda Arroyo, only about 0.17 feet of deposition would occur in that area on an average annual basis under existing conditions, and assuming that the confluence of the remaining three arroyos is approximately 40 acres, about 0.13 feet of deposition would occur annually.

Table 3.2 – Total Mean Annual Sediment Yield to Las Cruces Dam (acre feet)	
Existing Conditions	**8.7**
Future Conditions (Short Term)	**16.3**
Future Conditions (Long Term)	**2.9**
Dam Failure Without Protection (Existing)	**9.4**
Dam Failure Without Protection (Future)	**15.3**
Intentional Breach With Protection (Existing)	**8.7**
Intentional Breach With Protection (Future)	**16.3**

3.4.4. Sediment Transport Conclusions

This section discusses the relevant conclusions of the sediment transport analysis. A more detailed discussion appears in Technical Appendix B (USACE, 2010). Results show that the arroyos are generally in approximate equilibrium with the sediment supply that is derived from the upstream reach and local tributaries. The analysis is also consistent with the observed incision that has occurred downstream from Roadrunner Parkway on the North and South Fork Arroyos. The incision and associated channel widening are likely to continue as the channel adjusts to the upstream water and sediment supply. The reach of Alameda Arroyo downstream from Roadrunner Parkway is mildly degradational under existing conditions, and this degradational tendency will most likely become much stronger as the upstream watershed continues to develop.

Roadrunner Parkway is located at the approximate upstream limit of the Las Cruces Dam reservoir pool. The reaches immediately downstream from Roadrunner Parkway for approximately 1,200 to 1,500 feet on the four larger Arroyos and approximately 800 feet of the smaller flow paths have incised and the channels are relatively unstable. Below these reaches the arroyos transition immediately to sediment fans deposited in the flood pool basin of the Las Cruces Dam. As these sediment fans continue to build they will progress upstream into the incised reaches of the arroyos until they are at or near the crossings at Roadrunner Parkway.

Combined annual total sediment load to Las Cruces Dam is likely to increase from about 8.7 acre feet under existing conditions to about 16.3 acre feet in the short-term, and then decrease to about 2.6 acre feet under long-term future conditions. The design of the Las Cruces Dam for

Flood Risk Management purpose accounts for this sediment occupying a portion of the flood pool; therefore, it is not anticipated that any of the sediment would be removed. Those plant species adapted to a relatively high rate of sedimentation will persist or colonize the sediment fans; however, low lying areas of the southern end of the reservoir basin that currently retain standing water will be filled with sediment over the next 30 years, approximately.

3.5. Water Quantity

3.5.1. Precipitation and Stormwater Runoff

Water quantity from precipitation and storm water runoff in the study area would increase under the future without-project conditions. Future development adjacent to the study area is likely, which would increase the impervious area causing an increase in the amount and frequency of runoff within the study area.

3.5.2. Groundwater

Under future-without project conditions, groundwater levels within the study area are expected to be further impaired from increased human population densities and corresponding water demand in adjacent areas.

3.6. Water Quality

The only reliable source of surface water under existing conditions is from stormwater runoff. Future without-project conditions are expected to entail continued development near the study area. An increase in stormwater runoff would be likely due to the increase in impermeable surfaces within the watershed, and, therefore, an increase in contaminants in the stormwater would be expected. In addition, the City's new maintenance plan may require the City to keep the drainage channel free of debris and sediment so that water can be quickly conveyed to the outlet structure. Under existing conditions, the drainage channel gets plugged and standing water often occurs. Under this regime, contaminants and sediment have time to settle out prior to the water reaching the outlet structure. If the City continually maintains the drainage channel, contaminants and sediment would not have time to settle out and, therefore, turbidity may increase. Water quality can be expected to decrease under the future without-project conditions.

3.7. Air Quality and Noise

The City of Las Cruces has a maintenance plan that they are required to comply with in order to meet dam safety requirements. Under future without-project conditions, activities within the dam pool area would continue to occur in order to maintain this area, and some affects to air quality by maintenance associated with the dam or other potential projects in the area could continue. Intermittent use of machinery could have minor and temporary effects on air quality under future without-project conditions. Noise due to use of heavy equipment within the dam pool area could be expected in order to keep the drainage channel clear of sediment. This would have a temporary increase in noise effect.

3.8. Ecological Resources

Future without-project conditions would reflect the opposing trends of vegetation recruitment and habitat degradation. Overall, there would be a slight increase in the quantity of native arroyo riparian habitat over time. Shrub density data collected from proposed arroyo riparian restoration sites confirm that arroyo riparian shrubs have begun colonizing some areas during the 35 years since Las Cruces Dam was constructed. Eight of the fourteen plots sampled from proposed restoration areas contained small shrubs. One of these plots contained two shrub species; the other plots contained only one species per plot. Therefore, the expected increase in arroyo riparian habitat would take time, would not occur in all areas, and would not occur as quickly as it would if the project were implemented. Furthermore, species richness in the study area would remain unchanged. Under existing and future without-project conditions, only three or four species that are typical of native arroyo riparian habitat are dominantly present. Other plant species that are characteristic of arroyo riparian habitat do not currently exist within the study area and would not move into the project area in the future without the project. The existing playas would continue to be largely devoid of vegetation and this habitat eventually would be buried due to sedimentation. However, these areas would gradually convert to native arroyo riparian habitat. The cluster of existing cottonwoods would most likely persist through sedimentation due to the layered fine sediments forming perched water tables. However, without the project, further expansion of the cottonwood stands is unlikely. Two cottonwood recruitment events have occurred in the 35 years since dam construction, and the most suitable areas for cottonwood have already been colonized. Exotic invasive plant species would continue to increase, especially in areas that are not prone to high sediment loads. The study area would continue to be subject to wind and water erosion, resulting in deterioration of native arroyo riparian and upland shrub vegetation in parts of the project area. Habitat degradation within parts of the study area would occur due to increased development and a possible increase in dumping and off-road vehicle use. This could result in some locations within the study area becoming so degraded that they would be of little value as wildlife habitat. Migratory and resident birds and a wide variety of other wildlife species that depend on native vegetation or wetland habitats would continue to be faced with diminishing quality habitat and increasing constraints as described above.

3.9. Special Status Species

3.9.1. Peregrine Falcon

Although the preferred habitat of the Peregrine Falcon does not exist within the study area, it may fly over the study area during migration. The future without-project conditions would not differ from the existing conditions for the Peregrine Falcon.

3.9.2. Burrowing Owl

The City of Las Cruces Public Works Department has been working with Dr. Martha Desmond (NMSU) regarding the Burrowing Owls behind the Las Cruces Dam, in the spillways of the dam, at the Munson Drainage Pond, and at the El Molina Drain. Within the last year, Dr. Desmond and her students installed a total of 16 pairs of burrows at 16 nest sites. Burrowing Owls have

been observed using these artificial burrows. Therefore, existing habitat conditions would change and potentially increase within the study area under future without-project conditions.

3.10. Cultural Resources

No known historic properties or tribal concerns exist in the project's Area of Potential Effects (APE) as defined by 36 Code of Federal Regulation (CFR) 800.16(d) and by the proposed project description. State Historic Preservation Office consultation, with their concurrence of "no historic properties" for the APE, is located in Technical Appendix D (USACE, 2010). Consequently, future without-project conditions would have no effect on historic properties.

3.11. Land Use and Recreational Resources

Increased growth in the Las Cruces metropolitan area would be a further burden on the study area; however, the area would remain otherwise undeveloped. Increased population densities and corresponding water demand in adjacent areas could lower the water table further. Residential development on the east mesa, adjacent to the study area, could increase the number of visitors to the study area. In a future without-project setting, the lack of restoration and the design of a formal trail system to accommodate these additional users could result in even greater disturbance to existing wildlife habitat, further accelerating its decline. The potential for fire, off-road vehicle use, and dumping are likely to increase. Some of these problems might be addressed by local agencies if the project were not implemented, but not at as large of a scale or as expeditiously.

3.12. Socioeconomic Considerations and Environmental Justice

Under future without-project conditions, the existing conditions of neighborhoods adjacent to the dam pool area are likely to remain comparable to the present situation. However, the City of Las Cruces does have a Recreation Master Plan. Recreational features may be constructed in the future by local agencies; however, currently this is unknown. Under future without-project conditions, the neighborhoods would not benefit from potential improvements in quality of life stemming from restoration opportunities. Currently, there are no known restoration plans by local agencies for the Las Cruces Dam pool area.

3.13. Aesthetics

Under future without-project conditions, the reservoir pool area would continue to deteriorate aesthetically according to both conventional scenic vista and proposed vibrant ecology standards. Although there would be a slight increase in shrubs in some areas, the overall project area would continue to experience soil erosion, impacts from increased human use and surrounding urbanization, and increased numbers of non-native species. In addition to failing to mitigate the unaesthetic experience of the reservoir pool area, the future without-project would fail to address habitat degradation in erosion-prone areas and increased non-native species populations. Some efforts by local agencies and other initiatives, such as the City's Recreation Master Plan, might assist in improving aesthetics, but not to the level and quality that is proposed by this project. Currently, there are no known restoration plans by local agencies for the Las Cruces Dam pool area.

3.14. Environmental Engineering

No environmental engineering changes would result from the future without-project conditions.

4. PLAN FORMULATION AND EVALUATION

4.1. Summary of Historic and Existing Conditions

Construction of Las Cruces Dam and urbanization of the watersheds of the Alameda and Las Cruces Arroyos have disrupted flow paths and riparian corridors, altered the hydrology, and directly removed or degraded habitats along these arroyos and tributaries. The dam terminates the paths of the arroyos that historically passed through the study area. Soil used to construct the dam was excavated from what is now the flood pool, leaving nearly 400 acres of disturbed landscape. The disturbed area remains poorly vegetated 35 years later. Arroyo riparian vegetation has colonized a few of the disturbed sites; however, these areas lack the diversity of shrub species found in high-value arroyo riparian habitats.

Figure 4.1 - Photos of a portion of the flood pool from 1975 at completion of dam construction (Black and white) and in 2005 (color).

Urbanization of the area surrounding Las Cruces Dam has also had an adverse effect on the riparian habitats and corridors. The amount of impermeable surfaces and, therefore, storm flows have increased in the arroyos and caused incising of the channels immediately upstream of the study area to Road Runner Parkway. The Las Cruces Dam and encroaching development across the historic floodplain have also bisected wildlife corridors upstream of the study area.

The arroyos entering Las Cruces Dam naturally carry a high sediment load. Development upstream of the basin and the disposition of historic CCC dams within the watershed have impacted, and will continue to impact, the amount and timing of sediment entering Las Cruces Dam. Future conditions with and without the project account for the effects of this sedimentation. Figure 3.1 displays the habitat and sediment prone areas.

Since the construction of Las Cruces Dam, some changes have occurred in the types of plant communities that occur at that location. Altered hydrogeomorphology from the dam construction has provided the conditions for tall grass and cottonwood stands to develop. The non-native Johnsongrass has formed a monotypic stand covering the delta at the mouth of Alameda Arroyo in the flood pool basin. Rio Grande cottonwood became established in the mid to late 1990s and formed a stand in the southern portion of the flood pool basin. These habitats would normally be associated with a wetter condition such as that found along the Rio Grande or a perched water table near a seep or spring.Alternative Development Rationale
The planning process for this study has been driven by the overall objective of developing an ecosystem restoration plan that most reasonably maximizes net ecosystem restoration benefits by producing the maximum quantity of habitat or the most improvement in habitat value for the cost. The USACE follows a six-step planning process to provide a rational framework for problem solving and sound decision making:

- The specific problems and opportunities to be addressed in the study are identified and the causes of the problems are discussed and documented. Planning goals are set, objectives are established, and constraints are identified.

- Existing and future without-project conditions are identified, analyzed, and forecasted. The existing condition resources, problems, and opportunities critical to plan formulation, impact assessment, and evaluation are characterized and documented.

- The study team formulates restoration measures that address the planning objectives. An initial set of alternative measures is developed and evaluated at a preliminary level of detail.

- Alternative plans are developed using combinations of combinable restoration measures and evaluated for effectiveness, efficiency, completeness, and acceptability. The impacts of alternative plans are evaluated using the system of accounts framework specified in the USACE Principles and Guidelines and the Planning Guidance Notebook.

- Alternative plans are compared to each other to determine which best meets the criteria mentioned above. A cost effectiveness and incremental cost analysis is used to prioritize

and rank ecosystem restoration alternatives based on the cost of alternatives and the non-monetary metrics of benefits produced by each alternative. A public involvement program obtains public participation in the alternative identification and evaluation process.

- The study team selects plans that maximize benefits and minimize costs (consistent with the Federal objective). The least expensive plan that meets the planning objective is generally identified as the Tentatively Selected Plan.

4.2. *Public Scoping and Collaboration

4.2.1. Public Scoping

A number of public and governmental coordination meetings were held during the reconnaissance and early feasibility phases of the study. Contributions from Federal, state, and local agencies were received through coordination and project meetings as well as public meetings. These meetings were attended by USFWS, City of Las Cruces Planning Department, New Mexico Department of Game and Fish, and others. On April 1, 2002, a meeting was held with stakeholders, including the above agencies and several non-governmental organizations and researchers, to poll concerns on issues relating to Las Cruces Dam. On May 19, 2010, a public meeting was held to present potential restoration efforts and poll public concerns. USACE met with the Las Cruces City Council September 13, 2010, to present the Tentatively Selected Plan for Council resolution.

Scoping letters were sent to various public agencies and the interested public (Addendum A of this report) and meetings were held in regard to the project during the planning process. Agency and public contribution was received and is presented in Addendum A.

4.2.2. Collaboration

Early in the process, a Habitat Evaluation Team (HET) comprised of local biologists was formed to assist the study team with habitat evaluation and expected project benefits. Representatives from the USACE Albuquerque District, U.S. Fish and Wildlife Service (USFWS), New Mexico Department of Game and Fish (NMDGF), Mesilla Valley Audubon Society, and New Mexico State University actively participated in the assessment process.

4.3. *Public Concerns

USACE identified public concerns during the course of the reconnaissance and early feasibility phases of the study. Contributions came from Federal, state, and local agencies (listed above) through coordination and project meetings as well as public meetings.

The public and agency concerns that are related to the establishment of planning objectives and planning constraints are:

- Persistence of sparse or unvegetated areas left from dam construction, maintenance, unregulated off-road activity, and mining operation.

- Las Cruces Dam encompasses a large natural area with some high-quality habitat; however, the majority of the habitats are largely degraded and in need of improvement.

- No permanent water sources are available for wildlife within the Las Cruces Dam reservoir area. The project is constrained to the minimal water available provided by the East Mesa Water Reclamation Facility. Disconnected wildlife corridors eliminated access to the Rio Grande.

- Existing resources in the Las Cruces Dam reservoir area include seasonal wetlands (playas) that support terrestrial wildlife, waterfowl, shorebirds, and organisms such as tadpole and fairy shrimp. These areas should be improved and preserved.

- Plants and animal communities have low species diversity relative to other, high-quality habitats in the area.

- Restoration measures should not adversely affect the flood risk management function of the dam and, if possible, lower the maintenance requirements of the dam and basin.

- Preservation of cottonwood trees and playas.

- The community area lacks interpretive features with valuable educational opportunities.

- A large area within the urban community lacks recreational amenities.

- The presence of non-native species has or could degrade existing habitat.

4.4. Problems and Opportunities

Water resources projects are planned and implemented to solve problems, meet challenges, and seize opportunities. In the planning setting, a problem can be thought of as an undesirable condition such as some of those expressed by the public and listed above. An opportunity offers a chance for progress or improvement of the situation. The identification of problems and opportunities gives focus to the planning effort and aids in the development of planning objectives. Problems and opportunities can also be viewed as local and regional resource conditions that could be modified in response to expressed public concerns. This section identifies the problems and opportunities in the study area based on the assessment of existing and expected future without-project conditions.

On a regional scale, estimates of riparian habitat loss in the southwestern U.S. range from 40% to 90% (Dahl, 1990), and desert riparian habitats are considered to be one of the region's most endangered ecosystems (Minckley and Brown, 1994; Noss et al., 1995). Decline of natural riparian structure and function along the Rio Grande was recognized in the 1980s as a major ecological change (Hink and Ohmart, 1984; Howe and Knopf, 1991). In ecological terms, the cumulative effects of agriculture, urban development, and flood risk management measures initiated over the past several decades have resulted in a disruption of the original hydrologic and hydraulic regime and the ultimate degradation of the Rio Grande riparian ecosystem.

Opportunities exist to restore Rio Grande floodplain habitats to a less degraded and more natural state.

Combining the regional problems of habitat loss and degradation with the concerns presented in the previous section, USACE used the following problem and associated opportunity statements to formulate the study objectives:

- Loss of quantity and quality of riparian habitats in the Las Cruces Dam flood pool area.

The opportunity exists to restore areas of sparse or no riparian vegetation and increase the value of existing habitat that lacks diversity.

- Loss of connectivity of arroyo riparian habitat that comprise wildlife corridors along Alameda Arroyo, the North and South Forks of Las Cruces Arroyo, and Little Arroyo.

The opportunity exists to restore connectivity of existing arroyos or provide additional connectivity within the study area.

- Overall loss of riparian and wetland habitats along the Rio Grande flyway that provide stopover, feeding, and resting places for migratory birds and waterfowl.

The opportunity exists to create rare and valuable wetland and riparian habitats within the study area.

- Some non-native plant species are outcompeting native species, and other non-native species are beginning to establish themselves in the Las Cruces Dam reservoir area.

The opportunity exists to remove non-native plants growing in the study area and prevent the establishment of additional non-native plant species.

- The study area lacks recreational and interpretive amenities.

The opportunity exists to create additional recreational amenities that are compatible and compliment restoration measures.

4.5. Planning Objectives and Constraints

Planning objectives and constraints provide a framework for the development of alternative plans. Planning objectives are statements of what a plan is attempting to achieve. Planning objectives communicate to others the intended purpose of the planning process. Constraints are limitations imposed on the scope of the study from physical, political, or social considerations. For instance, the total long-term average-annual sediment supply to Las Cruces Dam is expected to increase under future without-project conditions and further degrade the habitat in the reservoir pool.

4.5.1. Federal Objectives

As planning objectives for this investigation, it is in the Federal interest to:

- Contribute to the National Ecosystem Restoration (NER) objective through restoration, with contributions measured by changes in the amounts and values of habitat. Numerous Federal laws and executive orders exist that have established the National policy for, and Federal interest in, the protection, restoration, conservation, and management of environmental resources. The focus of NER projects is "the restoration of ecosystems and ecological resources and not restoration of cultural and historic resources, aesthetic resource or cleanup of hazardous and toxic wastes" (ER 1105-2-100, Appendix E). Ecosystem restoration projects implemented by the USACE might not be capable of addressing every undesirable condition associated with an ecosystem, but should focus on restoration of "degraded significant ecosystem structure, function and dynamic processes to a less degraded, more natural condition" (ER 1105-2-100, Appendix E).

- Contribute to the National Economic Development (NED) consistent with protecting the nation's environment, pursuant to national environmental statures, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation.

- The Regional Economic Development (RED) account is intended to illustrate the effects that the proposed plans would have on regional economic activity and, specifically, on regional income and regional employment.

- The Environmental Quality (EQ) account is another means of evaluating the alternatives to assist in making a plan recommendation. This account is intended to display the long-term effects the alternative plans could have on significant environmental resources.

- Contributions to the Other Social Effects (OSE) account include long-term impacts to public facilities, health and safety, recreation, and community values.

4.5.2. 4.5.2 USACE Environmental Operating Principles

The Corps of Engineers has reaffirmed its commitment to the environment by formalizing a set of "Environmental Operating Principles" to be incorporated into formulation of project alternatives and contributing to decision-making and programs. These principles foster unity of purpose on environmental issues, reflect a new tone and direction for dialogue on environmental matters, and ensure that employees consider conservation, environmental preservation, and restoration in all Corps activities. By implementing these principles, the Corps will continue its efforts to develop the scientific, economic, and sociological measures to judge the effects of its projects on the environment and to seek better ways of achieving environmentally sustainable solutions. The principles are described in Engineering Circular 1105-2-404, "Planning Civil Work Projects under the Environmental Operating Principles," 1 May 2003.

- Achieve Environmental Sustainability. An environment maintained in a healthy, diverse, and sustainable condition is necessary to support life.

- Consider Environmental Consequences. Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of Corps programs and act accordingly in all appropriate circumstances.

- Seek Balance and Synergy. Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

- Accept Responsibility. Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that affect human health and welfare and the continued viability of natural systems.

- Mitigate Effects. Seek ways and means to assess and mitigate cumulative effects to the environment; bring systems approaches to the full life cycle of our processes and work.

- Understand the Environment. Build and share an integrated scientific, economic, and social knowledge base that supports a greater understanding of the environment and effects of our work.

- Respect Other Views. Respect views of individuals and groups interested in Corps activities; actively listen, and learn from their perspective in the search to find innovative win-win solutions to the nation's problems, solutions that also protect and enhance the environment.

4.5.3. Project Specific Objectives

The national objectives of NED and NER are general statements and not sufficiently specific for direct use in plan formulation. The water and related land resource problems and opportunities identified in this study are stated as specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect the problems and opportunities and represent desired positive changes in the without-project conditions.

Ecosystem restoration projects require that the planning team develop objectives and constraints that apply to a systems approach and take into consideration "aquatic wetland and terrestrial complexes, as appropriate, in order to improve the potential for long-term survival as self-regulating, functioning systems" (ER 1105-2-100, Appendix E). Objectives and constraints must be specific to the ecosystem as well as realistic and attainable in order for the planning process to succeed.

Based on the identified problems and opportunities, USACE developed key objectives of the feasibility study that include:

- Increase the amount and quality of riparian and wetland habitats within the project area, beginning in 2012 and realizing all habitat improvement objectives by 2017.

- Increase the overall connectivity of arroyo riparian habitats through the study area. This is expected to occur by 2017, once tree and shrub planting reach significant size.

- Provide a source of permanent water for wildlife within the study area. Creation of the permanent emergent wetland is expected to occur within one year of the start of construction. Water would be available to wildlife by 2012.

- Increase the amount and quality of riparian and wetland habitats within the study area to provide stopover, feeding, and resting places for migratory birds and waterfowl within the Rio Grande Flyway. Open water and wet meadow habitats would be available by 2012 with maturation of the vegetation and, therefore, realization of the full habitat benefits occur by 2017. Likewise, other riparian habitats would realize their full benefit according to the HSI models used by 2017.

- Opportunistically remove non-native plant species as part of the implementation of restoration measures. This would occur by 2013 at the completion of implementation of restoration measures.

- Provide additional recreational and interpretive amenities in the study area that are compatible and complimentary to the habitat restoration. All recreation amenities would be completed by 2013 along with the restoration measures.

4.5.4. Constraints

Constraints must also be specific to guide the planning process. The following constraints represent restrictions that limit alternative development or that need to be overcome:

- The Las Cruces Dam was built for flood risk management purposes, and the restoration measures cannot impair the ability of the dam to perform the function as designed. The USACE regulation ETL 1110-2-571 "Engineering and Design: Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures" requires that all woody vegetation be restricted from growing on or within 50 feet of the toe of the dam. As part of the operation and maintenance of the dam, the conveyance channel that connects Las Cruces and Alameda Arroyos must be maintained to be free of sediment. The City of Las Cruces dam maintenance plan calls for a 50-foot maintenance buffer on either side of the conveyance channel. For these reasons, no plantings or earthwork would be proposed for these areas or for the emergency spillways.

4.6. *Development of Alternative Plans

4.6.1. Alternative Plans and Measures

An alternative plan is made up of smaller components called management measures. Management measures initially considered in this study included restoring every native

vegetation community that would have naturally occurred within riparian or wetland areas within the project area, structural measures to address sediment input into some of the existing playas, and the addition of a permanent water source. For NEPA purposes USACE formulated alternative plans from various combinations of management measures based on their dependencies and exclusivities. The alternative plans were evaluated for cost effectiveness, completeness, and acceptability. Restoration measures, the smallest components of the alternative plans, were developed to provide a specific element or restorative function such as planting native riparian trees or diverting an arroyo to prevent sediment deposition in a seasonal playa wetland. Table 4.1 lists the seven proposed measures screened by the USACE and the five measures carried forward. The final array of measures is described in detail in the next section of this report. All measures are mutually exclusive in that they cannot be implemented at the same location and at the same time. For instance, a measure that includes creation of a wetland could not be implemented at the same location as planting arroyo riparian shrubs. Some measures were dependent on implementation of another measure or achieved a higher output when both measures were implemented. Measures were combined based on position in the landscape, dependencies, and combinability to form restoration measures. An initial screening eliminated unsuitable measures that exceeded the constraints of the project or were deemed impractical. Two measures that were deemed impractical early in the formulation process were measures to create sediment basins and to replace the non-native Johnsongrass with native tall grass species.

Sediment basins designed to trap sediment before entering the Las Cruces Dam flood pool would prevent existing seasonal wetlands (playas) from filling with sediment and allow for creation of permanent wetlands in the bottom of the basin. Mean annual sediment yield supplied by arroyo channels is approximately 8 Acre Feet, however, this rate is highly variable from year to year. In order to be effective, sediment basins would need to be located directly upstream of the project area. These locations are currently developed and would require land acquisition, relocation of occupants and demolition of structures. The sediment basins would affect restoration measures by preserving the playa areas and allow for a wetland to be built within the lower portions of the flood pool. The permanent wetland was relocated higher in the flood pool, out of the sediment prone areas. Allowing the sediment and water to flow into the basin has a positive effect on the arroyo riparian restoration measures.

Replacement of the non-native Johnsongrass with native species such as Alkali Sacaton would be ideal; however, the Johnsongrass is providing an ecosystem function that would be lost during the transition to native grasses. Furthermore, because the Johnsongrass is well established, the viability of the complete eradication and future exclusion of this species from the area is not a certainty. The habitat team decided that this measure was not practical due to the uncertainties of sustainability and the fact that the Johnsongrass in not likely to spread beyond the specific area of the flood pool basin where conditions are appropriate for its existence.

Several locations were investigated for placement of a permanent wetland. Ideal locations in the bottom of the flood pool basin are depressions that currently hold water for periods of time and are characterized by the habitat team as seasonal wetlands or playas. These low-elevation areas of the basin are prone to sedimentation. The existing playas or any wetland created in the lowest elevations of the flood pool would be inundated with sediment within 10 to 30 years. The persistence of the existing playas is limited as sediment will fill the depressions, transitioning the

playas to arroyo riparian or cottonwood habitats. The proposed permanent wetland location that was carried forward is outside of the sediment-prone areas and takes advantage of depressions created by sand and gravel mining operations.

A review of precipitation and runoff was conducted to determine if natural flows could be used as a supply of water to sustain a permanent wetland within the reservoir area. The supply of water from the watershed was estimated during the normal growing season, March through September, using local weather station data and the hydrologic model for the watershed. The analysis shows that the Las Cruces Dam reservoir area experiences minimal runoff during the period of March through June, the first four months of the growing season; therefore, USACE determined that water from natural runoff is not sufficient to support a permanent wetland restoration measure.

An alternative source of water that could be used to create a wetland comes from reclaimed wastewater. The East Mesa Water Reclamation Facility is located upstream of the Las Cruces Dam flood pool. The facility is intended to collect wastewater from the east mesa and treat it to produce high-quality reclaimed water that can be used for irrigation, primarily on the Sonoma Ranch Golf Course. During the winter months, excess water that will not be needed for irrigation may be disposed of by discharging it into Alameda Arroyo via the dam outlet. USACE anticipates that reclaimed water from the wastewater treatment plant will be available for use by this project. The water line carrying the reclaimed water to the dam outlet runs through the study area. Reclaimed water from this source will be available for the project in the amount of 10,000 to 20,000 gallons per day. The water source is dependable and can be regulated to deliver a known quantity of water throughout the year. USACE used this amount as the available water for permanent wetland alternatives in the analysis. The evaporation rate of 8,100 gal/ac/d was used as the maximum amount needed to support an emergent wetland during the growing season. Given the amount of available water, the maximum area of constructed emergent wetland that could be supported by reclaimed water is limited to approximately two acres.

Table 4.1 - Proposed Measures Screened and Carried Forward

Proposed Measures	Disposition
Sediment Traps	Screened - Cost Prohibitive
Johnsongrass Eradication/Replacement	Screened – Sustainability Uncertain
Arroyo Riparian Planting	Carried Forward for further analysis
Cottonwood Willow Planting	Carried Forward for further analysis
Create Permanent Wetland	Carried Forward for further analysis
Playa Plantings	Carried Forward for further analysis
Channel Diversion	Carried Forward for further analysis

4.6.2. Description of Proposed Restoration Measures

Five restoration measures were carried forward to be combined to form alternative plans and evaluated for efficiency and effectiveness. Table 4.2 presents these measures and the potential area of restoration for each measure. Figure 4.1 shows the locations of the proposed measures. The ultimate locations and area of restoration depend on the combination of measures included

in each plan because some measures are dependent on other measures. For example, cottonwood plantings around the margin of the permanent emergent wetland are dependent on the creation of a permanent wetland as a source of water. Table 4.3 in Section 4.8.2 displays the differences in acreage or habitat value for each measure when these dependencies are taken into account.

To quantify the environmental benefits necessary to compare the cost effectiveness of restoration measures, USACE commonly uses a measure of output termed a Habitat Unit (HU). Habitat Units are the non-monetary metric used to describe habitat value at any given time.

Table 4.2 - Proposed Measures and Total Potential Area of Restoration

Proposed Measures	Area (acres)
Arroyo Riparian Planting	71.99
Cottonwood Willow Planting	6.35
Create Permanent Wetland	2.19
Playa Plantings	3.60
Channel Diversion	0*

* The channel diversion influences the hydrologic function and longevity of some arroyo riparian and playa locations and, therefore, does not directly restore a particular area.

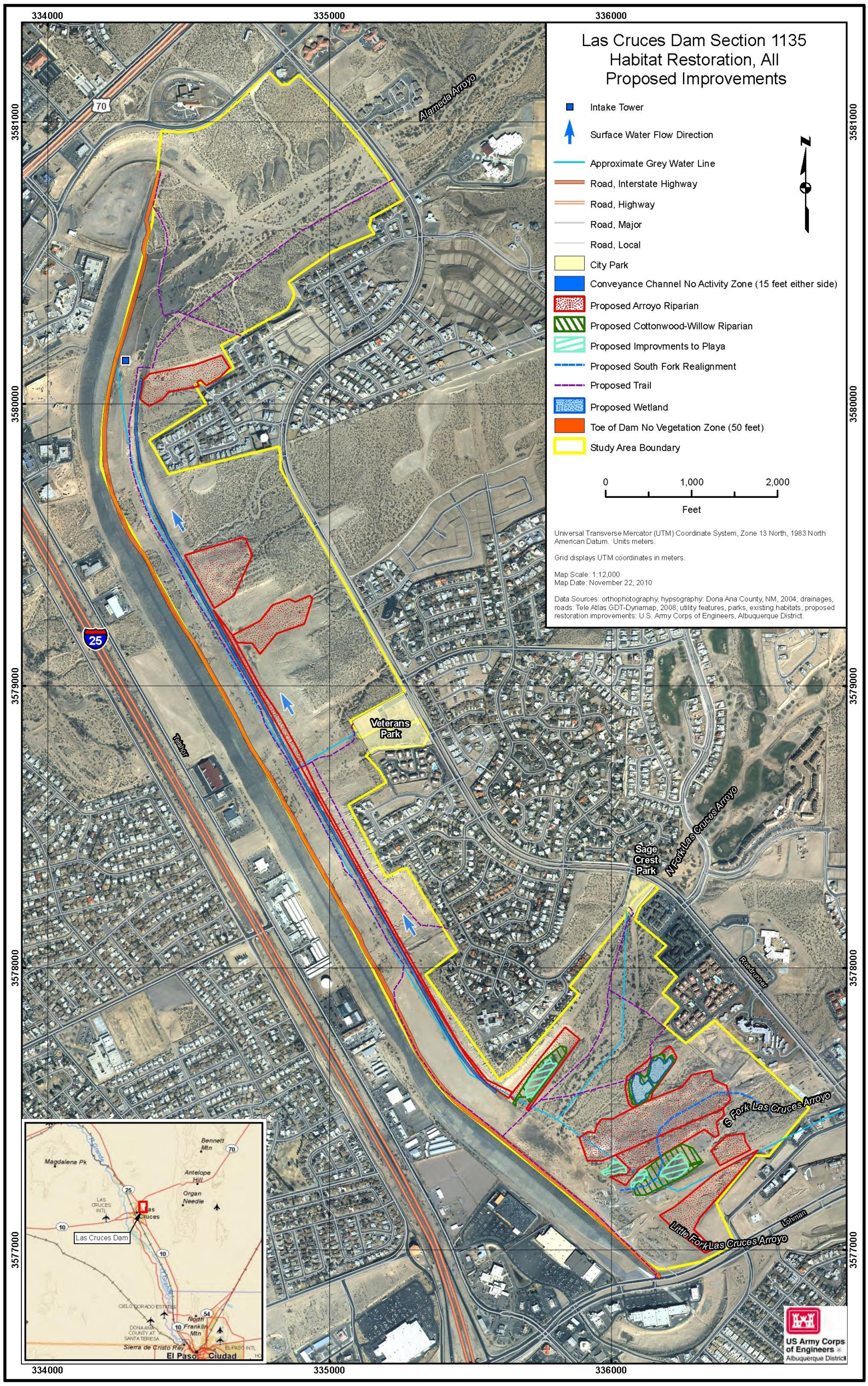

Figure 4.2 - Map Showing location of all proposed (post screening) restoration measures

4.6.2.a. Chihuahuan Desert Arroyo Riparian Areas

Historically, Alameda Arroyo and both forks of Las Cruces Arroyo provided invaluable riparian habitats to the area. The arroyos served as wildlife corridors that once led from the Rio Grande into the Organ Mountains and connected several arroyo systems. Alameda and Las Cruces Arroyos still contain patches of relatively diverse arroyo riparian habitat which serve as reference sites for this restoration measure. Construction of Las Cruces Dam across these arroyos bisected wildlife corridors and denuded the areas near the dam from which soil was taken for construction.

The Chihuahuan Desert Arroyo Riparian measure would restore approximately 72 acres of arroyo riparian habitat, improving its connectivity and diversity. The arroyo riparian plantings within the flood pool basin would provide a corridor of riparian vegetation connecting the Alameda and Las Cruces Arroyos. Restoring vegetation to these areas would also slow erosion and sedimentation. In this measure, a total of 1770 arroyo shrubs would be planted in clusters to form mottes, similar to the existing vegetation structure in the Alameda and Las Cruces Arroyos. Restoration areas would be planted with species already found in arroyos in the project area, including desert-willow (*Chilopsis linearis)*, four-wing saltbush (*Atriplex canescens*), apache plume *(Fallugia paradoxa)*, honey mesquite *(Prosopsis glandulosa)*, burrobrush (*Ambrosia monogyra*); little-leaf sumac (*Rhus microphylla*), and cutleaf brickellbush (*Brickellia laciniata).* USACE would add other appropriate species to increase diversity. Container-grown shrubs would be planted, and the shrubs will require irrigation and protection from rabbits during the three-year establishment period. Figure 4.3 is a conceptual drawing of Arroyo Riparian habitat.

When combined with the Channel Diversion/Realignment measure, one 17-acre block of proposed Arroyo Riparian habitat, the "gravel pit" site, would receive additional sediment and water, increasing the rate of plant growth. Therefore, Habitat Unit values are higher for the Arroyo Riparian restoration measure when combined with the Channel Diversion/Realignment measure.

Figure 4.3 - Arroyo Riparian Habitat (Conceptual Drawing)

4.6.2.b. Cottonwood-Willow Riparian

Small stands of Rio Grande cottonwood (*Populus deltoides* var. *wislizeniii*) became established in the southern end of the flood pool basin in the mid to late 1990s. The altered hydrogeomorphology caused by the dam created a condition favorable to establishment and persistence of this tree species and, therefore, would support cottonwood-willow-type riparian habitat. The cottonwood stands are recognized by the local community, especially the birding community, as a valuable ecological and aesthetic resource. Many resident and migratory bird species have been observed using the existing cottonwood trees. Cottonwood-Willow Riparian habitat provides wildlife cover, nest sites, and food, as well as shade for recreating humans, a niche for understory vegetation, and stability to the proposed permanent emergent wetlands. The Cottonwood-Willow Riparian measure would include the planting of 686 cottonwoods and associated understory vegetation in suitable areas within the flood pool but far enough from the dam to avoid conflicts with dam safety and maintenance requirements.

The proposed measure includes planting this vegetation type around the edges of two existing playas and the created wetland if the wetland were to be constructed. The three areas to be planted total 6.35 acres. Cottonwood poles or container-grown saplings would be planted to form a patchy canopy with gaps for understory species. Understory shrubs planted in the gaps would include Goodding's willow (*Salix gooddingii*) and coyote willow (*Salix exigua*). Other riparian shrubs would be added for diversity, such as seepwillow (*Baccharis salicifolia*), Torrey's wolfberry (*Lycium torreyi*), or arrow-weed (*Pluchea sericea*). Plants would require

watering and protection during their establishment period (see Planting Plan in Addendum D of this report).

The proposed cottonwood area surrounding the permanent emergent wetland, about 1.08 acre in size, would be planted only if a wetland is constructed. Without the wetland, the cottonwood restoration area would be reduced from 6.35 acres to 5.27 acres. Figure 4.4 displays a photograph of the existing cottonwoods at Las Cruces Dam, and Figure 4.5 is a conceptual drawing of the proposed cottonwood plantings around playas and playa vegetation.

Figure 4.4 – Existing cottonwoods at Las Cruces Dam

Figure 4.5 - Proposed cottonwood planting around playa and playa vegetation (This conceptual drawing does not depict the proposed density of these plantings)

4.6.2.c. Permanent Wetland Cells

Wetlands and the wet riparian habitats found within the Chihuahuan Desert contribute greatly to its biodiversity. Wetlands along the Rio Grande in the Mesilla Valley historically included marshes, wet meadows, oxbows, and seasonal ponds (Stotz, 2000). Away from the river, other perennial wetlands found in the Chihuahuan Desert include ciénegas, springs, and seeps. Before the construction of Las Cruces Dam, the Alameda and Las Cruces Arroyos were connected to the Rio Grande and to the Organ Mountains and provided a corridor along which wildlife could travel for access to water and wetland habitats. Providing a source of permanent water within the Las Cruces Dam area would restore the accessibility of water for local and migratory wildlife. A permanent water source would be used by wildlife, including migratory waterfowl, songbirds, and shorebirds using the Rio Grande Flyway. The scarcity of freshwater habitat in this arid ecoregion makes wetland habitat a restoration priority.

The Permanent Emergent Wetland restoration measure would mimic a ciénega or spring like those found in nearby mountains and increase the quantity and diversity of Chihuahuan wetland habitat. A source of permanent water would enable the project area to support a greater diversity of native plant and wildlife species. The proposed wetland would be supplied by reclaimed water provided by the City of Las Cruces. Early planning included wetlands of various sizes and with varied numbers of cells; however, the amount of water available to commit to this restoration measure ultimately determined the size and composition of the wetland. The City of Las Cruces uses reclaimed wastewater for irrigation of parks and medians as part of a recreation master plan. Based on forecasted demand and supply of wastewater the city was able to commit 10,000 gallons per day for the supply of a permanent wetland measure.

The small volume of water available limits size of this measure to two one-acre cells. The first cell would have permanent standing water with a central open water area six feet deep. This cell would contain taller, aquatic and emergent wetland species appropriate for constant inundation, including bulrushes (*Schoenoplectus* spp.) in the deeper water and spikerushes (*Eleocharis* spp.), rushes (*Juncus* spp.), and sedges (*Carex* spp.) in the shallower water. Native riparian shrubs such as coyote willow (*Salix exigua),* seepwillow (*Baccharis* spp.), threeleaf sumac (*Rhus trilobata),* and New Mexico olive (*Forestiera pubescens*) would be planted around the fringes with native grasses such as vine mesquite (*Panicum obtusum*), saltgrass (*Distichlis spicata*), tobosa (*Pleuraphis mutica*), and scratchgrass muhly (*Muhlenbergia asperifolia*). Water would be routed from the first cell to the second cell, a moist-soil wet meadow. This area would have vegetation similar to the shallow-water and fringe areas of the first pond, but would not support bulrushes, which require deeper permanent water. Both wetland cells would be planted with sedges and rushes from plugs set into moist soil. A total of 61,920 plugs would be planted in the wetlands and around their edges.

Adding wetlands to the proposed project has positive effects on two other habitat types present at Las Cruces Dam. In the models used to calculate environmental benefits (Habitat Units), the presence of permanent water nearby improves the habitat value of the seasonally-flooded playas and provides for additional Habitat Units. The wetland cells also provide another location for cottonwood planting around their margins, increasing the acreage available for cottonwood restoration. Figure 4.6 is a conceptual drawing of the proposed wetland cells.

Figure 4.6 – Permanent Wetlands (Conceptual Drawing)

4.6.2.d. Playa Vegetation

Several basins and borrow pits within the study area experience periodic inundation and ponding following large or consecutive rainfall events. These areas are functioning as playas, intermittently flooded basins that are valuable foraging areas for wildlife, especially migratory water birds. The playas at Las Cruces Dam currently have little or no vegetation and are not meeting their full potential as habitat. Vegetation has not established in or around the playas because the playas have no connection to, and are distant from, any natural source of seed or plant propagules. Additionally, the playas fluctuating water level and dry cycles make it unlikely that any seeds that arrive would encounter suitable conditions for germination.

The Playa Vegetation measure would add vegetation to 3.6 acres in and around four playa basins. The proposed restoration measure would apply both seed and live plants suitable to this habitat. Live plants would only be used for those species that do readily reproduce from seed. These plants will be watered to aid their establishment. Once established, these plants would act as seed sources or would spread vegetatively. Plant materials would include 13,650 wetland plants and grasses as "plugs" and 10.2 pounds of native grass seed. Grasses would be seeded during the monsoon season with seeding repeated during summer and fall the year after the remaining plantings are completed, as needed. Different scales of plantings were considered during early planning, including planting all live plants, planting throughout the entire playa basin and planting at densities that would maximize ground cover at implementation. There is some uncertainty how successful playa plantings may be due to fluctuating water levels and highly variable seasonal rains. The current planting plan for this measure provides a start for plants to self propagate and proposes multiple plantings to take advantage of wet conditions when they occur.

Vegetation within the playa would provide habitat for terrestrial species when the playa is dry. When flooded, the vegetation within the playa would provide food for waterfowl and amphibious

or aquatic species and a greater surface area for algal growth. Figure 4.7 shows riparian grasses and wetland plants indicative of those included in this measure.

Figure 4.7 - Riparian grasses and wetland plants such as these would surround the playas

Sedges and rushes would be planted in the shallow water areas, and grasses would be planted around the moist soil margins of existing playas. Species such as spikerushes (*Eleocharis macrostachya, E. palustris*) and Baltic rush (*Juncus arcticus* var. *balticus*) would grow in shallow water at the edges of playas. Nutsedge *(Cyperus esculentus)*, a sedge whose tubers are eaten by waterfowl, would grow in the moist-soil margins. Grasses around the edges of the playas would be similar to those used around the permanent emergent wetlands and would include vine-mesquite *(Panicum obtusum*), tobosa (*Pleuraphis mutica*), alkali sacaton (*Sporobolus airoides*), saltgrass (*Distichlis spicata*), and scratchgrass muhly (*Muhlenbergia asperifolia*). Grasses would be seeded; wetland plants would grow from seed, if available, or from container-grown 'plugs'. Plugs would need to be watered during establishment if the playa margins become dry.

As described above, the habitat value of playas increases when a permanent wetland measure is included in the restoration plan. The permanent water allows for amphibious species to take refuge in the wetland when playas are dry. The playas are located in sediment-prone areas and are subject to being completely covered with sediment within approximately the next 30 years. Three of the playas are affected by the channel realignment measure, described below, because it would delay the sedimentation of those playas. If the South Fork Arroyo channel is not realigned, the two southern-most playas will fill with sediment in approximately eight to 11 years. Because their acreage will decrease during the time intervals Target Year (TY) 6 through TY 21, the HU values for playas without the channel realignment are less than corresponding values for playas with channel realignment.

4.6.2.e. Channel Diversion/Realignment

South Fork Arroyo carries sediment and water into the southern playa basins. The Channel Diversion/Realignment measure would divert the arroyo, allowing it to deposit sediment in an abandoned gravel pit in which arroyo riparian restoration is proposed. The measure would delay the sediment from reaching four of the playas for approximately ten years and would extend the expected life of this ephemeral wetland habitat and its obligate associated species, tadpole and

fairy shrimp. The flows diverted from the arroyo provide added water to enhance the development of a proposed arroyo riparian restoration area.

The Channel Diversion/Realignment measure increases the values of the Arroyo Riparian and Playa Vegetation measures. When Channel Diversion/Realignment is included in a restoration alternative, the adjacent arroyo riparian area, a patch of 17 acres where sediment would be deposited, is expected to experience more favorable conditions for riparian shrub growth. Therefore, the Habitat Unit value for the Arroyo Riparian measure increases. The extended life of the southern playa basins gives playas a higher Habitat Unit value under plans that include the Channel Diversion/Realignment measure. As stated above, without the Channel Diversion/Realignment measure, the two southernmost playas would fill with sediment in approximately eight to 11 years, lowering their Habitat Unit values for the period of analysis. With the Channel Diversion/Realignment measure, those playas fill more slowly (filling by year 36) and the cumulative HUs are greater.

4.6.3. Formulation of Alternative Plans

After developing the proposed restoration measures, the study team combined them into alternative restoration plans (or "project alternatives") for subsequent comparison, evaluation, and decision making. Alternative plans range from doing nothing (the No Action Plan) to the Do All Plan, which includes all measures. All other plans contain a combination of one to five of the proposed restoration measures. The evaluation of these alternative plans is described in the following section.

4.7. *Evaluation of Alternative Plans

4.7.1. General

A total of 120 possible alternative restoration plans result from combinations of restoration measures, taking into account combinability and dependencies. The study team developed a number of alternative plans and compared the plans with a reasonable estimation of the future without-project condition. The comparison provides a metric allowing for the ultimate identification of the recommended NER Plan. The NER Plan reasonably maximizes ecosystem restoration benefits compared to costs, considering the cost-effectiveness and incremental cost of implementing other restoration alternatives. In addition to considering ecosystem benefits and costs, the NER Plan would consider information that cannot be quantified, such as environmental significance and scarcity, socioeconomic impacts, and cultural resources information.

USACE policy (ER 1105-2-100) requires that potential ecosystem restoration projects be analyzed for cost-effectiveness and incremental benefits gained from various restoration alternatives. Incremental cost and cost effectiveness analysis (CE/ICA) are the techniques used by the USACE to develop cost-effective restoration projects. Analysis of cost effectiveness, in general, compares the relative costs and benefits of alternative plans. The least expensive Best Buy Plan which meets the restoration objectives is usually selected.

Specifically, cost-effectiveness analysis compares the costs and expected benefits (environmental outputs) among various alternatives. If different alternatives can produce the same level of

output, only the least expensive (least-cost) choice makes economic sense for that level of output; economically *inefficient* alternatives can be eliminated from further consideration. Similarly, if one alternative can produce a greater level of output for the same or less cost than others (cost-effective), only the greater output choice makes economic sense; economically *ineffective* alternatives can be eliminated. After elimination of inefficient and ineffective alternatives, there remain several least-cost, cost effective alternatives offering a range of output values from which to identify the means of meeting the ecosystem restoration objectives.

To perform CE/ICA, the USACE entered each of the restoration measures into Institute for Water Resources Planning Suite (IWR-Plan), including the No Action option for each measure. Once a planning study comprised of variables, outputs, and attributes has been defined with the plan editor within IWR-Plan, the plan generation module was used to populate a new planning set with plan alternatives. Generated planning sets were displayed with the information needed to assist planners in managing the plans and keeping them in context. IWR-Plan generated 120 plans, including six Best Buy Plans and eight cost effective plans. Addendum E (USACE, 2010) provides a more detailed explanation of the execution of the IWR-Plan.

4.7.2. Environmental Outputs

For the Las Cruces Dam project, the study team calculated Habitat Units (HU) from Habitat Suitability Index (HSI) models for selected wildlife species that would be expected to benefit from the proposed habitat restoration measures. HSI is a number between 0 and 1 where 0 represents no habitat value and 1 represents optimum habitat. HUs are calculated by multiplying the HSI value by the area (in acres) of each proposed restoration measure.

Models used for USACE studies must be certified or approved. To remain within the time and funding constraints of the study, the study team made the decision to assess ecosystem benefits using existing, certified HSI models developed for the USFWS. To assist the study team with habitat evaluation and expected project benefits, a Habitat Evaluation Team (HET) comprised of local biologists was formed. Between September 2009 and March 2010, the team selected and applied the HSI models using field data gathered from sites within the study area and expert knowledge from the HET. Refer to addendum C (USACE, 2010) to review the study team's habitat assessment methodology and results.

In studies focused on long-term effects, HUs generated for indicator species are estimated for several target years over a 50-year period of analysis. Future habitat conditions are estimated for both without-project (e.g., No Action Plan) and with-project conditions. The projected long-term effects of the project are reported in terms of Average Annual Habitat Units (AAHU) values. AAHU values for each of the proposed restoration measures are shown in Table 4.3. AAHU values for selected plans (combinations of restoration measures) are shown in Table 4.4. On 21 January, 2010, the HET met for a site visit and discussion of likely future conditions with and without the proposed project.

Table 4.3 - Environmental Outputs of Proposed Features

Proposed Feature	Cost	Area (acres)	Existing HUs	Total AAHUs Created
Created Permanent Wetland	$906,799	2.19	0	1.27 AAHU's 0.26 added to playa AAHU's
Channel Diversion	$ 383,676	- - -	0 0 0	0.21 added to playa AAHU's (With Wetland) 0.17 added to playa AAHU's (no wetland) 0.88 added to arroyo riparian AAHUs
Cottonwood planting around wetland	$23,612	1.08	0	0.79 AAHU's
Cottonwood planting around playas	$104,944	5.27	0	4.88 AAHU's
Arroyo Riparian Planting (w/o channel diversion)	$389,175	71.99	12.23	16.52 AAHU's
Arroyo Riparian Planting (with channel diversion)	$389,175	71.99	12.23	17.40 AAHU's
Playa Plantings (w/o wetland or channel)	$229,298	3.60	0	1.09 AAHU's
Playa Plantings (w/o wetland, with channel)	$229,298	3.60	0	1.26 AAHU's
Playa Plantings (with wetland, w/o channel)	$229,298	3.60	0	1.35 AAHU's
Playa Plantings (with wetland AND channel)	$229,298	3.60	0	1.56 AAHU's

Note: Habitat outputs (AAHU's) differ for some measures when they are implemented in combination with other measures. (see discussion in section 4.6 and Appendix C)

4.7.3. Alternative Comparison

As previously stated, the model generated 120 plans. Of those plans, six were Best Buy Plans and eight were cost effective. Other than the Cottonwood (one of the Best Buys) and the Arroyo Riparian (cost effective) measures, several measures were deemed non-effective or non-efficient by the model when the measure was evaluated in isolation, such as channels alone, playa alone, and wetlands alone. Efficiencies developed when these measures were evaluated in conjunction with other measures. Addendum E (USACE, 2010) presents the specific measures and discusses the reasons why a particular measure is effective or non-effective. Addendum E also discusses the incremental cost analysis.

For this analysis, the Do All Plan (the Plan that included all proposed measures) was eliminated from consideration after the preliminary run. ER 1105-2-100, Paragraph E-36.c. (6) (c), recommends the removal of large plans which may mask the cost-effectiveness of smaller plans due to production efficiencies of the larger plan. The single Do All Plan is identified in cost-effectiveness analysis as efficient and effective simply because there are no other plans that produce that quantity of output. For similar reasons, the Do All Plan is identified as a Best Buy Plan because that plan has the lowest production unit cost to achieve that quantity of output. Placing a constraint to eliminate the Do All alternative revealed smaller plans, to include the Tentatively Selected Plan, would be Best Buys absent the Do All Plan. Addendum E (USACE, 2010) provides further detail on how the final analysis was conducted. The results of the final analysis showed that all major conclusions and observations displayed in the first analysis

remained the same. However, the final analysis showed that by eliminating the Do All Plan, two cost effective plans (under the preliminary analysis) became best buy plans.

Table 4.4 - Ranking of Cost Effective Plans by Cost (in actual, 2010 Price Level)

Final Run	Name	Cost	Output (AAHU)	Plan Type of Final Run
0	No Action Plan	0	0	Best Buy
1	Cottonwood around Playas	104.944	5.14	Best Buy
2	Arroyo AND Cottonwood around Playas	366.701	16.67	Best Buy
3	Mining Right AND Arroyo outside Mining Right AND Arroyo inside Mining Right AND Cottonwood around Playas	644.119	21.66	Best Buy
4	PlayPlantings AND Mining Right AND Arroyo outside Mining Right AND Arroyo inside Mining Right AND Cottonwood	873.417	22.75	Best Buy
5(x)	Playa Plantings AND Mining Right AND Arroyo outside Mining Right AND Arroyo inside Mining Right AND AND Wetland (2 Cell) AND Cottonwood (Fringe) AND Cottonwood aound Playas	1803.828	25.33	Best Buy
6	Playa Plantings AND Mining Right AND Arroyo outside Mining Right AND Arroyo inside Mining Right AND Wetland (2 Cell) AND Cottonwood around Playas and Channel	2163.892	25.37	Best Buy
7	Arroyo outside Mining Right	261.757	11.79	Cost Effective
8	Mining Right AND Arroyo outside Mining Right AND Arroyo inside Mining Right	539.175	16.78	Cost Effective
9	Playa plantings AND Arroyo outside Mining Right AND Cottonwood around Playas	595.999	17.76	Cost Effective
10	Playa plantings AND Mining Right AND Arroyo outside Mining Right AND Arroyo inside Mining Right AND Cottonwood around Playas AND Channel	1257.093	23.8	Cost Effective
11	Mining Right AND Arroyo outside Mining Right AND Arroyo inside Mining Right AND Wetland (2 Cell) AND Cottonwood (Fringe) AND Cottonwood around Playas	1574.53	23.98	Cost Effective
12	Playa Plantings AND Mining Right AND Arroyo AND Arroyo inside Mining Right AND AND Wetland (2 Cell) AND Cottonwood around Playas	1780.216	24.28	Cost Effective

(x) = Tentatively Selected Plan

4.7.4. Selection of the Tentatively Selected Plan

The next steps in plan selection are to compare the Best Buy Plans with the federal and project specific goals in order to evaluate their acceptability. The alternatives must be verified to ensure that they do not exceed the constraints of the project or cause significant negative impacts to the environment. The objectives presented in Section 4.6.2 include restoration goals as well as recreation and education goals. Table 4.5 compares the restoration measures with the study objectives. For the comparison of Best Buy Plans, restoration goals are addressed here. The feasibility criteria listed in the Federal guidelines for water resources projects are:

- *Completeness* – Does the plan include all necessary parts and actions to produce the desired results? Is the plan capable of being implemented with no further actions needed to fulfill the project?

- *Effectiveness* – Does the alternative substantially meet the objectives? How does it measure up to the constraints?

- *Efficiency* – Does the plan maximize net NER benefits?

- *Acceptability* – Is the plan acceptable and compatible with laws and policies?

The cost effectiveness and incremental cost analysis presented above identifies a set of plans that meet the criteria for efficiency. All plans meet the criteria for completeness because the measures that comprise each plan were evaluated for implementability prior to cost analysis. Each individual measure and, therefore, each restoration plan contributes to restoration objectives; however, only those plans that include the permanent emergent wetland meet the objective of providing a permanent water source in the study area. Only Plans 4 and 5 meet all restoration objectives and, therefore, the criteria for effectiveness.

USACE presented the final array of plans to the public and the sponsor, the City of Las Cruces, on 13 September, 2010. Comments received during the public meeting favored a plan that included creating a permanent wetland. The plans were also presented to the city council, and the council chose Plan 5 over plan 3 unanimously. Due to the positive feedback on the Tentatively Selected Plan and the fact that the restoration measures were developed with public input, the plan is considered acceptable.

Table 4.5 Comparison of restoration measures with study objectives.

	MEASURES					
OBJECTIVES	**Created Wetland**	**Cottonwood Plantings**	**Arroyo Riparian Plantings**	**Playa Plantings**	**Channel Diversion**	**Proposed Recreation Plan**
Increase the amount and quality of riparian and wetland habitats within the project area.	2 Acres created (1.27 AAHU's)	6.35 acres of new habitat (5.67 AAHU's)	71.969 acres of new or improved habitat (16.52 AAHU over without project condition)	3.6 acres of habitat improved to provide 1.35 AAHU's over the WOP condition	Increases the AAHU outputs of Arroyo Riparian and Playa measures by 0.88 and 0.21 respectively.	NO
Increase the overall connectivity of arroyo habitats through the study area.	NO	Provides vegetated area contiguous with Arroyo riparian corridors	Provides a vegetated corridor connecting the Alameda and Las Cruces arroyos along the outlet channel	NO	NO	NO
Provide a source of permanent water for wildlife within the study area.	YES	NO	NO	NO	NO	NO
Increase the amount of riparian and wetland habitats within the study area to provide stopover, feeding, and resting places for migratory birds and waterfowl within the Rio Grande Flyway.	2 Acres created	6.35 acres of new habitat	71.969 acres of new or improved habitat	Improved to provide additional food resources	Partial: Will prevent 3 playas filling with sediment for an additional 10 to 20 years	NO
Opportunistically remove non-native plant species as part of the implementation of restoration measures.	NO	Measure will include removal of Salt Cedar and Vitex.	Measure will include removal of Salt Cedar and Vitex.	NO	NO	NO
Provide additional recreational and interpretive amenities in the study area that are compatible and complimentary to the habitat restoration.	NO	NO	NO	NO	NO	YES

The Best Buys Plans, Plans 1 through 6, are carried forward in plan selection. Plans 2 through 5 provide over 400% of the outputs of Plan 1 with only 10% increase in cost per AAHU from Plan 1 to Plan 2. Plans 2 through 5 have relatively small increases in output from plan to plan with similar increases in cost per AAHU except for Plan 4. The incremental cost per output for plan 3 is far less than the incremental cost per output for plan 4; therefore from an economic perspective plan 3 would become the preferred plan. The increase in cost per AAHU from Plan 4to Plan 5 is almost twice the increase between other plans and the next larger plan.

Plans 5 and 6 meet the study objective of providing a permanent source of water to the study area. The graph in Figure 4.8 demonstrates that the shift from Plan 3 to Plan 5 might not be advisable compared to other plans because the incremental cost per unit increases sharply compared to the increase (or shift) in output. Table 4.6 shows the incremental cost per habitat units for Best Buy Plans. Plan 5 costs $1,803,828whereas Plan 6 costs $2,163,892. Plan 6 contains the channel measure, which produces outputs in concert with other restoration measures at an incrementally higher cost. Plan 5 is the first efficient plan that meets the study objective of providing permanent water; therefore, Plan 5 is the Tentatively Selected Plan. Addendum E (USACE, 2010) discusses the identification of the Tentatively Selected Plan.

Figure 4.8 - Graphical representation of Incremental Cost and Output of Best Buy Plans

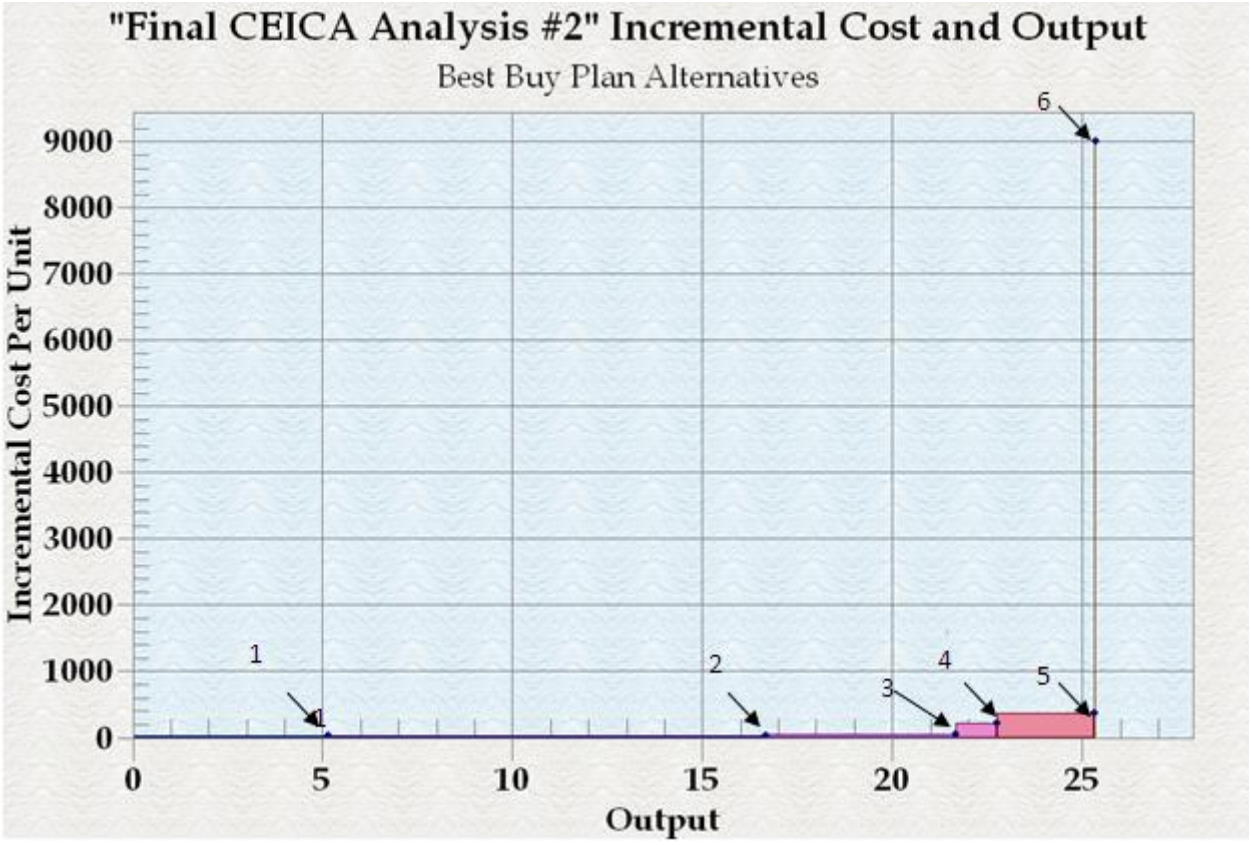

Table 4.6 – Incremental Cost per HU from ICA Analysis (2010 Price Level)

Plan	Output (HU)	Cost ($1,000's)	Average Cost ($1000/HU)	Incremental Cost (1,000's)	Incremental Output (HU)	Incremental Cost per Output
0 (No Action)	0	0.00				
1	5.14	104.94	20.4171	104.9440	5.1400	20.4171
2	16.67	366.70	21.9977	261.7570	11.5300	22.7023
3	21.66	644.12	29.7377	277.4180	4.9900	55.5948
4	22.75	873.42	38.3920	229.2980	1.0900	210.3651
5	25.33	1,803.83	71.2131	930.4110	2.5800	360.6244
6	25.37	2,163.89	85.2933	$360.0640	0.0400	9,001.6000

The four national accounts are also considered in the comparison and evaluation of alternative plans, as are the associated evaluation criteria. In the 1970 Flood Control Act, Congress identified four equal national accounts for use in water resources development planning. The accounts are the National Economic Development (NED), Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE). USACE policy requires evaluation of flood risk management studies via the NED account and ecosystem restoration via the EQ account. Contributions to the SOE and RED are considered ancillary under corps authorities.

Because the primary outputs for the Las Cruces Dam Restoration Project would be ecosystem restoration, benefits are realized for the EQ as well as OSE accounts. Benefits of recreation are accounted for within the NED Account. Benefits to the RED are realized from both the restoration and recreation components.

4.7.4.a. Environmental Quality (EQ)

All of the Best Buy Plans would contribute to the EQ account by increasing the amount and quality of high value habitat in the study area by their respective quantity of outputs. All Best Buy Plans provide an increase in habitat and, therefore, benefits to the EQ account as quantified by AAHU's in Table 4.3. Benefits to the EQ account increase with plan outputs as do the costs for the project and incremental costs for each AAHU. As described earlier, only Plans 4 and 5 will meet all objectives of the study. Benefits would increase in the following criteria as the amount and quality of habitat increases:

- Water Quality – The restoration plan would provide some improvements to water quality through trapping any natural filtration of particulates. This is particularly true because the area functions as a storm water catchment. Additional riparian habitats would facilitate filtration of water and the breakdown of some pollutants through biologic processes.

- Air Quality – An increase in the number and acres of plants would contribute in a minor way to absorption of carbon dioxide and release of oxygen in this urbanized area. Las

Cruces Dam acts as a heat sink during warmer months providing a large area of shady, relatively moist environment that contrasts the urban asphalt and concrete.

- Wildlife – The increase in habitat diversity would provide for increases in richness and abundance of wildlife species.

- Noise – There would be a temporary increase in noise due to construction that would potentially increase in duration with an increased project size. The restoration area itself acts as a noise sink that absorbs or attenuates urban and traffic noise.

The larger the project, the more benefits to this account would accrue. The cost effective analysis has provided a measure of efficiency to determine what the incremental cost of these outputs would be.

4.7.4.b. Other Social Effects (OSE)

Other Social Effects (OSE) is a measure of impacts to the community in terms of satisfaction, well-being, and happiness. The state of community education, health, social connectedness, standard of living, and happiness could be impacted by a new project. Primary affects to OSE from the proposed restoration would benefit health, standard of living, and education by providing a public area of improved aesthetics and air quality and by providing educational opportunities. There would be significant benefits to the community from the facilities provided from the recreation component of the project through additional recreational opportunities and increase in quality of the recreational experience.

The proposed project would provide amenities such as benches and shade structures for an improved recreational experience. Habitat improvements would enhance the recreational experience through those criteria listed under the EQ account and the aesthetic quality of the area. The cottonwood gallery forest or view over an emergent wetland would provide a novel viewshed from the urban environment. Habitat improvements would provide the opportunity to view wildlife.

Scoping and public involvement has provided contributions from the local community to the study objectives. These objectives were incorporated within the constraints of the project and reflected in the array of project alternatives. Further involvement through public meetings and public involvement of project monitoring will continue to engage the community and promote public ownership of the project.

4.7.4.c. Regional Economic Development (RED)

The RED is intended to illustrate the impacts of the proposed alternatives to the regional economy, especially employment and income. The proposed project would benefit these criteria as well as have the potential to increase recreation and tourism related industry and property value immediately adjacent to the project area. Increased recreation and tourist visitation to the area might increase the revenues of local businesses. A temporary increase in employment would occur during construction consistent with the project cost. Long-term operation and maintenance would provide some benefits. Finances required from the City of Las Cruces as the

non-Federal sponsor would include LERR&D at zero cost and annual operations and maintenance cost estimated to be $11,000 per year.

4.7.4.d. National Economic Development (NED)

The Federal objective of water and related land resources planning should contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable Executive orders, and other Federal planning requirements. "Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also those that may not be marketed".

4.7.5. Recreation Plan

Section 1135 of the USACE Continuing Authorities Program allows for inclusion of a recreation component to the study. The recreation should compliment and not detract from the ecosystem restoration components. The recreation plan for the Las Cruces Dam environmental restoration study was derived from a 2001 recreation master plan prepared by the USACE for the City of Las Cruces. The master plan presented alternatives for recreation amenities throughout the city. These amenities include: formalized gravel trails, informational kiosk and shade structures, hardened crossings to traverse the conveyance channel, and wildlife blinds for bird and wildlife observations. The proposed recreation plan selected those amenities from the master plan that occur in the study area. Slight changes were made to the alignment of trails and location of wildlife blinds to compliment the restoration features without detracting from habitat values. Formalized gravel trails would follow existing primitive trail or access road alignments. Kiosks and benches would be placed at strategic locations along improved trails.

The USACE performed additional analysis to identify the benefit-cost ratio for the selected recreation plan. This analysis is presented below and is described in Technical Appendix E (USACE, 2010).

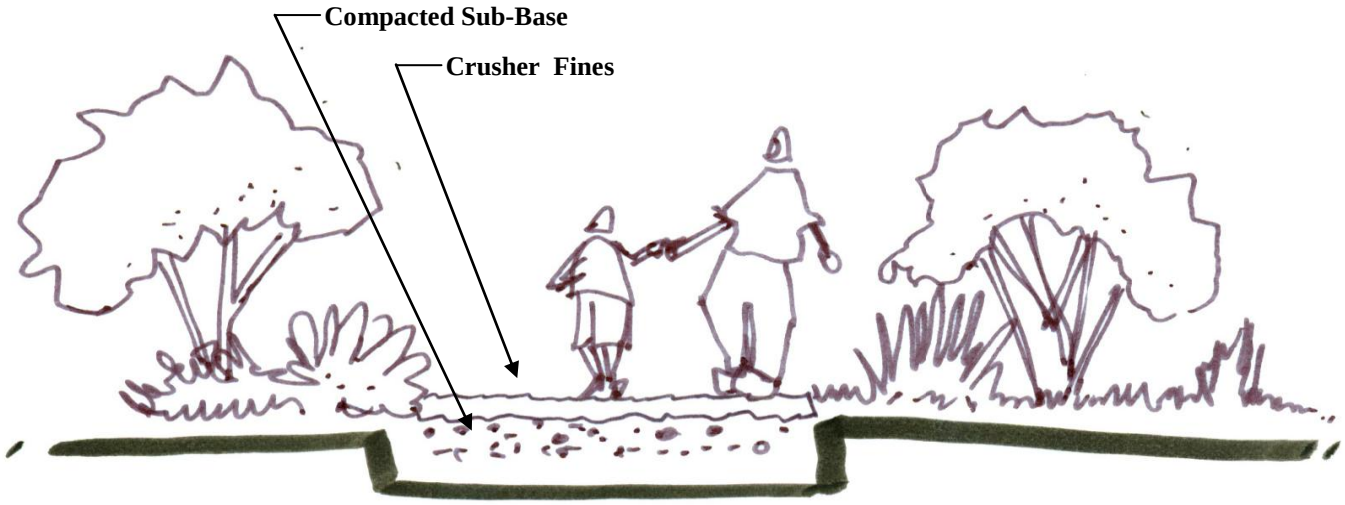

Figure 4.9. Stabilized Crusher Fine Trail

4.7.5.a. Recreation Overview

The current supply of recreation facilities located in the Las Cruces Dam project area includes recreational trail facilities and two parks. The Triviz Trail runs for two miles south of the dam. This trail is essentially separated into isolated segments and does not connect to other recreational trails; therefore, the usability of Triviz Trail is limited. The two parks in the study area are Veteran's Park and Sagecrest Park. The city parks are shown in Figures 3.1 and 4.2. Currently, the recreational use of the project site varies. The types of recreation observed during site visits include walking, running, bicycling, pet walking, bird watching, and off-road vehicle use.

This recreation analysis follows the NED benefit evaluation procedures contained in ER 1105-2-100, Appendix E, Section VII. Because the recreation features identified in the proposed project are of a small scale and incidental to the project purpose, the USACE selected the unit day value (UDV) method of benefit evaluation for this analysis. The UDV calculations require an estimation of five criteria, obtained from Economic Guidance Memorandum (EGM) 10-3, when evaluating the without- and with-project recreation experience. A discussion of each of the five criteria for the without-project condition, as well as the reason(s) for the proposed point boost, follows:

- **Recreation Experience –** This criterion tries to explore the recreation opportunities that exist at the site. In the case of the Las Cruces Dam project site, two general activities common to the region are trail use (such as walking/running and cycling) and general park use. In the two parks located in the project site, general activities include youth soccer practices during the fall and spring and general use of the park by the local population. The proposed recreation plan would improve the trails within the Las Cruces Dam project site by adding bridges (to connect trails), adding kiosks, and adding viewing blinds (to view wildlife).

- **Availability of opportunity –** This criterion evaluates the uniqueness of the recreation experience by identifying the number and proximity of available substitutes. In the project area, two parks and a system of trails exist. Within Las Cruces, several parks and trails of similar length are located within one hour's travel time. The proposed recreation plan significantly increases the availability of opportunity.

- **Carrying capacity –** This criterion evaluates the ability of the recreation facilities to handle the existing and projected demand. Excessively crowded facilities diminish the recreation experience for users. The proposed recreation plan includes adding formal gravel trails to guide users through the natural environment and to provide extra facilities for recreation visitors.

- **Accessibility –** This criterion examines the relative ease by which users can get to and through the recreation site. The study area currently includes two parks (Veteran's and Sagecrest Parks) as well as the Triviz Trail. Currently, access is limited by the lack of roads and the lack of parking space. The proposed recreation plan includes an expanded trail system connected by bridges linking the parks to the restored habitat area and additional parking at the two parks.

- **Environmental –** This criterion measures the esthetic value of the recreation experience. The Las Cruces Dam area is an island of habitats formerly found in this area as well as important habitat that would be found only along the Rio Grande or isolated locations near the mountains. The proposed recreation plan includes efforts to increase the amount of vegetated area and improve wildlife viewing through an increase in wildlife abundance and diversity, and the plan is expected to increase the overall esthetic value.

4.7.5.b. UDV Evaluation of the Existing Project Condition

EGM 10-3 outlines the general and specialized recreation valuation for UDV point values for fiscal year 2010 and outlines the value of the recreation experience per visit based upon the point values assessed. The previous discussion of the five criteria used for establishing a value of the recreation experience afforded by the Las Cruces Dam area indicates that the proposed project would touch most of these criteria in a beneficial direction. What is unclear is the qualitative improvement's translation to the UDV point values. Therefore, multiple scenarios were developed to evaluate the impact of the proposed project on the existing recreation facilities. One scenario assumes the existing facilities have relatively low point values (the "minimum points" scenario), and the proposed recreation features provide a significant boost to the quality of the recreation experience. Another scenario assumes the recreation experience has a relatively high starting value (the "most likely" scenario) and the proposed recreation features are somewhat less beneficial than described in the "minimum points" scenario. This analysis is discussed in detail in Technical Appendix E (USACE, 2010). Based on EGM 10-3, Table 4.7 presents an estimate of the minimum, most likely, and maximum UDV computed for the without-project condition. Converting these point values into dollars per EGM 10-3, the without-project condition is worth $4.21 per visit (at the minimum) $4.56 per visit (at the most likely) and $4.92 per visit (at the maximum). The difference between the minimum and the maximum is $0.71.

Table 4.7 - Estimate of the Unit Day Valuation of the Existing Condition

UDV Calculations		Without Project			Rationale
		Minimum	Most likely	Maximum	
Recreation Experience	Two general activities	0	3	4	Parks, primitive walking trails
Availability of Opportunity	Several within 1 hr travel time and a few within 30 min travel time	0	2	3	Located in an urban area, all recreation features located within 1hr travel time
Carrying Capacity	Basic facilities to conduct activities	3	4	5	Parking lots, benches and tables
Accessibility	Fair access, poor quality roads to site; limited access within	4	5	6	Limited access within site.
Environmental	Average esthetic quality; factors exist that lower quality to a minor degree	3	4	6	Average esthetic quality. Off road vehicles (non-designated) lower esthetic quality
		10	18	24	

4.7.5.c. Recreation Usage in the Existing Project Condition

Two parks, Veteran's Park and Sagecrest Park, represent the most significant recreation features in the study area. According to the City of Las Cruces Parks Maintenance Plan (2002) and the City Parks and Recreation Master Plan (2005), Veteran's Park is classified as a "Community Park", which is defined as a park with a service radius of two miles. Because Veteran's park is known to have more usage then a traditional community park, a service radius of three miles was used for this analysis. Sagecrest Park is classified as a "Neighborhood Park", which is defined as a park with a service radius of one third of a mile. The formula $A = \pi r^2$ was used to convert the service radius to a service area. USACE determined that the service area of Veteran's Park was 28.26 miles and Sagecrest Park was 0.342 miles.

According to the 2000 U.S. Census Bureau, State and County Quick Facts, the number of persons per square mile in Las Cruces is 1,425.7. Using that figure and applying that to the service radii described above, the total number of residents in the service area is 40,290 for Veteran's Park and 488 for Sagecrest Park. Because the two parks basically service the same area, the USACE assumed that the 488 residents served by Sagecrest Park are included in the service area of Veteran's Park. The City of Las Cruces identified recreation usage in their Parks and Recreation Master Plan, which is presented in Table 4.8. The USACE calculated the total number of annual visits to Veteran's and Sagecrest Parks by multiplying those percentages by the total number of residents in the service area. The service area of Veteran's Park includes vast areas of open space; therefore, USACE decided to cut the number of residents in half to 20,145 to represent the total service population. Census data indicate that the total population of Las Cruces in 2006 (the date of the most recent estimate) was 86,268; therefore, 20,145 is considered a conservative figure. Table 4.9 displays the results.

The annual visitation figure is conservative for many reasons. First, the Parks and Recreation Master Plan identifies that over one third of respondents visit city parks and other recreation facilities "a few times a year", and no effort has been made to quantify that usage. Second, eight percent of respondents "never" visit city parks and recreation facilities. Finally, Veteran's Park hosts a number of special events honoring veterans (Veteran's Day, Memorial Day, and the 4th of July), which increases the number of visitors to that park each year.

Table 4.8 - Frequency of Park and Recreation Facility Visits

Frequency of Park Visits	Percentage of Las Cruces Population
Weekly	26.30%
Monthly	18.00%
Quarterly	10.90%

Table 4.9 - Frequency of Visitors and Visits to Las Cruces Parks

Frequency of Park Visits	Number of Las Cruces Residents per Frequency		Total Number of Visits per Frequency
Weekly	5,298	X 52 weeks	275,496
At least monthly	3,626	X 12 months	43,512
At least quarterly	2,195	X 4 quarters	8,780
Total	**11,119**	**Total**	**327,788**

Based off total service population of 20,145

4.7.5.d. UDV Evaluation of the Proposed Project Condition

USACE expects that the restoration efforts in the Las Cruces Dam area will improve the environmental aesthetic. The features of the recreation plan (kiosks, trail crossings, and viewing blinds) are expected to touch each of the other criteria in the UDV assessment in a positive fashion. Table 4.10 presents the minimum, most likely, and maximum point assessment of the marginal benefits attributed to the proposed recreation features.

Converting these point values into dollars per EGM 10-3, the with-project condition is worth $4.99 per visit (at the minimum) $5.85 per visit (at the most likely) and $6.74 per visit (at the maximum). The difference between the minimum and the maximum is $1.75 for the with-project condition. For comparison, the without-project condition (most likely) is worth $4.56 per visit and the with-project condition (most likely) is worth $5.85 per visit. Therefore, the benefits attributable to planned recreation features are worth $1.29 per visit for the most-likely assessment.

Table 4.10 - Estimate of the Unit Day Valuation of the With-Project Condition

UDV Calculations		With Project			Rationale
		Minimum	Most likely	Maximum	
Recreation Experience	Several general activities	5	8	10	Multiple parks, kiosks, viewing blinds, and improvement to walking trails
Availability of Opportunity	Several within 1 hr travel time and a few within 30 min travel time	0	2	3	Located in an urban area, all recreation features located within 1hr travel time
Carrying Capacity	Adequate facilities to conduct without deterioration of the resource or activity experience	6	7	8	Parking lots, benches, tables, bridges to connect trails
Accessibility	Fair access, good roads within site	7	8	10	Improved trails and Improved access to site
Environmental	Above average esthetic quality, any limiting factors can be easily rectified	7	9	10	Above average esthetic qualities (such as wetlands, playas and Arroyo/cottonwood riparian
		25	34	41	

4.7.5.e. Benefit Determination of the Proposed Recreation Features

This evaluation started with an assessment of the value of the existing, without-project recreation experience in the study area. Table 4.4 presents an estimate of the without–project UDV values and Table 4.10 presents an estimate of the with-project UDV values. Multiplying the benefits identified in Table 4.4 and 4.10 by the extrapolated annual visitation established in Table 4.9 provides the annual benefit of the proposed recreation plan. The recreation plan is estimated to cost $213,600. Table 4.11 displays that for a $213,600 recreation plan, with a period of analysis of 50 years and an interest rate of 4.375%, the total annual cost is $11,589. Table 4.11 shows that the Benefit Cost Ratio (BCR) exceeds 10 to 1.

Table 4.11: BCR Calculation

Without Project UDV Value (points)@ most likely	Without Project UDV Value (dollars)	With Project UDV Value (points) @ most likely	With Project UDV Value (dollars)	Benefits per visit (dollars)	Annual Benefits	BCR	Cost
18	$4.56	34	$5.85	$1.29	$422,846.52	36.48689	$11,589.00

4.7.6. Resource Significance

The Tentatively Selected Plan improves or increases the amount of significant riparian and wetland habitats known to be rare or scarce in the Chihuahuan desert as described in Section 1.4 and throughout the document. It would improve the scarce native riparian habitat to a more natural state, including a mosaic of habitat types and a riparian corridor connecting Las Cruces to Alameda Arroyos. The Tentatively Selected Plan would provide habitat for the numerous migratory birds that use the area for nesting and stopover as well as a abundance of resident wildlife. The Tentatively Selected Plan also meets the goals of increasing the amount and value of riparian and wetland habitats within the Rio Grande Flyway. It also provides for the intent and, in many cases, the letter of several Federal environmental laws, directives, and executive orders concerning restoration and conservation efforts listed in Table 4.12.

Table 4.12 Assessment of Tentatively Selected Plan Compared to Federal Laws, Regulations and Guidance	
North American Waterfowl Mgmt. Plan	3.6 Acres of seasonal wetlands used for feeding and roosting sites will be improved to provide additional food resources.
Executive Order No. 11990 (Protection of Wetlands)	Through this project, 2 acres of permanent wetlands will be created and approximately 3.6 acres of seasonal wetlands would be improved.
North American Wetlands Conservation Act of 1989	
Executive Order No. 11988 of May 1977 (Floodplain Management)	The project retains flood protection functions while improving ecosystem function and increasing high value riparian and wetland habitats.
Migratory Bird Conservation Act of 1929, and associated treaties	The restoration will provide a variety of high quality habitats that will benefit migratory birds using the Las Cruces Dam as feeding, stopover and breeding site. Habitat improvements will benefit neotropical migrants by providing essential feeding and resting habitats.
Migratory Bird Treaty Act of 1918	

As stated in section 1.4, wetlands are an integral component of the Rio Grande ecosystem, not only increasing diversity but also enhancing the value of surrounding plant communities for wildlife. From 1918 to present, wetland-associated habitats have undergone a 93% reduction (Hink and Ohmart, 1984; Scurlock, 1998). Among the greatest needs of the Rio Grande riparian ecosystem are the preservation of existing wetlands and expansion or creation of additional wetlands (Crawford *et al*., 1993). Other perennial wetlands found in southern New Mexico include marshes or ciénegas, springs, and seeps. Ciénegas occur as geographically isolated wet depressions or seeps that are hydrologically supported by seasonal discharge of shallow groundwater aquifers and springs. Ciénegas, spring seeps and perched wetlands provide unusually persistent and long-lived wetlands (NMDGF, 2006). Little is known about the distribution and abundance of these habitats in New Mexico today; however, loss of these wetland habitats has been well documented (Sivinski, in press).

Among the greatest needs of the riparian ecosystem are the preservation of existing wetlands and expansion or creation of additional wetlands (Crawford *et al*., 1993). Within the Chihuahuan desert, restoration or creation of wetland habitats is especially important due to their scarcity. Likewise, availability of surface water and greater demands for both surface and groundwater make wetland restoration and creation especially challenging in the desert. Any opportunity to provide these critical habitats should be taken advantage of.

The habitat suitability models used in the proposed restoration study do not distinguish between the value of the different habitats. One habitat unit (HU) of arroyo riparian habitat appears to be equal to one HU of wetland habitat as discussed in section 4.8. HSI models are based the fact that survival of all species relies on the basic necessities of food, water, shelter and reproduction. While arroyo riparian habitat is scarce and in decline, wetland habitats are even more so. Further, a permanent source of free water provides a critical function for wildlife of all types not

present in the study area. The water source augments the shelter and food sources provided by other restoration measures in completing the necessary resources for survival of wildlife; food, shelter and water. Further, the wetland provides for reproduction in the case of aquatic or semi-aquatic species, thereby adding to the diversity of species in the study area.

Regional and local efforts to conserve or restore similar riparian and wetland habitats are evident from actions currently taking place in the Las Cruces area. The Bureau of Land Management (BLM) has managed the Aguirre Springs Campground and natural area with access, facilities and interpretation of the vital area supported by seasonal and permanent springs. Similarly, BLM operates the Dripping Springs Natural Area conserving a unique canyon spring that is home to four species of endemic plants and the rare Colorado chipmunk. Aguirre and Dripping Springs areas are located approximately 10 miles east of the Las Cruces Dam. The Organ Mountains-Desert Peaks Wilderness, Act-S. 1689, proposes to designate two new National Conservation Areas (NCA) and eight wilderness areas in Doña Ana County, New Mexico, which would be included in BLM's National Landscape Conservation System. The Organ Mountain parcel would place most of the mountainous areas of the Organ Mountains (approximately eight miles from the Las Cruces Dam) in wilderness status and much of the upper bajada (within six miles of the Las Cruces Dam) as National Conservation Area. The upper watershed of the Alameda and Las Cruces Arroyos would, therefore, be within wilderness and the NCA.

Approximately eight miles north of the Las Cruces Dam, the New Mexico State University operates the Chihuahuan Desert Rangeland Research Center in order to protect and insure availability of Chihuahuan Desert resources for teaching, research, and extension endeavors that benefit the citizens of New Mexico. The over 64,000-acre research center was established in 1927 by Congressional Act S4910, 1927.

The state of New Mexico has created Mesilla Valley Bosque State Park along the western bank of the Rio Grande southwest of Las Cruces. This is New Mexico's newest state park, which opened December 2008. The heart of the park is 52 acres of Rio Grande floodplain known as the "Old Refuge;" the total park acreage is about 945 acres of both wetlands and Chihuahuan Desert habitats. A local organization, Friends of Mesilla Valley Bosque State Park, is crucial to the operation of the state park providing financial support and volunteers. Picacho Bosque Wildlife Management Area, about five miles southwest of Las Cruces is an approximately 30-acre area of Rio Grande floodplain managed for wildlife.

Located in the northern Chihuahuan Desert, the 935-acre Chihuahuan Desert Nature Park site is a topographically and biologically diverse example of the Chihuahua Desert set aside for education and conservation. The Chihuahua Desert Nature Park encompasses a small section of the Doña Ana Mountains approximately six miles north of Las Cruces Dam. The park is operated by the Asombro Institute for Science Education, a nonprofit 501(c)(3) organization dedicated to increasing scientific literacy by fostering an understanding of the Chihuahuan Desert.

5. *DESCRIPTION OF THE TENTATIVELY SELECTED PLAN

5.1. General

Alternative Plan 4 is the least-cost plan that meets all of the restoration objectives. The plan includes all restoration measures except the diversion of the South Fork Las Cruces Arroyo channel. Table 5.1 reiterates the aerial extent of each restoration measure. Figure 5.1 shows the restoration measures included in the Tentatively Selected Plan.

Table 5.1 - Restoration Measure and Area Affected

Proposed Measure	Area (acres)	Total AAHUs Created	
Created Permanent Wetland	2.19	1.27	AAHU's
Cottonwood Planting	6.35	5.67	AAHU's
Arroyo Riparian Planting (w/o channel diversion)	71.99	16.52	AAHU's
Playa Plantings	3.60	1.35	AAHU's

Plantings of the various habitat types would be located in areas that would support that particular type of vegetation. Arroyo riparian plantings will be implemented in areas that receive runoff from arroyos or from stormwater outfalls. The added water, as well as scour and deposition of soils, provides the appropriate conditions for the habitat type. Cottonwood plantings will occur in areas where water persists for longer periods of time such as the depressions within the reservoir pool area and areas where fine sediments have been deposited and hold water in the root zone for longer periods of time. Similarly, playa species are dependent on the additional water found in the depressions but can withstand the inundation as well as periods with no standing water.

The created permanent wetland will support the hydrophytic and emergent vegetation within the clay-lined cells. Supplemental water seeping out of the wetland cells will also support riparian shrub and tree species in a narrow band around the fringe of the wetland.

Residents as well as migratory wildlife will benefit from the increased acreage of habitat, improvement of existing degraded habitats to a more natural state, and the creation of permanent wetland habitats. The proposed restoration will provide a larger diversity of plant species within the existing habitats as well as a greater diversity of habitat types. In turn, wildlife diversity would be expected to increase with new species moving to the study area from adjacent areas. The permanent water source in the wetland, improved forage availability in seasonal playas, and more complex habitat structure provided by the mosaic of arroyo riparian, cottonwood wetland and existing grassland habitats would attract a wider variety of migratory birds to the area.

5.1. Recreational Amenities

Recreational amenities include formalized gravel trails, informational kiosk and shade structures, hardened crossings to traverse the conveyance channel, and wildlife blinds for bird and wildlife observations with minimal disturbance to the wildlife. These recreational features, and any features constructed in the future, would complement but not detract from the restoration

measures implemented in the Tentatively Selected Plan. The recreation plan partially fulfills the long-term master plan adopted by the City of Las Cruces. According to conceptual plans within the master plan, the Las Cruces Dam recreational trails would be connected to other trails leading to other parts of the city.

5.1. Implementation process

Implementation of the project would take place over a three-year period, although implementation could take longer due to seasonal restrictions for planting or funding availability. The project would be phased to efficiently make use of available funds and accomplish tasks requiring sequential implementation. Whereas wetland construction can be accomplished in a relatively short time (a few months) and any time of year, the plantings would take place in early fall to take advantage of monsoonal moisture and allow plants to establish root systems through the winter.

Access to all work areas will be along existing disturbed roads. A right-of-way access from the City of Las Cruces will be required for staging areas, storage areas, excess spoil, disposal sites, and construction. Staging would occur in existing disturbed sites within the reservoir pool area. Any additional access and subsidiary staging areas to facilitate construction activities would be coordinated with the sponsor, if needed.

Earth-moving activities for construction of the created wetland would take place first in order to provide the location and necessary water for planting of cottonwood or arroyo riparian plant species around the completed wetland. The remainder of the restoration measures would take place according to the planting seasons as described below.

Plantings of arroyo riparian and cottonwood restoration measures would take place in early fall to take advantage of monsoonal moisture and allow new plants to establish root systems during the winter. All plants for these measures would be transplanted nursery plants grown in tall pots. Cages would be installed to protect the young plants from herbivores during the initial years after planting. The plants would be watered for the first three years using an injection method that delivers water directly to the root zone, thereby conserving water and promoting deep rooting of the young plants. Plantings around the wetland would be expected to receive water seeping from the wetland and, therefore, would not require additional watering. For a more detailed discussion of planting methodologies, refer to the Planting Plan in Addendum D of this report.

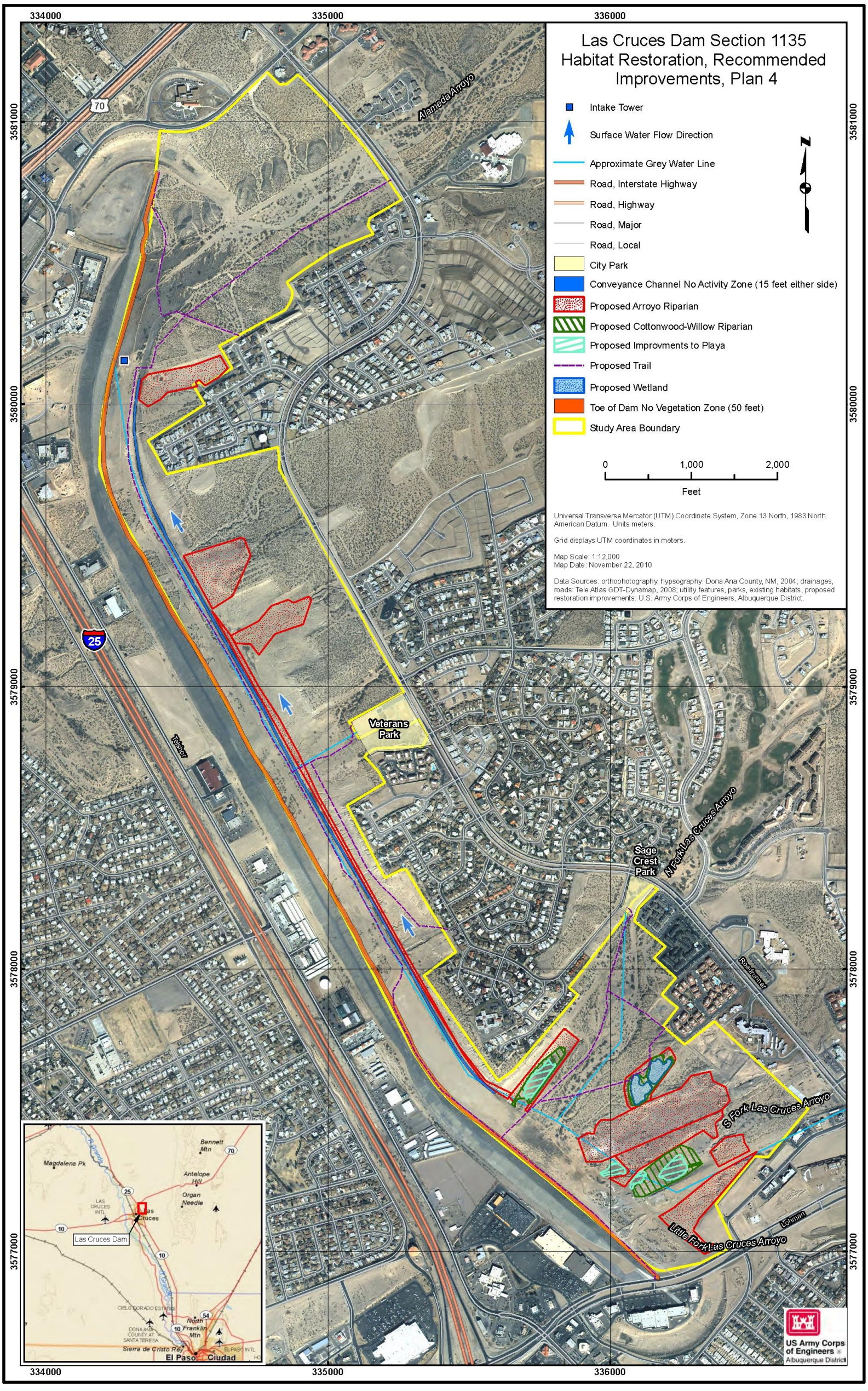

Figure 5.1 - Restoration Measures Included in the Tentatively Selected Plan.

5.2. Risk and Uncertainty

Uncertainty and variability are inherent in water resources planning; therefore, an assessment of uncertainty is made to provide a basis for decision making. Uncertainty is described as the difficulty inherent to predicting the outcome or the inability to provide a probability distribution for an outcome. Alternatively, if a reasonable probability distribution can be formed for an outcome, this is described as risk. The degree of risk and uncertainty generally differs among various aspects of a project and over time.

The sediment analysis predicts the rate at which the lower elevations of the flood pool and allocated sediment pool would fill with sediment over the period of analysis. USACE performed these calculations to verify that all outputs in habitat value (HSI) were valid over the period of analysis. Based on these analyses, USACE validated the restoration features and resulting habitat outputs (AAHU). AAHU outputs for the playa improvements were calculated for the expected life of these habitats before burial by sediment. Cottonwood and arroyo riparian restoration is planned outside of the allocated flood pool; however, inflowing sediment may still be deposited in these areas. Cottonwood and arroyo riparian plants thrive in the sediment depositional areas due to the presence of additional water during storms and because the alternative layers of fine and course sediments that are deposited trap and hold water within the root zones. As stated earlier, the wetland measure was located outside of sediment-prone areas.

All restoration features lie within the flood pool of Las Cruces Dam. The improved playa features are planned in areas that would be inundated as soon as runoff begins entering the flood pool. These areas would remain inundated for approximately one day during a 50% chance event and for approximately four days during a 10% chance event. The cottonwood and arroyo riparian areas would begin to inundate during the 50% chance event and would remain inundated for approximately two days during the 10% chance event. The wetland measure is located at an elevation that would not begin to be inundated until between the 4% and 2% events and would remain inundated for approximately three days during a 1% chance event.

Several restoration features are affected by seasonal weather patterns. The success rate of tree and shrub planting using standard methods varies between 65% and 85%. Particularly dry or hot conditions for the first year to two years following planting reduces the success rate whereas wet conditions promote the establishment of plants. For the purposes of the Las Cruces Dam Restoration Project, planting methods were proposed with proven success rates. Plant density is proposed to accommodate a reasonable 20% to 30% mortality rate while still meeting the restoration objectives. Costs for implementing the measures were based on these figures. The plants growing within and surrounding the permanent wetland will receive water despite weather conditions and would be expected to have high survival rates. Irrigation will be used to establish new trees planted at a distance from the wetland in order to minimize weather dependent risk. Shrub planting will take place in the cool season to give plants time to establish roots before summer; however, a particularly dry year could cause a low success rate for plantings and require plant augmentation in the following year. Because the plants would be irrigated, high plant mortality would only be expected in an exceptionally hot or dry year.

5.3.

5.4. Design and Construction Considerations

The majority of the habitat restoration consists of tree or shrub plantings. Planting and irrigation methods are designed to minimize mortality and establish the plants within a three-year timeframe. Irrigation will use an injection method that will deliver water directly to the plant roots and encourage deep growth to depths where soil water is more persistent. Planting will occur in the autumn to give plants time to establish roots before the heat of summer occurs. The planting methodologies applied to this restoration use lessons learned from other project implemented in the region. Planting design proposes to utilize one or two year old seedlings (opposed to half grown or mature plants) to maximize successful plant establishment. Initial densities of plantings are planned to offset mortality and avoid replanting that would extend establishment periods with irrigation. If necessary, some thinning could be performed three years after planting to account for higher than predicted survivorship of trees. Otherwise plantings were designed to allow self thinning of plants as they mature.

Las Cruces is located in a highly arid region with unpredictable, sporadic rainfall events. The area converted from short grass prairie to desert shrubland over 200 years ago. The Shrubland ecology is characterized by an island of nutrients and topsoil at the base of each shrub separated by some distance of barren soil. The soils between shrubs are depleted, sandy to gravelly and lack organic material that would aid in the retention of moisture. This limits the likelihood of any germinated seed surviving to establish. Since the original topsoil and its seed bank within the study area was excavated to construct the dam, re-vegetation has been very slow. Native grass seeding of the area occurred twice post-construction with very little or no result. Over the 35 years since the dam construction seeds carried by arroyos, storm drains or wind have gradually established a new seed bank. In areas that received runoff and sediment deposition, revegetation of common arroyo riparian species has occurred naturally while areas within the flood pool with limited hydrologic input from storm runoff or arroyos remain sparsely vegetated. Several species of plants and shrubs are also absent or very rare in the study area presumably because these species do not recolonize disturbed sites readily. Establishment of seedlings using irrigation is intended jump start the revegetation process.

Only a hand full of plant species have colonized the playa areas. A lack of seed introduction and large fluctuations in water levels apparently have precluded successful seedling establishment. Restoration measures for these areas include spreading seeds from appropriate plants species as well as planting plugs of species that do not reproduce well from seed. The periodic inundation of these areas should allow these species to germinate and establish; however, plantings at three different times in two years is proposed so that the measure is not jeopardized by a single overly dry or wet year. Conversely, the change in hydrology and geomorphology of the lowest portions of the flood pool basin resulted in a condition adequate for cottonwood trees to become established. Based on the age structure of cottonwoods in the study area there appears to have been 3 years since the late 1990's in which new cottonwood seedlings germinated. The future without project condition would see additional colonization of these species although at a low rate. Plantings would establish new cottonwood trees in the larger area and derive benefits to wildlife and habitat function sooner.

The created wetlands will be designed to 'spill' a small amount of water around the edges of each cell so that a fringe of cottonwood and arroyo riparian species will have a permanent supply of water. The lower 'wet meadow' portion of the created wetland will employ a layer of gravel below two feet of soil to allow water to reach the entire wet-meadow cell. The gravel layer will be sandwiched between filter material to prevent the gravel from being clogged with silt or clay.

Earth moving operations used to create the wetland, and any other vegetation disturbance, will be performed only from September to March to avoid bird-nesting season. The created wetland will take advantage of existing depressions created during gravel-mining operations. Excavated soil will be used to construct wetland berms or contours or to cover the Geosynthetic Clay Liner (GCL) liner so that no disposal of soil is required.

Existing roads and trails and staging areas will be used to access areas for planting and irrigation. Where possible, existing disturbed areas such as ad-hoc roads and trails will be raked and planted to rehabilitate the area. Vertical mulching, scattering of boulders, and dead plant material will be used to discourage further use of ad-hoc trails.

5.5. Operations and Maintenance

USACE designed the restoration measures to be sustainable so that once the plants are established no maintenance of the plantings would be required. Maintenance requirements will be minimal for the bulk of the restoration area. The created wetland will require monitoring to ensure a constant inflow of water at the rate the wetland is designed to accommodate. Inflow apparatus to the wetland and between the wetland cells will require monitoring and minor cleaning. The primary threat to most restoration features would be vandalism or damage from off-road vehicle use. Particularly sensitive are the seasonal playa wetlands because playa plants are highly susceptible to damage during the dry period. The layer of fine soils that hold water in the playas must remain intact for them to persist. Recreational features would require the most maintenance and will account for the bulk of maintenance efforts.

Since the Las Cruces dam is designed to intercept and detain floodwaters the flood pool area is subject to inundation. The flashy nature of the arroyos within the study area can cause rapid rises in water within the arroyo channels and the flood pool with little warning time. As part of the operations and maintenance the sponsor will incorporate the Las Cruces flood pool area into its flash flood emergency response plan. The plan will provide a warning and evacuation plan in case of flash flood events in the Alameda and Las Cruces Arroyo watersheds.

Off-road vehicle recreation poses a risk to the success of habitat restoration efforts. Off-road vehicle use could potentially damage plantings or wetland features. Further, off-road activities could reduce habitat outputs through disturbance of wildlife near restoration areas. The City of Las Cruces has initiated restrictions on this activity in the study area. The continued restriction of off-road activity would be required as part of the project to protect restoration features and prevent disturbance of wildlife.

5.6. Monitoring and Adaptive Management

Recent USACE guidance, *Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) – Monitoring Ecosystem Restoration*, requires that a

plan be developed for monitoring the success of the ecosystem restoration. This monitoring plan shall:

- Include a description of the monitoring activities to be carried out, the criteria for ecosystem restoration, and the estimated costs and duration of the monitoring; and

- Specify that the monitoring shall continue until such time as the Secretary of the Army determines that the criteria for ecosystem restoration success will be met.

The guidance also states that "an adaptive management plan (i.e., a contingency plan) will be developed for all ecosystem restoration projects".

Post-project monitoring is a crucial requisite of the adaptive management process because performance feedback may generate new insights on ecosystem response and provide a basis for determining the necessity or feasibility of subsequent design or operational modifications. Success should be measured by comparing post-project conditions to the restoration project purpose and needs and to the without-project conditions.

Monitoring also provides the feedback needed to establish protocols and make adjustments where and when necessary to achieve the desired results. Two types of monitoring are proposed to evaluate project success and to guide adaptive management actions. The first type of monitoring, termed "Validation Monitoring", would involve various degrees of quantitative monitoring aimed at verifying that restoration objectives have been achieved for both biological and physical resources. Specific hypotheses addressing type and amount of functional improvements anticipated over specified time periods would be developed and tested as project success criteria. The second type of monitoring, termed "Effectiveness Monitoring" would be implemented to confirm that project construction elements perform as designed. For example, effectiveness monitoring would be used to evaluate percent survival of native plant material installed. Both types of monitoring would be used to guide adaptive management of proposed projects and to guide future restoration designs. Technical Appendix F (USACE, 2010) contains the complete Monitoring and Adaptive Management Plan.

5.7. Schedule for Design and Construction

USACE will begin design of the plans and specifications for the project upon completion of the Project Partnership Agreement. USACE plans to award construction contract in October 2012, and project completion is scheduled for October 2013. Technical Appendix G (USACE, 2010) contains the schedule for design and construction.

5.8. Cost Estimates

Table 5.2 – Las Cruces Dam Restoration and Recreation Costs; derived from the MCACES, differences due to rounding

Las Cruces Dam Restoration, Las Cruces NM October 2010 Price Level			
Item	Federal Cost	Non-Federal Cost	Total Cost
Ecosystem Restoration (ER)			
Feasibility	$1,077,000	$0	$1,077,000.00
Feasibility Cost Adjusted	-$269,000	$269,000	$0
Design	$243,000	$81,000	$324, 000
LERRD	$0	$150,000	$150,000
Ecosystem Restoration	$1,291,000	$430,000	$1,721,000
Construction Management	$238,000	$79,000	$317,000
Subtotal	$2,580,000	$1,009,000	$3,589,000
Interest During Construction Based on escalation Tables	$28,000	$9,000	$38,000
Total ER Cost	$2,608,000	$1,018,000	$3,627,000
Recreation			
Feasibility	$10,000	$0	$10,000
Feasibility Cost Adjusted	-$5,000	$5,000	$0
Design	$18,000	$18,000	$36,000
LERRD	$0.00	$0	$0
Recreation Features	$127,000	$127,000	$255,000
Construction Management	$18,000	$18,000	$35,000
Subtotal	$168,000	$168,000	$336,000
Interest During Construction Based on escalation Tables	$2,000	$2,000	$4,000
Recreation Subtotal	$170,000	$170,000	$340,000
	Federal Cost	Non-Federal Cost	
Total Project Cost	$2,778,000	$1,163,000	$3,868,000
O&M	Non-federal Sponsor O&M is estimated at $14,000		

*LERRDs are limited to the cost of a required mineral rights required; other LERRDs were appraised and credited in prior federal/nonfederal cost sharing project and are not applicable here.

**Ecosystem Restoration Costs include a cost shared $100,000 for monitoring and adaptive management

6. *FORESEEABLE EFFECTS OF THE TENTATIVELY SELECTED PLAN

6.1. Physiography, Geology, and Soils

There is expected to be a short-term temporary adverse effect on soils due to disturbance during construction of the wetland measure. Once the wetland and surrounding plantings were complete the area would be resistant to wind and water erosion. The Tentatively Selected Plan will not have any long term effects on the physiography, geology, or soils in the project area since restoration measures would not change the soil chemistry or permeability.

6.2. Climate

Warming temperatures have produced observable changes in the hydrologic cycle and sea level. Some evident impacts of warming temperatures include: (1) reservoir management in mountainous regions where snow pack is an important form of water storage is impacted by snowmelt earlier in the spring, and (2) coastal design and management is impacted by rising sea levels and potentially large storm surges resulting from larger and more intense hurricanes (Western Regional Climate Center, 2003). Researchers note the possibility for more extremes in terms of flooding and drought. The potential for severe droughts and increasing flood risks has been considered in the Tentatively Selected Plan; however, a tool does not exist to perform a detailed analysis of future flows within the specific area of the project. Because the source of water for the proposed created wetlands is reclaimed water rather than groundwater or other natural water resources, the likelihood of drought affecting the created wetland water source is minimal. However, adaptive management would be used as needed based on changes related to climate change and other factors.

6.3. Hydrology and Geomorphology

USACE does not anticipate that the proposed project would change the existing hydrology or geomorphology of the study area. Precipitation runoff will continue to flow through the study area. Existing depressions (playas) within the study area (i.e., at the mouth of South Fork Arroyo) will continue to capture runoff in the near future. Plantings in and around the playas will evapotranspire water that, in the without-project condition, would have been lost to evaporation and infiltration. USACE anticipates that the playas will eventually fill with sediment at the same rate with or without the proposed project.

6.4. Water Quantity

6.4.1. Precipitation and Stormwater Runoff

Water quantity from precipitation and stormwater runoff passing through Las Cruces Dam would remain the same as for without-project conditions. USACE does not anticipate that precipitation and surface-runoff water volumes would be sufficient to support permanent wetlands in the study area.

USACE does not anticipate that the permanent wetland-cell alternative will introduce more water downstream of the project area. The wetland-cell alternative was designed to prevent significant

infiltration of water and sized to accommodate evaporation/evapotranspiration rates. USACE anticipates that the reclaimed water will evaporate/evapotranspire completely from the wetland. Adjustment of the flow rate from the pipe outlet might be required to balance evaporation/evapotranspiration and the water necessary to sustain the wetlands.

6.4.2. Groundwater

As discussed previously, the water table is typically 30 to 300 feet below the minimum elevation of the pool. USACE proposes to use a Geosynthetic Clay Liner (GCL) for use under the majority of the created wetland cells and a bentonite/soil mix liner on the outer edge of the cells to hold water at the surface. Only a very small amount of water from the wetlands may infiltrate the ground to groundwater; water losses are almost entirely evaporative. Groundwater quantity would not change from current conditions under the Tentatively Selected Plan.

6.5. Water Quality

Soil disturbance would result from debris removal and excavation of the two one-acre wetland cells. Denuded soils would temporarily be susceptible to potential erosion by wind and water. This erosion could result in the introduction of more sediment to the drainage channel. The potential for stormwater pollution during construction is minimal for this project. A National Pollutant Discharge Elimination System (NPDES) permit would be obtained by the construction contractor.

Construction of the wetland cells could reduce some sediment and contamination loading to the drainage channel. The created wetlands would act as a natural filter and would allow sediments and contaminants to settle out, which would improve water quality. Uptake of nutrients, metals, and other compounds by wetland plants in the wetlands similarly may result in localized improvements in water quality.

Section 404 of the Clean Water Act, (CWA; 33 U.S.C. 1251 *et seq.*) as amended, provides for the protection of waters of the United States through regulation of the discharge of dredged or fill material. The USACE Regulatory Program (33 CFR Parts 320-330) requires that a Section 404 evaluation be conducted for all proposed construction that may affect waters of the United States. The restoration (proposed plantings) of the Las Cruces Dam pool area is authorized under a Nationwide Permits No. 27 for Aquatic Habitat Restoration, Establishment and Enhancement Activities and No. 12 for Utility Line Activities (tie-off from reclaimed water pipe to created wetlands). Because the proposed action meets the conditions of these Nationwide Permits, the 404(b)(1) analyses has already been completed and additional 404(b)(1) analysis is not required. All conditions under these permits would be adhered to during construction.

The construction of the wetlands would take place outside of the Ordinary High Water Mark determined from set criteria by the USACE Regulatory Branch. The proposed upland area is outside of the Ordinary High Water line that would be indicated by shelving, changes in sediment texture, and changes in vegetation. This area is within the upland desert shrub community and is dominated by Creosote bush *(Larrea tridentata)*, generally with few other species. This plant community at Las Cruces Dam is disturbed and impoverished. Therefore,

other than the activities mentioned above that would be authorized under Nationwide Permits 27 and 12, no other activities would occur within waters of the United States.

Section 402(p) of the CWA regulates point-source discharges of pollutants into waters of the United States and specifies that storm water discharges associated with construction activity be conducted under NPDES guidance. Some ground disturbance may take place. Therefore, an NPDES permit would be required. A Notice of Intent would be filed, and a Storm Water Pollution Prevention Plan (SWPPP) for the project would be developed by the contractor and be kept on file at the construction site and become part of the permanent project record. The USACE would obtain the NPDES permit prior to commencement of construction activities. Compliance with these requirements would ensure that the Tentatively Selected Plan would have no significant effect on water quality. Silt fences would be installed prior to construction in all areas and other standard Best Management Practices (BMP) would be implemented. All construction activities would be conducted in compliance with all applicable Federal, state, and local regulations. No adverse impact to water quality is anticipated.

6.6. Air Quality and Noise

The air quality within the proposed project area is generally good. All vehicles involved in transporting rubble and spoil from the project site to the deposition area would be required to have passed a current New Mexico emissions test and have required emission control equipment. Implementation of the Tentatively Selected Plan would not exceed existing Federal or state air quality standards. PM_{10} emissions from construction would be ameliorated by environmental design features and BMPs. Construction dust and vehicle emissions would be temporary and would not be expected to incrementally degrade existing conditions. All work areas would continually be wetted down to minimize dust. All vehicles hauling material would be covered during transport. Therefore, short-term impacts to air quality are anticipated during construction but would be abated to the extent possible using BMPs as described above. The Tentatively Selected Plan would be in compliance with all Federal, state, and local requirements. No long-term adverse effects to air quality would result from the proposed action.

Background noise levels in the proposed project area are low. According to the Noise Center for the League for the Hard of Hearing (League for the Hard of Hearing), a typical quiet residential area has noise level of 40 decibels. A residential area near heavy traffic has a noise level of 85 decibels. Heavy machinery has a noise level of 120 decibels. During construction, noise would temporarily increase in the vicinity during vehicle and equipment operation. The Noise Center advises that noise levels above 85 decibels would harm hearing over time and noise levels above 140 decibels can cause damage to hearing after just one exposure. However, the increase in noise during construction would be minor and temporary, ending when construction is complete. The project would take place during normal work hours between 7:00 a.m. to 5:00 p.m. to minimize disturbance. All OSHA and local municipality requirements would be followed. The proposed action would cause minor, short-term noise impacts during construction; however, the impacts would occur only during normal working hours.

6.7. Ecological Resources

6.7.1. Vegetation Communities

The Tentatively Selected Plan would result in substantial increase in area of cottonwood-willow riparian and emergent wetland habitats. The restoration would also improve the structure and function of native arroyo riparian and playa habitats. With the exception of Johnsongrass, the few non-native plant species found in the study area would be removed.

The Tentatively Selected Plan includes approximately 85 acres of proposed restoration work. Seventy-two acres of Chihuahuan Desert arroyo riparian restoration would include planting disturbed and sparsely vegetated areas with plant species typical to that habitat type. In addition, plantings of other species that are typical of the Chihuahuan Desert arroyo riparian habitat, but are currently absent in the project area, would be planted to increase plant species to the study area.

The Tentatively Selected Plan would create a total of 6.35 acres of cottonwood-willow riparian habitat in three separate areas (around north and south playas and around the created wetlands). The creation of this habitat would provide wildlife cover as well as protection and stability to the wetland. The improvement of 3.6 acres of playa habitat is proposed in the four existing playas. The playas on site are shallow basins that retain rain and stormwater runoff for weeks at a time. Currently, these basins are unvegetated. Restoration species would include sedges or rushes in the deeper areas and grasses that tolerate periodic inundation in the shallower areas and margins.

Under the Tentatively Selected Plan, two one-acre emergent wetland cells would be created. The small volume of available reclaimed water limits this feature to two one-acre cells. The first wetland cell would have permanent standing water with a central open water area approximately six feet deep. This cell would contain a variety of emergent aquatic and wetland herbaceous, rhizomatous species appropriate for constant growing season inundation, with native phreatophyte (water-loving) species on the fringes. Water would be routed to the second cell, which would be a moist-soil wet meadow. This area would have plant species that are tolerant of inundation but do not require it (i.e., riparian herbaceous species with riparian grasses and shrubs around the edge). These permanent emergent wetlands would provide an extremely valuable and rare resource.

Because the outlet of the Las Cruces Dam is an ungated structure that lacks a trash-rack, new woody plant establishment would need to be considered in the Operation and Maintenance Plan to avoid potential clogging of woody debris within the outlet structure during flood events. Of the 500 acres of flood pool, only 100 acres would be restored under the Tentatively Selected Plan. Of the 100 acres to be restored, most planting would be similar in structure to what currently exists. Because this concern would be addressed within the Operations and Maintenance Plan, the potential for clogging the outlet would be very low.

The long-term positive effects of restored native vegetation, enhanced playas, and created cottonwood-willow and wetland habitats is expected to outweigh the short-term, minor negative

effects, which would be caused during the construction of the two one-acre cell wetlands and possible other work during construction of the proposed project.

6.7.1.a. Invasive Species

Under the Tentatively Selected Plan, some invasive plant species would be removed. Although Salt cedar and Chaste tree densities are not at a problematic level, it would be advantageous and proactive to selectively thin these species before they increase or become uncontrollable. Therefore, the Tentatively Selected Plan would have a beneficial effect by removing non-native vegetation and planting native vegetation.

6.7.1.b. Noxious Weeds

Salt cedar within the Proposed Action Area would be treated in order to prevent its spread (See Addendum C of this report for treatment prescription). It is anticipated that due to efforts to treat resprouts of non-natives and replanting of native species, treatment should belay new infestation of weedy species. This would, however, be monitored. Regrowth of all vegetation would be monitored throughout the duration of the project for infestation by noxious weeds and non-native species such as Salt cedar.

Any new patches of weeds found during construction of the Tentatively Selected Plan would be noted, treated (if a proven method for treatment exists), or avoided (if no treatment method exists) as pertinent. Also, the contractor would be required to wash all equipment being used before entering the project area. Therefore, it has been determined by the USACE that the Tentatively Selected Plan is within compliance of Executive Order 13112 and there would be a beneficial effect from removing non-native vegetation and possibly existing weed species (as described above) from the Proposed Action Area.

6.7.2. Wildlife

Wildlife in the area would be briefly disturbed during the vegetation planting and during construction of wetland cells. These effects would be temporary and some mobile wildlife would leave the construction area upon initiation of the activities listed above.

Restoration of the Chihuahuan Desert arroyo riparian habitat would increase the amount and types of food and cover available for wildlife and indirectly increase wildlife species richness and abundance. The improvement to the existing playas would provide habitat for several species of animals (birds, invertebrates, amphibians, reptiles, and mammals). The emergent wetlands would create a permanent source of open water habitat and edge habitat, thus increasing the abundance of wildlife in the study area. The emergent wetland communities would enrich the local fauna by attracting many species of birds and other animals that are relatively uncommon in the arid Southwest.

Wildlife displacement during construction would be minimal. Under the Tentatively Selected Plan, a total of 85 acres are proposed for restoration, enhancement, and creation of wetlands. However, only two acres would be disturbed by the construction of the wetland, while the remaining 83 acres are proposed for restoration and enhancement of native vegetation. Therefore, due to the overall limited disturbance of the proposed project, only short-term, minor

adverse impact would occur to wildlife as a result of the Tentatively Selected Plan, and long-term beneficial effects would result.

A Fish and Wildlife Coordination Act Report (FWCA) was not prepared by the USFWS for this project. All measures (activities) considered for this project would modify less than ten acres of a water body and therefore, the project is exempt from the Act. Communication with the USFWS was conducted early in the planning process and the Corps was encouraged to move forward with the project without a FWCA. Communication with the USFWS can be found in Appendix A.

6.8. Special Status Species

Special status animal species listed by USFWS (USFWS, 2010) and New Mexico Department of Game and Fish for Doña Ana County (NMDGF, 2010) that may be present within the study area include the Peregrine Falcon, a state threatened species and a USFWS species of concern, and the Burrowing Owl, a USFWS species of concern. Due to the ease of mobility of the Peregrine Falcon, the limited disturbance of the proposed project, and the lack of preferred habitat in the project area, the Tentatively Selected Plan would have no effect on the Peregrine Falcon. Locations of restoration work proposed under the Tentatively Selected Plan do not occur at or near the sites where the Burrowing Owls were recorded during the CBC. The construction of the permanent wetland would occur at the southern end of the study area, which is at the opposite end of the area where the Burrowing Owls were detected. Due to the location and the limited disturbance of the proposed project, the Tentatively Selected Plan would have no effect on the Burrowing Owl.

6.9. Cultural Resources

This project as currently defined would have no effect on historic properties. There are no known historic properties or tribal concerns in the project's Area of Potential Effects as defined in 36 CFR 800.16(d). State Historic Preservation Office consultation is located in Technical Appendix D (USACE, 2010).

6.10. Socioeconomic Considerations and Environmental Justice

The Tentatively Selected Plan would benefit the socioeconomic environment of the City of Las Cruces area adjacent to the study area. Potential effects would be associated with construction of the project and include beneficial effects associated with localized purchases of material, equipment, and supplies and the effects of additional worker salaries and income. Increased recreational and interpretive opportunities may lead to more business for local merchants and other public institutions. The improvements to the study area in tandem with the existing public institutions would help the area become an even greater destination for tourists.

6.11. Land Use and Recreational Resources

There would be effects to current land uses in the project area as a result of the proposed project. No changes to land-use designations would be made as a result of the proposed project. Recreational land use, such as walking, biking, hiking, and jogging would increase with the proposed project. Recreational features within the study area would include improved existing trails and a new trail system, a pedestrian bridge, wildlife blinds, educational signs, and benches

(see Figure 4.1 for these measures). The trail system would traverse the area of the Tentatively Selected Plan, as well as link to other trails outside the area. Educational signs would inform observers of the ecological function and importance of each plant community and water-related area. Other aspects of the Tentatively Selected Plan would improve safety for recreational users because trails would be enhanced.

Construction activities would temporarily impede recreational activities in the study area (especially near the south end where the permanent wetlands would be constructed). All work zones would be designated and signed with cautionary information. The existing trails would be kept clear for use by visitors as much as possible, and all machinery and vehicles would yield to visitors. Implementation of the Tentatively Selected Plan would result in considerable enhancement of the recreation system in the study area. The Tentatively Selected Plan conforms to, and builds upon, the City of Las Cruces plans for the recreation system in the Las Cruces Flood Control Recreation Master Plan.

Cumulatively, these trails, once built and maintained, have the potential to significantly reduce the human impact on wildlife and vegetation within the study area while increasing the functionality of the existing recreation system. These trails would enable the Las Cruces Dam to connect to the Rio Grande along the outfall channel as well as other places within the greater City of Las Cruces. These trails would also provide access to the top of the dam, which provides dramatic views of the surrounding city and countryside. A unique and improved recreational and interpretive experience would be provided to neighboring residents, the larger community, and many visitors to Las Cruces. Therefore, the Tentatively Selected Plan would have short-term negative effects on recreation with long-term positive benefits. Figure 6.1 displays the Tentatively Selected Recreation Plan.

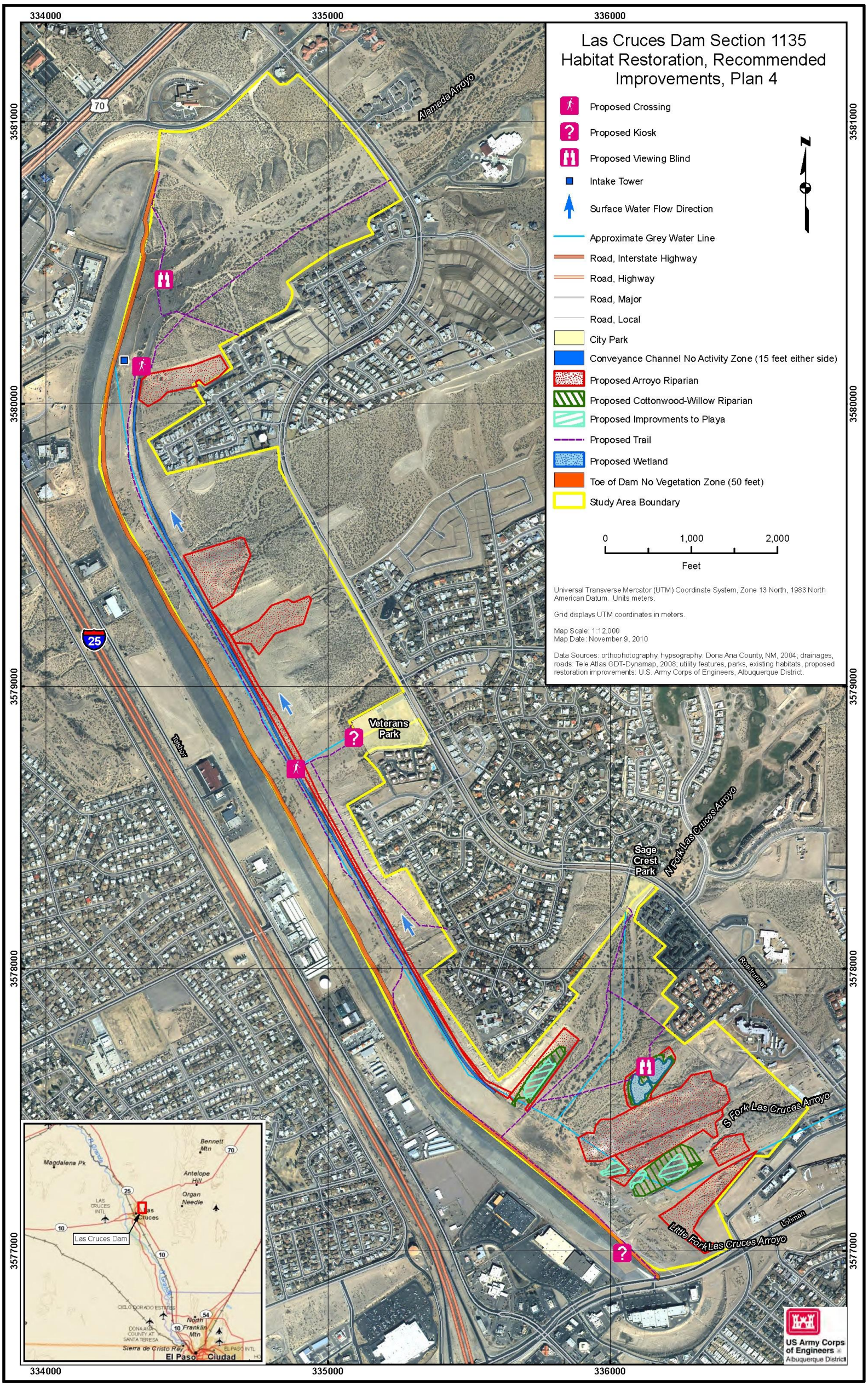

Figure 6.1 – Tentatively Selected Recreation Plan

6.12. Environmental Engineering

This project as currently defined would have no effect on the environmental engineering.

6.13. Aesthetics

In order to accomplish the goals of the project, construction within the study area would include machinery of varying sizes. This would cause short-term negative affects to aesthetics during construction. Post-construction, some visual effects would be noticed. The new emergent wetlands area and enhancement of the playas would be in place and much of the area would have new shrub and grass planting. Therefore, negative, short-term impacts by the Tentatively Selected Plan would affect aesthetics during construction. Immediately after construction, the area would have a 'recently planted' and somewhat manicured look. These impacts would decrease over a short period of time as the vegetation grows and water enters the wetland cells. Revegetation along with the additive water features would increase the aesthetics of the site within a few years of maturation.

6.14. Indian Trust Assets

Indian Trust Assets (ITAs) are a legal interest in assets held in trust by the United States Government for Indian tribes or individuals. The United States has an Indian Trust Responsibility to protect and maintain rights reserved by or granted to Indian tribes or individuals by treaties, statues, executive orders, and rights further interpreted by the courts. The Secretary of the Department of the Interior (DOI), acting as the trustee, holds many assets in trust. Some examples of ITAs are lands, minerals, water rights, hunting and fishing rights, titles and money. ITAs cannot be sold, leased, or alienated without the express approval of the United States Government. The Indian Trust Responsibility requires that all Federal agencies take all actions reasonably necessary to protect such trust assets. The Department of Defense's American Indian and Alaska Native Policy, signed by Secretary of Defense William S. Cohen on October 20, 1998, and DOI's Secretarial Order 3175 and the Bureau of Reclamation's (Reclamation) ITA Policy require that the USACE, as the project's Lead Federal Agency, and Reclamation, as the Federal Land Managing Agency, consult with tribes and assess the impacts of its projects on ITAs. If any ITAs are identified and are to be impacted, further consultation on measures to avoid or minimize potential adverse effects would take place. If the project results in adverse impacts, consultation regarding mitigation and/or compensation would take place.

6.15. Floodplain and Wetlands

Jurisdictional wetlands (relative to Section 404 of the Clean Water Act) do not occur within the proposed project area. Evidence shows that hydric soils existed in the study area and jurisdictional wetlands may have occurred; however, the dam has altered sediment transport to the extent that historical wetlands have been filled.

Executive Order 11988 (Floodplain Management) provides Federal guidance for activities within the floodplains of inland and coastal waters. Preservation of the natural values of floodplains is critically important to the nation and the State of New Mexico. Federal agencies are required to "ensure that its planning programs and budget requests reflect consideration of flood hazards and

floodplain management." The majority of the study area is located in areas of the 1.0%-chance flood or areas between limits of the 1.0%-chance flood and 0.2%-chance flood according to the effective Federal Emergency Management Agency Flood Insurance Rate Map. Because the proposed work would involve restoring native vegetation and constructing wetland cells, and the work would not constitute any alterations within the historic floodplain, the Tentatively Selected Plan would have no effect on the floodplains.

Executive Order 11990 (Protection of Wetlands) requires the avoidance, to the greatest extent possible, of both long-term and short-term impacts associated with the destruction, modification, or other disturbance of wetland habitats. No wetlands currently exist within the project area; therefore, no impacts to wetlands would occur.

6.16. Cumulative Effects

Cumulative effects are "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR § 1508.7). The geographic extents, for which cumulative effects are considered, vary for each of the resources analyzed. Similarly, actions taken in the past, present, and reasonably foreseeable future within the study area, when combined with the actions in the Tentatively Selected Plan, could contribute to cumulative effects and may vary with the resource being considered. The USACE evaluated environmental impacts associated with the study area relative to the Tentatively Selected Plan.

6.16.1. Other Projects in the Region

Construction of Las Cruces Dam in 1975 contributed to the ecological disturbance of the historic arroyo riparian ecosystem of the Las Cruces and Alameda Arroyos. Within the dry bed reservoir of the Las Cruces Dam, wind and water erosion have become a problem in areas where soils were removed or exposed due to vegetation removal during the construction of the dam. Impacts to the immediate and surrounding landscape and local terrestrial ecosystem have stabilized since dam construction.

The City of Las Cruces has been offered a grant from the New Mexico Department of Transportation to build a trail system along the Las Cruces Dam outfall channel that would connect the proposed Las Cruces Dam trail system to the existing La Llorona River Trail. The Tentatively Selected Plan would work in harmony with the proposed trail system. The proposed project would have no cumulative negative impact, but potentially a cumulative positive benefit.

The Chihuahuan Desert Nature Park, located north of the study area, is a 960-acre nature park that works with local educational interests to promote awareness of the value of this ecosystem. The Bureau of Land Management is currently working on a land exchange for portions of the North Fork of the Las Cruces Arroyo, upstream of the study area, and will analyze the preservation of the associated arroyo riparian ecosystems. The Tentatively Selected Plan is consistent with the Chihuahuan Desert Nature Park's mission of increasing scientific literacy by fostering an understanding of the Chihuahuan Desert. Additionally, the Tentatively Selected Plan would complement the Bureau of Land Management's plans to preserve the upper reaches

of the North Fork of the Las Cruces Arroyo. The proposed project would have no cumulative negative impact, but potentially a cumulative positive benefit.

6.16.2. Hydrology and Geomorphology

The Tentatively Selected Plan would have no impact on the hydrology as it relates to the environment of the study area. The effects of past projects have been documented, and this project attempts to rectify some of the impacts caused by those earlier projects. In addition, other projects are planned for this area, and these projects would work in harmony with the Tentatively Selected Plan to enhance ecosystem health and function in the Las Cruces Dam flood pool area. Therefore, the cumulative effects on the geomorphology and hydrology would not negatively impact the study area.

6.16.3. Water Quality

For the Tentatively Selected Plan to have cumulative effects on water quality within the reservoir pool area, a threshold in concentration of some pollutant, due to the effects of the Tentatively Selected Plan, would have to be exceeded. In this case, the additive effect of a pollutant due to actions taken in the Tentatively Selected Plan combined with existing water quality conditions would have to exceed a toxicity level or water quality standard. No action under the Tentatively Selected Plan would have an additive or long-term adverse impact on the existing water quality conditions. Some minor, localized, long-term beneficial effects to water quality could occur as a result of the removal of pollutants by project features such as created wetlands and the vegetation enhancement of the playa areas. In summary, cumulative adverse effects on water quality as a result of the Tentatively Selected Plan would not occur.

6.16.4. Air Quality and Noise

Minor cumulative effects to air quality and noise levels would occur during the project construction period. However, the additive effects on air quality and noise would not extend beyond the period of equipment operation. During the period of construction, effects on air quality or noise would not likely exceed any critical environmental thresholds due to the Tentatively Selected Plan.

6.16.5. Ecological Resources

The Tentatively Selected Plan would have beneficial effects on restoration of native riparian vegetation and wet habitat in the study area. Therefore, no adverse cumulative effects would occur from implementing the Tentatively Selected Plan. Planting of native species would improve vegetation structure and species composition. These project features would not cause adverse cumulative impacts to wildlife habitat. Additionally, habitat diversity would be improved by the Tentatively Selected Plan. While revegetation eventually avoids a significant adverse effect of the Tentatively Selected Plan, there would remain a short-term adverse effect on wildlife populations until planted shrub communities mature. USACE estimates that a minimum of ten years would be required for planted shrubs to achieve stature and densities resembling existing conditions. In summary, this project would have a positive impact on the

environment resulting from the potential cumulative effects of other nearby projects carried out by Federal and non-Federal agencies.

6.16.6. Recreational Resources

A number of new recreational and interpretive features have been proposed for the study area, which would increase access and opportunities throughout the area. The features would provide a more permanent and environmentally sound structure for such activities through formalizing and stabilizing trails, eliminating redundant trails, and providing new features, such as wildlife blinds, viewing areas, interpretive signage, and benches. Although recreational access in the study area would be temporarily limited during the construction process, the Tentatively Selected Plan would have a positive additive, long-term impact on the recreational and interpretive value of the Las Cruces Dam reservoir pool area. In summary, cumulative adverse effects on recreation as a result of the Tentatively Selected Plan would become strongly positive upon completion of the project.

6.16.7. Aesthetics

Although aesthetics would be temporarily impacted during the construction process by the increased amount of bare earth and staging areas, the Tentatively Selected Plan would have a net positive additive and long-term impact on the aesthetic value of the study area. In summary, cumulative effects are likely to improve overall aesthetics.

6.16.8. Irreversible and Irretrievable Commitment of Resources

An irreversible and irretrievable impact is the commitment of resources that are lost forever. No foreseeable irreversible and irretrievable commitments of resources are associated with this project. Procedures to ensure the security and integrity of any resource would be diligently maintained at all times.

6.16.9. Conclusion

The summary of effects listed in Table 6.1 includes some short-term adverse effects that will result in long-term benefits. A summary of BMPs to be implemented during construction of the project include:

- Silt fence (without lead weights) would be installed in areas that would be disturbed to reduce erosion.
- Fueling of vehicles would not take place in the sediment pool area.
- Cleaning of all equipment is required prior to entering the site.
- Construction activities would take place in the designated area only, avoiding any unnecessary damage to existing native vegetation.

- To avoid impacts to migratory birds, work that would disturb woody vegetation would not occur between April 15 and August 30 unless the affected area is first surveyed by a biologist and determined not to have nesting birds.

- Existing roads and right-of-ways and staging areas should be used to the greatest extent practicable to transport equipment and construction materials to the project site.

- Exposed and disturbed soil surfaces would be watered at a frequency sufficient to avoid dust.

- Earthmoving and other dust-producing activities would be suspended during periods of high winds when dust control efforts are unable to prevent fugitive dust.

- Stockpiles of debris, soil, sand, or other materials would be watered or covered.

- Materials transported on or off site by truck would be covered.

Based on the analysis of potential effects, the BMPs to be implemented during construction, and the goal of the project to restore the Chihuahuan Desert ecosystem and provide valuable water features, USACE anticipates that the project would have an overall positive benefit to the study area and to the City of Las Cruces.

Table 6.1 - Summary of Effects

Existing Environment	*Foreseeable Effects*
Physiography, Geology, Soils	Short-term temporary adverse effects on soils
Hydrology and Hydraulics	No effect
Water Quality	No effect
Air Quality and Noise	Negligible, short-term adverse effects
Plant Communities	Short-term negative effects with long-term positive effects
Fish and Wildlife	Short-term negative effects with long-term positive effects
Endangered and Protected Species	No effect to: Burrowing Owl and Peregrine Falcon
Cultural Resources	No Historic Properties Affected
Socioeconomic Considerations	No adverse effect
Environmental Justice	No adverse effect
Land Use	No adverse effect
Recreational Resources	Short-term negative effects with long-term positive effects
Aesthetics	Short-term negative effects with long-term positive effects
Indian Trust Assets	No adverse effect
Floodplains and Wetlands	No adverse effect

7. CONSISTENCY WITH THE ENVIRONMENTAL OPERATING PRINCIPLES

The recommended plan provides for the improvement of ecosystem habitat within the Las Cruces Dam reservoir basin in a cost effective and efficient manner. Other Federal, state and local agencies, as well as, local conservation groups, New Mexico State University and the public participated in the study by providing technical knowledge, historic accounts opinion and support. These participants were involved in the planning process and endorse the recommended plan. The environmental operating principles were addressed in the project as follows:

Environmental Sustainability

• Restoration measures were designed to be self sustaining after a period of establishment.

• The created wetland measures incorporates minimal operation and maintenance for a vital function within the local ecosystem.

Interdependence of Life and the Physical Environment

- Restoration measures were formulated based on climate and hydrogeomorphology within the study area.
- Geomorphology that had been altered by construction and operation of the Las Cruces Dam provides the opportunity to improve or expand habitat types that were not present prior to dam construction.

Seek Balance and Synergy between Human. and Natural Systems

- The study coordinated alternative development with the community members, sponsor, and State and Federal agencies.
- Proposed recreation features are compatible and do not detract from restoration measures.

Continue* to *Accept Corporate Responsibility and Accountability

- Addressed agency and public concerns.
- Provided for restoration of habitats impacted by the construction of the Federal project.

Assess and Mitigate Cumulative Impacts* to *Environment

- Project designed to provide for local as well as migratory wildlife species to maximize far reaching beneficial effects.

Build and Share Knowledge

- Multi-partner effort to obtain study information, formulate alternative plans and assess with and without projects conditions.
- Utilized local knowledge of hydrologic and habitat conditions.
- Utilized local and regional knowledge restoration methodologies.

Respect the Views* of *Individuals and Groups

- Listened to and incorporated views of others through public involvement and team meetings.

8. *COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

This Final DPR with Integrated EA was prepared by the Corps, Albuquerque District, in compliance with all applicable Federal Statutes, Regulations, and Executive Orders, as amended, including the following:

- National Historic Preservation Act (16 U.S.C. 470 *et seq.*)
- Archaeological Resources Protection Act (16 U.S.C. 470aa *et seq.*)
- Clean Water Act (33 U.S.C 1251 *et seq.*)
- Clean Air Act (42 U.S.C. 7401 *et seq.*)
- Endangered Species Act (16 U.S.C. 1531 *et seq.*)
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations
- Executive Order 11988, Floodplain Management
- National Environmental Policy Act (42 U.S.C 4321 *et seq.*)
- CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Part 1500 *et seq.*)
- Native American Graves Protection and Repatriation Act (25 U.S.C. 3001 *et seq.*)
- Executive Order 11593, Protection and Enhancement of the Cultural Environment
- Executive Order 11990, Protection of Wetlands

- U.S. Army Corps of Engineers' Procedures for Implementing NEPA (33 CFR Part 230; ER 200-2-2)
- Farmland Protection Policy Act (7 U.S.C. 4201 *et seq.*)
- Executive Order 13112, Invasive Species
- Federal Noxious Weed Act (7 U.S.C. 2814)
- Energy Independence and Security Act of 2007, P.L. 110-140, Section 438, 121 Stat. 1492, 1620 (2007)
- Migratory Bird Treaty Act, 16 U.S.C. 703, et seq.
- Fish and Wildlife Coordination Act, 48 Stat. 401; 16 USC 661 et. seq.
- Executive Order 13524, Federal Leadership in Environmental, Energy, and Economic Performance

9. *PREPARATION, CONSULTATION AND COORDINATION

9.1. Preparation

Personnel primarily responsible for preparation of this Final DPR with Integrated EA include:

- Danielle Galloway – Biologist
- John Schelberg – Archaeologist
- Dana Price – Botanist
- William Shutter – Geologist
- Ryan Gronewald – Hydraulic Engineer
- Debbie Smith – Civil Engineer
- Mark Doles – Planner
- Alicia AustinJohnson – Project Manager
- Julie Alcon – Supervisory Ecologist (QC)
- Gregory Everhart – Archaeologist (QC)
- William DeRagon – Biologist (QC)

9.2. Consultation and Coordination

Agencies and other entities contacted formally or informally during scoping and in preparation of this Final DPR with Integrated EA and/or who will be notified of the public review of the document include:

- U.S. Fish and Wildlife Service
  -Communication with the USFWS was conducted early in the planning process and the Corps was encouraged to move forward with the project without a FWCA report. Communication with the USFWS can be found in Addendum A.
- U.S. Environmental Protection Agency, Region 6
- U.S. Department of Agriculture
- U.S. Bureau of Reclamation
- New Mexico State Forestry Division-Energy, Minerals, and Natural Resources Department
- New Mexico State Historic Preservation Office (see Appendix D for compliance status)
- New Mexico Department of Transportation-Environmental Section
- New Mexico Environmental Department-Water & Waste Management Division

- New Mexico State Engineer
- New Mexico Department of Game and Fish
- New Mexico State University
- Doña Ana County Flood Commission
- City of Las Cruces
- Mesilla Valley Audubon Society
- Adjacent Property Owners
- Interested Pueblos and Tribes:
- Comanche Nation of Oklahoma
- Fort Sill Apache Tribe
- Kiowa Tribe of Oklahoma
- Mescalero Apache Tribe
- Navajo Nation
- Pueblo of Isleta
- White Mountain Apache Tribal Council
- Ysleta del Sur Pueblo

10. RECOMMENDATIONS

I recommend approving the Tentatively Selected Plan to be implemented within the flood pool reservoir of the Las Cruces Dam, Las Cruces, New Mexico. Project restoration measures include:

- Creation of a two-acre wetland using reclaimed wastewater.
- Improvement or establishment of approximately 72 acres of Chihuahuan Desert arroyo riparian habitat.
- Establishment of 6.3 acres of cottonwood riparian habitat.
- Improvement of 3.6 acres of playa habitat.

The estimated first cost of the recommended restoration is $3,279,000. The estimated annual Operation and Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) cost is $11,000, including $1,000 to maintain the effluent line and $10,000 to maintain overgrowth and revegetation. The Federal portion of the estimated total first cost is $2,459,000.

10.1. Consistency with project purpose

The construction and operation of the Tentatively Selected Plan would be consistent with Engineer Regulation 1105-2-100, specifically, "The objective of ecosystem restoration is to restore degraded ecosystem structure, function and dynamic processes to a less degraded, more natural condition. Restored ecosystems should mimic, as closely as possible, conditions which would occur in the absence of human changes to the landscape and hydrology". The project would also be consistent with the authorized purposes and current operation of the Las Cruces Dam. Activities proposed within the Tentatively Selected Plan would not raise the Federal

Emergency Management Agency's designated base flood elevation at the dam facility either during or after the project is completed. Additionally, the features of the proposed project would not alter the extent or frequency of damaging discharges within or downstream from the project area.

10.2. Real Estate Requirements

The City of Las Cruces is the current owner of all lands required for the project. Real Estate requirements for the ecosystem restoration project consists of approximately 90-100 acres of Chihuahuan Desert riparian ecosystem restoration in several areas within the dry bed reservoir of the Las Cruces Dam, restoration of intermittent flow arroyos, and creation of approximately 5-10 acres of seasonal wetland (please see real estate map with acreages in Appendix H).

No credit will be provided for project lands, because full credit was provided for the original cost-shared construction of the dam in 1975. Acquisition of one underlying mineral right will be required, however, with the credit estimated at $150,000. Please see appendix H for the detailed RE plan.

10.3. Cost Sharing Requirements

The non-Federal sponsor is responsible for the cost share amount equal to 25% of total project costs as well as LERRDs and OMRR&R. All costs for construction in excess of that amount will be accomplished by the local sponsor as a betterment. Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including, but not limited to, the items of cooperation listed below:

- Provide all lands, easements, and rights of way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights of way to enable the disposal of dredged or excavated material as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the ecosystem restoration features;

- Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share, therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

- Provide, during construction, 100% of total project investment costs.

- Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights of way or the addition of facilities which might reduce the outputs produced by the ecosystem restoration features, hinder operation and maintenance of the project, or interfere with the project's proper function;

- Shall not use the ecosystem restoration features or lands, easements, and rights of way required for such features as a wetlands bank or mitigation credit for any other project;

- Keep the recreation features, and access roads, parking areas, and other associated public use facilities open and available to all on equal terms;

- Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4605), and the regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

- For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and state laws and regulations and any specific directions prescribed by the Federal government;

- Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

- Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

- Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of three years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20;

- Comply with all applicable Federal and state laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying, and enacting without substantial change

the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

- Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal government determines to be subject to the navigation servitude, only the Federal government shall perform such investigations unless the Federal government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

- Assume, as between the Federal government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal government determines to be required for construction, operation, and maintenance of the project;

- Agree, as between the Federal government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

- Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

The City of Las Cruces requested the current proposed project and would serve as the local cost-sharing sponsor of the project. The cost-sharing requirements and provisions would be formalized with the signing of a Project Partnership Agreement (PPA) between the City and the Department of the Army following approval of this feasibility report. In the PPA, the sponsor would agree to provide all lands, easements, rights of way, relocations and disposal costs and any betterment costs.

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DETAILED PROJECT REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

SECTION 1135

LAS CRUCES DAM ENVIRONMENTAL RESTORATION PROJECT

ADDENDUMS

ADDENDUM A

Public Scoping Letter
Comments Received during Public Scoping and Meeting
Public Review Letter
Comments Received during the Public Review Period
Communication with USFWS on the FWCA Report

November 30, 2009

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

Dear XXXXX:

The U.S. Army Corps of Engineers, Albuquerque District (Corps), is preparing a Feasibility Study Report / Environmental Assessment for the *Las Cruces Dam Ecosystem Restoration Project, Las Cruces, Doña Ana County, New Mexico* project. The purpose of the study is to determine the extent of riparian habitat degradation and develop alternatives to improve this ecosystem to a more naturally functioning system within the study area. From these alternatives, an environmentally sound, economically viable, and publicly acceptable alternative shall be selected and recommended for approval for construction. See Figure 1 for the project location. This scoping letter is to solicit issues and comments on the project under the National Environmental Policy Act (NEPA).

Funding was approved for this project under Section 1135 of the Water Resources Development Act of 1986 (Public Law 99-662), as amended. Section 1135 provides authority for the Corps to modify the structures and operation of Corps projects to improve the quality of the environment when it is determined that such modifications are feasible and consistent with the authorized project purposes. It also provides authority to implement restoration measures at locations where projects built by the Corps or jointly by the Corps and other Federal agencies, have contributed to the degradation of the quality of the environment, if such measures do not conflict with the authorized project purposes. A project is accepted for construction only after detailed investigation clearly shows its engineering feasibility, environmental acceptability, and economic justification.

The project area is located on approximately 600 acres of flood pool, maintenance roads and right-of-way for the outfall channel behind the Las Cruces Dam. The Las Cruces Dam is situated directly east of Interstate 25 on the east side of the City of Las Cruces. The dam was constructed in 1975 by the Corps to reduce flood damages from flow originating in the Las Cruces and Alameda Arroyos. The dam is owned and operated by the City of Las Cruces.

The proposed ecosystem restoration project consists of approximately 90-100 acres of Chihuahuan Desert riparian ecosystem in several areas within the dry bed reservoir of the Las Cruces Dam, restoration of intermittent flow arroyos and creation of approximately three acres of wetlands using reclaimed water provided by the City of Las Cruces. Figure 2 illustrates where these preliminary habitat restoration measures are located.

Please inform us of any issues you feel need to be addressed in the Feasibility Study Report / Environmental Assessment for this proposed project. Send your correspondence within 30 days from the date of this letter to:

U.S. Army Corps of Engineers, Albuquerque District
Attn: Mrs. Danielle A. Galloway, Biologist
Environmental Resources Section
4101 Jefferson Plaza NE
Albuquerque, NM 87109-4335

If you have any questions or need additional information, please contact Mrs. Galloway at (505) 342-3661, or e-mail address danielle.a.galloway@usace.army.mil. Thank you for your time and attention.

Sincerely,

Julie A. Alcon
Chief, Environmental Resources Section

Enclosures (2)

Scoping Letter Sent to:

U.S. Fish and Wildlife Service (Murphy)
U.S. Environmental Protection Agency (Gilmore)
Natural Resources Conservation Service (Podoll)
Bureau of Reclamation (Hansen)
Energy, Minerals, and Natural Resources Department (Sivinski)
New Mexico Department of Transportation (McVickar)
New Mexico Environmental Department (Goldstein)
New Mexico State Engineer (D'Antonio)
New Mexico Department of Game and Fish (Wunder)
New Mexico State University (Assistant Professors)
Doña Ana Flood Commission (Dugie)
City of Lac Cruces Public Works Department (Grijalva)
City of Las Cruces Utilities (Widmer)
Mesilla Valley Audubon Society (Griffin)
SW Area Game Manager Habitat Specialist (Mathis)
Local Citizens and Neighborhood Organizations

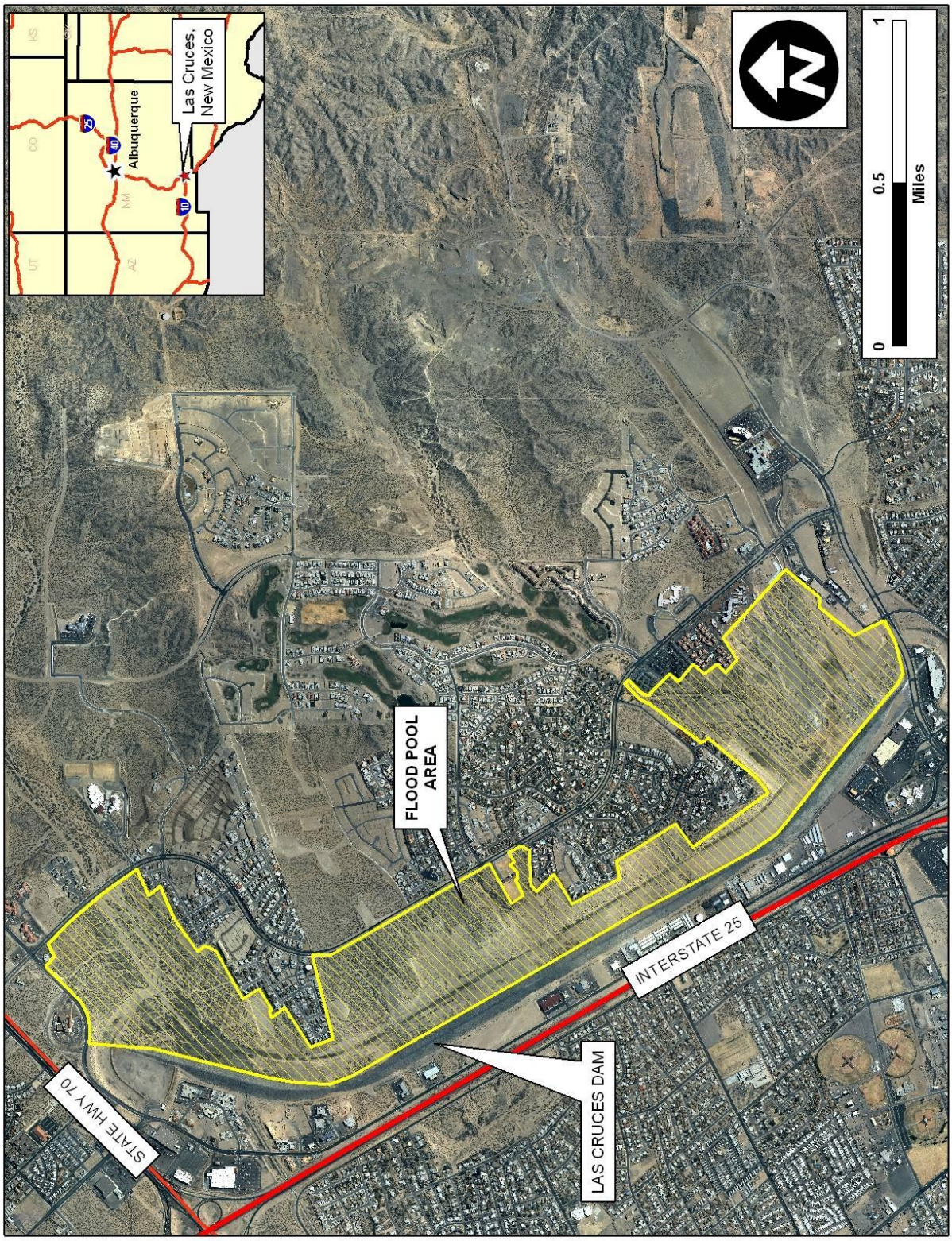


Figure 1. Las Cruces Dam Ecosystem Restoration Project Location and Designated Flood Pool Area.

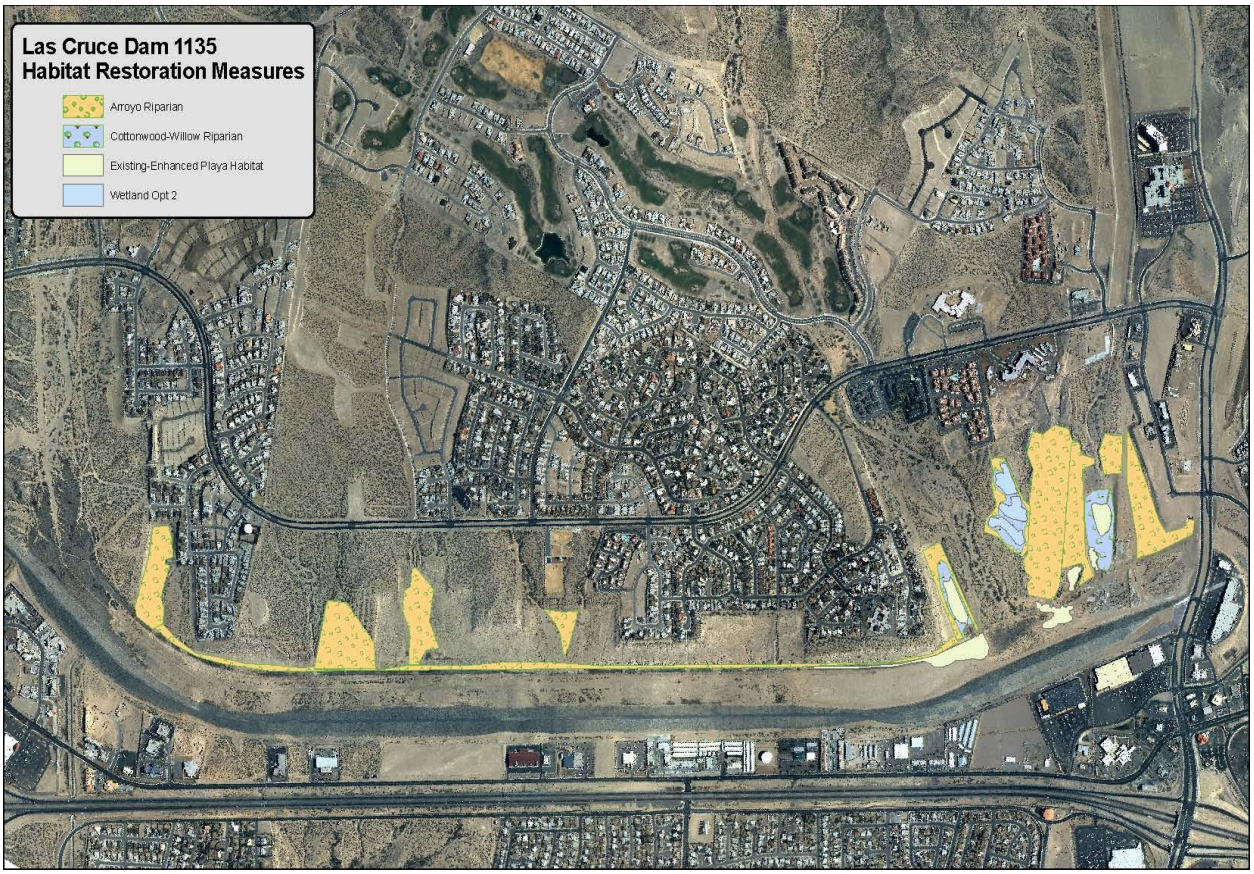


Figure 2. Preliminary Habitat Restoration Measures for the Las Cruces Dam Environmental Restoration Project.

From: William Little [wmlittle@zianet.com]
Sent: Thursday, May 20, 2010 3:14 PM
To: Galloway, Danielle A SPA
Cc: AustinJohnson, Alicia M SPA; Adrienne Widmer
Subject: Las Cruces Dam Environmental Restoration Project

I am writing to recommend against including an artificial wetland in the project. It is inappropriate from a number of standpoints.

1. There is no context for a wetland at the site; before or after the dam I expect there would not have been a defined wetland in those arroyos.

2. A two-acre postage stamp, far from any similar feature, does not fit the environmental context or the landscape.

3. The proposed clay liner is unlikely to be a very long-lived construct. Some of the plants proposed are phreatophytes that will soon breach the clay, if it doesn't desiccate on its own. The purple pipe water can be used to start vegetation, but probably shouldn't be dedicated to a permanent feature.

4. I am somewhat concerned about establishing a phreatophyte (cottonwood-willow) community, as well. The Arroyo Riparian ecotone is, I expect, the pre-existing model to which the restoration should conform. However, this is not nearly as serious as the wetland issue.

From: Nancy Stotz [nstotz1@comcast.net]
Sent: Friday, June 04, 2010 4:20 PM
To: AustinJohnson, Alicia M SPA; Galloway, Danielle A SPA
Subject: LC Dam restoration plan--Recreation answers

1. What types of recreation occurs in the area (including Sagecrest and Veterans Parks) RIGHT NOW? So far we understand people run/walk the dam crest, and visit Veterans and Sagebrush Parks. The existing parks provide places for picnicking and informal play. Runners and walkers walk the dam.Anything else? Is there a nearby playground/swingset? Ball field for soccer/football/baseball/softball?

The undeveloped parts of the dam area currently get extensive use by walkers and runners, from both the adjacent neighborhoods and elsewhere around town (folks from other parts of town especially use the trail on top of the dam, parking at either end--some runners make a loop by doing one direction on top and the other on the roads behind the dam). Lots of use by dog walkers, many of whom allow dogs to run off-leash and very few of whom pick up after their dogs (not great for wildlife or aesthetics). For a while, some search and rescue dog training occurred, especially along Alameda Arroyo and in the dense stand of Johnsongrass behind the north end of the dam. Area also gets some use by mountain bikers, both on top of and behind the dam. Area gets some use by wildlife watchers (especially to watch birds and experience deafening calls of spadefoots when seasonal ponds first form). Unfortunately, area also gets a lot of recreational use by unauthorized motor vehicles (dirt bikes, ATVs and 4-wheel drive SUVs).

Developed parks also get a lot of use by dog walkers who don't want to go out in desert behind the dam (lack of paved trails on sandy substrate may dissuade some walkers from dam area). Sagecrest Park has a playground and one picnic table. Lawn gets some use for regular tee-ball, very young soccer team practices. Veteran's Park has a gazebo, several picnic tables, and restrooms. Large grassy lawn gets use for soccer practice. Memorial wall and Baataan March statue attract visitors and special events; flag pole authorized for garrison flag use means flag-raising and lowering ceremonies on big holidays.

2. Outside of Sagecrest and Veterans Parks, are there any other parks east of the Las Cruces Dam? Where are they and what facilities do they provide?

There are 2 new parks out in the Sonoma Ranch development. Desert Trails Park, off of Mission Drive, is a mostly undeveloped naturally vegetated park with paved walking trails. There's also a developed park farther east (off a main street whose name I can't remember and Google maps doesn't identify--side street adjacent to it is Southern Canyon Loop)--big playground, basketball court, and picnic tables. The ballfields and playgrounds at the 2 **schools on Roadrunner** Parkway (Desert Hills Elementary and Camino Real Middle School) also get used outside of school hours.

3. What facilities exist at Sagecrest and Veterans Parks? Restrooms? Water Fountains? I see parking at Veterans Park, but not at Sagecrest. Again, any benches, tables, playground equipment? Are these facilities crowded at any time?

Sagecrest Park has a playground, one picnic table, and a water fountain. A few benches near playground. No bathroom last I saw it, but I believe it's on the City's list to add one to the park. Lawn gets some use for regular tee-ball, very young soccer team practices. In spite of limited tables, park gets regular use for big family gatherings and can be packed on big holidays like Easter. More extensive shade seems to make up for lack of tables (and trees provide a place to hang pinatas!).

Veteran's Park has a gazebo, several picnic tables, a water fountain and restrooms. Benches near statue. Large grassy field gets use for older-kid soccer practice. Memorial wall and Baataan March statue attract visitors and special events; flag pole authorized for garrison flag use means flag-raising and lowering ceremonies on big holidays. Again, lots of use for big family gatherings, huddling for shade under gazebo.

4. Judging by the aerial photography, getting to the parks is easy. Any congestion issues getting to or moving through the parks? Are any available facilities (ball fields or courts, restrooms, playground equipment, etc...) used so much as to create a congestion issue?

Lack of parking at Sagecrest Park can create issues--lots of people turning off of Roadrunner make a u-turn so they can park on same side of street next to park, which has become more dangerous with recent build-out of higher-density development across the street. Sidewalk connecting to neighborhood to west, accessed via Frontier, is not continuous since build-out on south side of Frontier hasn't happened yet.

Lack of a curb cut through the Roadrunner median means access to Veteran's Park from northbound Roadrunner requires people to pass the park and make a u-turn at Mission to come back to the park. Corners and hills along Roadrunner limit visibility (there was a fatal accident in this stretch last year).

5. Where does a recreation user go for a similar experience, in the event Sagecrest and Veterans parks are unavailable? How far does one have to travel? How many substitute locations are there? City Parks and Rec. lists about 50 parks, some of which are fairly familiar.

New developed park out in Sonoma Ranch (see question 2) is about a mile and a half away from Veteran's Park. Since it's brand new, it also lacks good shade, except for shade structure built over playground.

6. How attractive are Sagecrest and Veterans parks relative to other city parks? Anything special about those parks from an aesthetic view?

Shade at Sagecrest Park is a big deal--I know a 'play group' of several moms who rotate their kids around through different city parks, and Sagecrest is one that they really like, because of the shade. Veteran's Park statue and memorial are unique and a big draw. Both parks currently get some use as access points for walking in desert areas behind the dam, and make sense as entry points to the area.

From: Beth Bardwell [bethbardwell@zianet.com]
Sent: Monday, April 05, 2010 4:56 PM
To: Price, Dana M SPA
Cc: Sallenave, Rossana; ccusack@nmsu.edu; griffinbio@gmail.com; Patrick Alexander; Nancy Stotz; patrick.mathis@state.nm.us; wboeing@nmsu.edu; dcowley@nmsu.edu; mdesmond@nmsu.edu; fernald@nmsu.edu; davebc@nmsu.edu; idolly@nmsu.edu; dtruji@nmsu.edu; AustinJohnson, Alicia M SPA; Galloway, Danielle A SPA; Doles, Mark W SPA; Melissa_Mata@fws.gov; Sharon Thomas
Subject: Re: Las Cruces Dam Restoration Project- Habitat Team (#1 of 2)

Hi Dana:

Thank you for the update.

I wanted to respond to your question: "One issue that has come up in preliminary results is that because of its small size, the wetland is relatively more expensive than other restoration measures in relation to the benefits we can show for it. We would appreciate your opinion as to whether a permanent wetland is a desirable project objective. "

In my opinion, a permanent wetland is extremely desirable project objective because of the proposed and ongoing maintenance activities that will likely eliminate and/or reduce ponding of water that occurs there now coupled with the current use of those wet areas by wildlife and the scarcity of freshwater habitat in our arid ecoregion.

One alternative, would be for the City to expand the size of the wetland. This would necessitate transfering title from the Burn Construction easement back to the CLC and dedicating a larger portion of purple pipe water from the East Mesa Water Treatment plant.

RE: LC Dam Section 1135 Study
19 May 2010 Public Meeting Comments

Alicia—
Below are my comments in response to copies of the handouts provided at the meeting, which I was unable to attend in person.

Comment Form Prompt #1: General comments in regards to the proposed study measures.

Of the three "Preferred Plans" presented by the USACOE, I like Plan 4 the best, because it includes playa plantings, which I feel are quite appropriate for the dam's flood pool. Playa plantings could take advantage of existing seasonal storm water flows, and they could provide vegetative cover for large swaths of currently bare areas behind the south end of the dam (which would improve wildlife habitat, reduce wind and water erosion, and provide significant aesthetic benefits). I do have some concerns and questions about the proposed playa planting measures, however.

1. I am confused by the references to a proposed realignment of the South Fork of the Las Cruces Arroyo on the Powerpoint slides. The text suggests the realignment is necessary to reduce sedimentation in the playas, but how will proposed playa vegetation establish if storm water isn't going to those low-lying spots anymore? How will sediment be removed from the altered alignment, and are we trading one unvegetated area (the current playas) for a new future one (when sediment is removed from the new alignment)? How do sedimentation rates in those existing playa areas behind the dam compare to natural playas on the Jornada and elsewhere? Since natural playas are closed basins, I would assume playas accumulate sediment naturally, so native species may be adapted to some level of sedimentation. Eliminating this realignment would reduce the cost of the playa work significantly.

2. On a related note—aren't spikerushes and Baltic rush essentially emergents that require permanent (or close to it) water? I don't recall the Jornada playas having a central deep zone where such plants occur, though perhaps there are more well-watered playas in some locations that support them. Are seasonal storm water flows collecting behind the dam going to be dependable enough to support such plants, and are they as are well-adapted to sedimentation as the playa grasses?

3. I am very pleased to see both the playa plantings and the cottonwood/willow plantings adjacent to the playas included in the plan. Over the past couple of years, City staff members provided various reasons for dewatering the playas—dam safety, water rights, the 96-hour rule, mosquitoes, etc.—but I assume that their inclusion in the study after years of collaboration means the City and Corps have decided to address these issues together, in order to maximize wildlife habitat and ecological values behind the dam. I hope a similar collaboration will take place as the City develops a more sustainable operations and management plan for the dam in order to minimize negative ecological impacts of required maintenance activities (which I understand is in the RFP stage).

Though most of my questions and comments about Plan 4 address the playa plantings, I support all the proposed restoration measures in the plan. The arroyo riparian areas would improve connectivity for wildlife between the 2 forks of the Las Cruces Arroyo and Alameda Arroyo, and they would provide vegetative cover and improve the aesthetics of some areas that are currently fairly barren. The proposed wetlands created with treated sewage water would provide a habitat type that has all but disappeared from the Mesilla Valley, since the native wetlands and bosques historically created by the Rio Grande's dynamic flows have been almost entirely eliminated to facilitate flood control and the delivery of irrigation water. Combined, all of the proposed measures would provide a truly remarkable resource for the wildlife and human residents of the City of Las Cruces. As I understand it, the habitat models used in the cost-benefit analysis for this project do not take into account the specific location of the dam—essentially, the heart of a fast-growing city. Because of the size of the dam's flood pool and its connectivity to arroyos upstream, it represents an area large enough to support natural processes and wildlife populations that could not exist in smaller areas, yet it is easily accessible to City residents and visitors looking for opportunities for passive recreation and environmental education. I don't know how to put a dollar figure on it, but I sincerely believe that the Corps and the City have an opportunity to develop a truly remarkable resource in the dam's 700-acre flood pool, creating a meaningful wildlife oasis in the midst of a busy city that will enhance the lives of so many.

Comment Form Prompt #2: Ideas on recreation components.
I would like to see the recreation component of the plan emphasize passive recreation and education/interpretation. Developed recreation sites already exist in the vicinity of the dam (Sagecrest and Veteran's parks, Desert Hills Elementary and Camino Real Middle schools) and currently, passive use of the area behind the dam is limited to those willing to deal with soft sandy soils and informal trails (which are fairly treacherous in some locations and/or during certain seasons). The recreational features developed in association with this Section 1135 project should emphasize and celebrate the ecological features being restored. More specifically, a hard-surface trail (surfaced with permeable pavement) to provide access to the constructed wetlands and playas behind the south end of the dam should be created, with at least 2 access points (one from Sagecrest Park and one from the south end of the dam at Lohman Avenue). Eventually, interpretative signage could provide education about natural and restored features along the trail, perhaps through collaboration with a conservation/environmental education organization.

Depending on how extensive the recreation features can be, another good location for a permeable hard-surfaced trail would be along the western edge of the drainage ditch connecting the south and north ends of the dam (where the City currently maintains a sandy access road), including connectivity to Telshor/Northrise via the north spillway or northern tip of the dam. Access points for this trail could be located at the south and north ends of the dam, at Veteran's Park, and along storm water drainages from adjacent neighborhoods, such as the west end of Laredo Drive (access from the park and neighborhoods would require short spur trails to provide links to the main north-south trail). Access from neighborhoods closer to the north end of the dam is complicated by very steep storm water drainages, but perhaps could be accomplished via a trail along Alameda Arroyo connecting to drainage gaps near Nebula Way, Stellar Way, and/or Scenic Circle. The 2001 Recreation Master Plan also depicts a couple of bridges crossing the drainage ditch, which would greatly improve neighborhood and Veteran's Park access to the

dam's flood pool, especially now that the City has begun dredging that ditch with more regularity (bridges would also reduce damage done to the edges of the ditch by park visitors and neighborhood residents trying to get across to walk along the west side of the ditch).

Thank you for all of your work on this plan, and for allowing me to submit my comments electronically. I will be on the road for several more weeks, but feel free to contact me if you've got any follow-up questions. I will have occasional email access, so I may not be able to respond right away, but I'll see your message eventually.

May 11, 2011

Planning, Project and Program Management Division
Planning Branch
Environmental Resources Section

Dear :

The U.S. Army Corps of Engineers (Corps), Albuquerque District, in cooperation with and at the request of the City of Las Cruces, New Mexico, is planning to restore 72 acres of Chihuahuan Desert Arroyo Riparian habitat, 3.6 acres of playa habitat, 6.35 acres of Cottonwood-Willow Riparian habitat, and construct two one-acre emergent wetland cells behind the Las Cruces Dam in the City of Las Cruces, Doña Ana County, New Mexico (See enclosure for location of proposed restoration and recreation features). The proposed action also includes the implementation of recreational features, such as new trail systems, improvements to existing trails, pedestrian crossings, interpretative signage, and wildlife viewing blinds. The Corps plans to award the construction contract in October 2012, and project completion is scheduled for October 2013.

This work is proposed under Section 1135 of the Water Resources Development Act of 1986 (Public Law 99-662), as amended. Section 1135 provides authority for the Corps to modify the structures and operation of Corps projects to improve the quality of the environment when it is determined that such modifications are feasible and consistent with the authorized project purposes. It also provides authority to implement restoration measures at locations where projects built by the corps or jointly by the Corps and other Federal agencies, have contributed to the degradation of the quality of the environment, if such measures do not conflict with the authorized project purposes.

Available for your review is the Draft Detailed Project Report with Integrated Environmental Assessment (DPR/EA), titled, **"Las Cruces Dam Environmental Restoration Project"** located at http://www.spa.usace.army.mil/fonsi/. The Corps is soliciting comments from Federal, State, Tribal and local interests to comply with the National Environmental Policy Act (NEPA). Areas of the report that are required for NEPA have an asterisk next to that section in the Table of Contents and within the body of the DPR/EA.

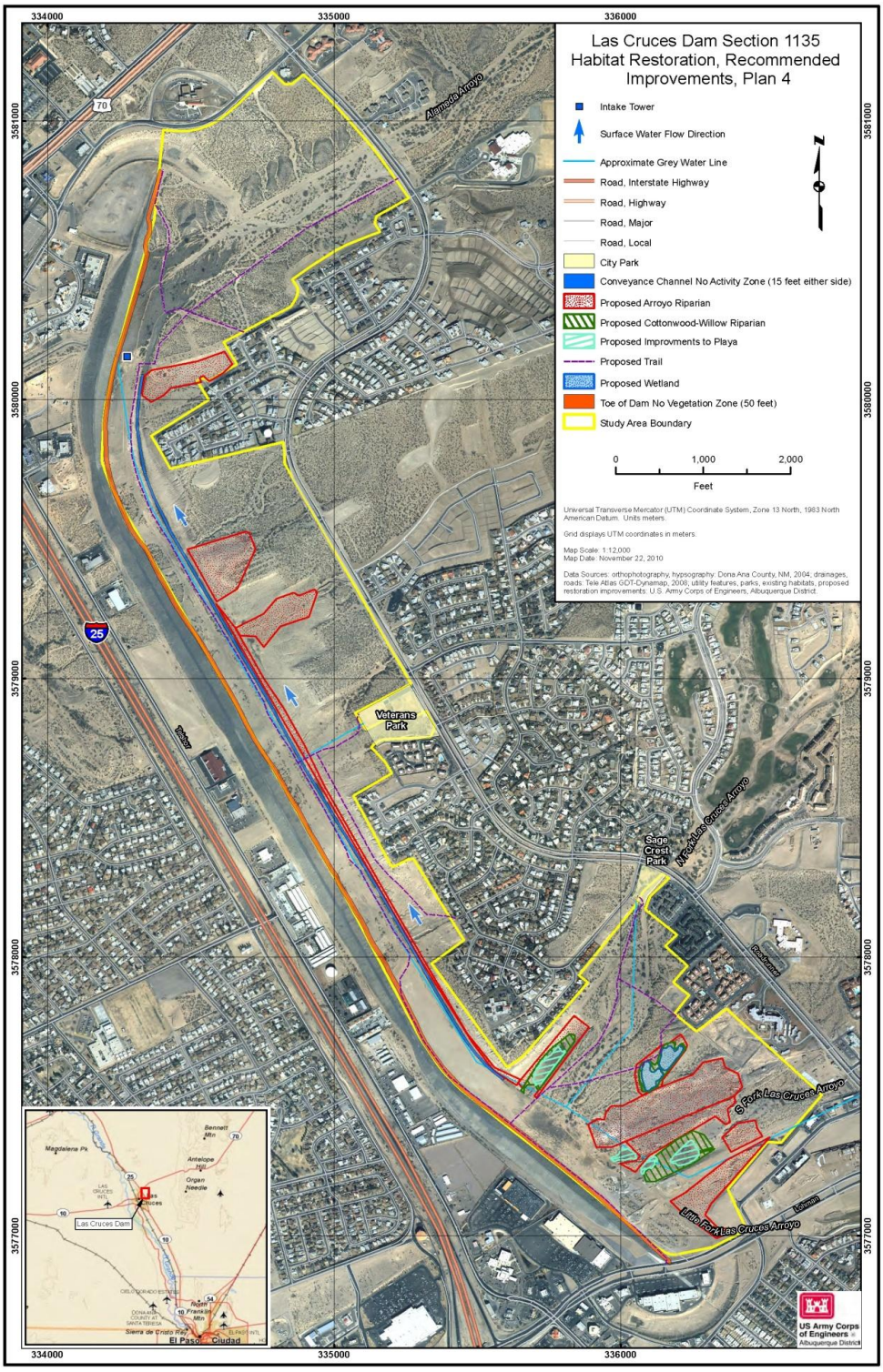
Please review the Draft DPR/EA and provide any written comments to the above address, Attn: Mrs. Danielle Galloway, Environmental Resources Section. Written comments must be received **no later than June 2, 2011,** so that comments can be addressed and revisions made to the Draft DPR/EA in a timely manner. If we do not receive comments by this date, we will assume you have no concerns or have no objections to the project. You may facsimile your correspondence to (505) 342-3668. If your agency needs additional time to review and make comments to the DPR/EA beyond the above deadline, the Corps may grant an extension depending on the reason. Please contact Mrs. Galloway as soon as possible if an extension is needed.

If you have any questions or need additional information, please contact Mrs. Galloway, biologist, at (505) 342-3661 or e-mail at danielle.a.galloway@usace.army.mil or myself at (505) 342-3281 or email at julie.a.alcon@usace.army.mil. Thank you.

Sincerely,

Julie Alcon
Chief, Environmental Resources Section

Enclosure



Enclosure:
Location of Proposed Restoration and Recreation Features

Communication with USFWS on the FWCA Report

From: Melissa_Mata@fws.gov [mailto:Melissa_Mata@fws.gov]
Sent: Monday, February 22, 2010 12:22 PM
To: Price, Dana M SPA
Subject: Information about Las Cruces Dam Project

Hi Dana,

I apologize for any delay in response, but within the last several weeks a few changes have occurred within our office. Several positions in this office will not be filled and as a result our workloads were re-examined and responsibilities have changed. Due to this unfortunate circumstances it has been identified that we will not have the resources to participate on the Habitat Evaluation Team for the Las Cruces Dam Project and will be unable to work on a Coordination Act Report (CAR) at this time. We encourage you to move forward with your project without a CAR and recommend that you contact Dave Dreesen at the Plant Materials Center (865-4684 or David.Dreesen@nm.usda.gov or http://plant-materials.nrcs.usda.gov/nmpmc/) for a recommendation on native plants for your riparian and wetland restoration areas. We apologize for any inconvenience, but hope to you work with you again under better circumstances. <http://plant-materials.nrcs.usda.gov/nmpmc/>

Melissa Mata, Fish Biologist
United States Fish and Wildlife Service
New Mexico Ecological Services Field Office
2105 Osuna NE, Albuquerque, New Mexico 87113-1001
Phone: (505) 761-4743, Fax: (505) 346-2542 melissa_mata@fws.gov

ADDENDUM B

Environmental Resources Lists

Special Status Species Listed for Doña Ana County, New Mexico

Common Name	Scientific Name	Federal Status (USFWS[a])	State of New Mexico status (NMDGF)[b]
Animals			
Aplomado Falcon	*Falco femoralis septentrionalis*	E	E
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	E	E
Least Tern	*Sterna antillarum athalassos*	E	E
Mexican Spotted Owl	*Strix occidentalis lucida*	T	T
Yellow-billed Cuckoo	*Coccyzus americanus occidentalis*	C	C
Common Black-Hawk	*Buteogallus anthracinus anthracinus*	SC	T
Peregrine Falcon	*Falco peregrinus anatum*	SC	T
Arctic Peregrine Falcon	*Falco peregrinus tundrius*	SC	T
Northern Goshawk	*Accipiter gentilis atricapillus*	SC	---
Burrowing Owl	*Athene cunicularia hypugaea*	SC	---
Mountain Plover	*Charadrius montanus*	SC	---
Baird's Sparrow	*Ammodramus bairdii*	SC	T
Black Tern	*Chlidonias niger surinamensis*	SC	---
Bell's Vireo	*Vireo bellii arizonae*	SC	T
Pale Townsend's Big-eared Bat	*Corynorhinus townsendii pallescens*	SC	---
Western Red Bat	*Lasiurus blossevillii*	SC	---
Colorado Organ Mountains Chipmunk	*Neotamias quadrivittatus australis*	SC	T
Desert Pocket Gopher	*Geomys arenarius arenarius*	SC	---
Pecos River Muskrat	*Ondatra zibethicus ripensis*	SC	---
White Sands Wood Rat	*Neotoma micropus leucophaea*	SC	---
Doña Ana Talussnail	*Sonorella todseni*	SC	T
Anthony Blister Beetle	*Lytta mirifica*	SC	---
Obsolete Viceroy Butterfly	*Basilarchia archippus obsoleta*	SC	---
Common Ground-dove	*Columbina passerina pallescens*	---	E
Buff-collared Nightjar	*Caprimulgus ridgwayi ridgwayi*	---	E
Brown Pelican	*Pelecanus occidentalis carolinensis*	---	E
Desert Bighorn Sheep	*Ovis canadensis mexicana*	---	E
Varied Bunting	*Passerina versicolor versicolor*	---	T
Neotropic Cormorant	*Phalacrocorax brasilianus*	---	T
Bald Eagle	*Haliaeetus leucocephalus alascanus*	---	T
Broad-billed Hummingbird	*Cynanthus latirostris magicus*	---	T
Costa's Hummingbird	*Calypte costae*	---	T
Violet-crowned Hummingbird	*Amazilia violiceps ellioti*	---	T
Gray Vireo	*Vireo vicinior*	---	T

Common Name	Scientific Name	Federal Status (USFWS[a])	State of New Mexico status (NMDGF)[b]
Spotted Bat	*Euderma maculatum*	---	T
Plants			
Grayish-white giant hyssop	*Agastache cana*	SC	SC
Organ Mountains giant hyssop	*Agastache pringlei var. verticillata*	SC	SC
Castetter's milkvetch	*Astragalus castetteri*	SC	SC
Organ Mountains paintbrush	*Castilleja organorum*	SC	SC
Standley's Whitlowgrass	*Draba standleyi*	SC	SC
Organ Mountains pincushion cactus	*Escobaria organensis*	SC	E
Sandberg pincushion cactus	*Escobaria sandbergii*	SC	SC
Sneed's pincushion cactus	*Escobaria sneedii var. sneedii*	E	E
Villard pincushion cactus	*Escobaria villardii*	SC	E
Arizona coralroot	*Hexalectris spicata var. arizonica*	SC	E
Vasey's bitterweed	*Hymenoxys vaseyi*	SC	SC
Organ Mountains evening primrose	*Oenothera organensis*	SC	SC
Dune prickly pear cactus	*Opuntia arenaria*	SC	E
Deer-horn cactus	*Peniocereus greggii var. greggii*	SC	E
Alamo beardtongue	*Penstemon alamosensis*	SC	SC
Nodding cliff daisy	*Perityle cernua*	SC	SC
New Mexico rock daisy	*Perityle staurophylla var. staurophylla*	SC	SC
Mescalero milkwort	*Polygala rimulicola var. mescalerorum*	SC	E
Supreme sage	*Salvia summa*	SC	SC
Smooth figwort	*Scrophularia laevis*	SC	SC
Plank's catchfly	*Silene plankii*	SC	SC

[a] **Endangered Species Act (ESA)** (as prepared by U.S. Fish and Wildlife Services) **status:** Only Endangered and Threatened species are protected by the ESA.

E= Endangered: any species that is in danger of extinction throughout all or a significant portion of its range.

T= Threatened: any species that is likely to become and endangered species within the foreseeable future throughout all or a significant portion of its range.

C= Candidate: taxa for which the Services has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species.

SC= Species of Concern: taxa for which information now in the possession of the Service indicates that proposing to list as endangered or threatened is possible appropriate, but for which sufficient data on biological vulnerability and threat are not currently available to support proposed rules.

[b] **State of New Mexico status:**

E= Endangered Animal species whose prospects of survival or recruitment within the state are in jeopardy.

R= Rare
T= Threatened Animal species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future.

Plant Species observed at Las Cruces Dam Study Site

Genus-species	Common name
Acacia constricta	Mescat acacia
Ailanthus altissima *	tree-of-heaven
Amaranthus spp.	Pigweed
Ambrosia monogyra	Burrobrush, cheesebush
Aristida purpurea	Purple three awn
Artemisia dracunculus	'tarragon'
Atriplex canescens	Four-wing saltbush
Baccharis salicifolia	Seepwillow
Baileya multiradiata	Desert marigold
Bouteloua gracilis	Blue grama
Brickellia laciniata	Brickell bush
Caesalpina gilliesii *	Bird of paradise tree
Cevalia sinuata	Stinging cevalia
Chilopsis linearis	Desert willow
Citrullus lanatus *	watermelon
Clematis drummondii	Texas virgin's bower
Croton neomexicana	New Mexico croton
Cyperus esculentus	Nutgrass
Dasyochloa pulchella	fluffgrass
Datura wrightii	Sacred datura
Echinocereus sp.	hedgehog or beehive cactus
Ephedra trifurca	Mormon tea
Eriogonum sp.	Wild buckwheat
Fallugia paradoxa	Apache plume
Gutierrezia sarothrae	Broom Snakeweed
Krameria parviflora	Range ratany
Larrea tridentata	Creosote bush
Lepidium sp.	Peppergrass

Plant Species observed at Las Cruces Dam Study Site (cont.)

Linum vernale	Chihuahua flax
Melampodium leucanthum	Blackfoot daisy
Mimosa aculeaticarpa var. biunicifera	Wait-a-minute bush
Muhlenbergia porteri	Bush muhly
*Parkinsonia sp. (aculeata?)**	Palo verde, retama
Phacelia integrifolia	scorpionweed
Populus deltoides var. wislizenii	Cottonwood
Prosopsis glandulosa	Honey mesquite
Rhus microphylla	little-leaf sumac
*Salsola tragus **	Russian thistle
Setaria vulpiseta	Plains bristle grass
Solanum elaeagnifolium	Silverleaf nightshade
*Sourghum halepense **	Johnsongrass
Sphaeralcea sp.	Globe mallow
Sporobulus wrightii	Giant sacaton
*Tamarix chinensis **	Salt cedar
*Ulmus pumila **	Siberian elm
Verbena sp.	New Mexico Vervain
Verbisina encelioides	Crownbeard (cowpen daisy)
*Vitex agnus-castus **	Vitex, chaste tree
*Xanthium strumarium **	Cocklebur
Yucca elata	soaptree yucca
Ziziphus obtusifolia	lotebush, graythorn

Amphibian and Reptile Species that occur with Doña Ana County:

Genus-species	Common name
Scaphiopus couchii	Couch's Spadefoot
Scaphiopus couchii	Couch's Spadefoot
Spea multiplicata	New Mexico Spadefoot
Bufo cognatus	Great Plains Toad
Bufo punctatus	Red-spotted Toad
Bufo woodhousii woodhousii	Woodhouse's Toad
Masticophis flagellum testaceus	Coachwhip
Crotaphytus collaris auriceps	Collared Lizard
Sceloporus undulates consobrinus	Eastern Fence Lizard
Phrynosoma cornutum	Texas Horned Lizard
Uta stanburiana	Side Blotched Lizard
Crotalus molossus molossus	Blacktail Rattlesnake
Crotalus viridis Cerberus	Western Rattlesnake
Tantilla nigriceps	Plains Blackhead Snake
Leptotyphlops dissectus	Texas Blind Snake
Sonora semiannulata	Ground Snake
Lampropeltis getula	Desert Kingsnake
Trimorphodon biscutatus	Lyre Snake
Hypsiglena torquata	Night Snake
Diadophis punctatus arnyi	Ringneck Snake
Terrapene ornate	Ornate Box Turtle
Aspidoscelis uniparens)	Desert Grassland Whiptail
Aspidoscelis neomexicana	New Mexico Whiptail
Aspidoscelis exsanguis	Chihuahuan Spotted Whiptail

Avian Census Surveys from May and June 2006

Genus-species	Common name
Calamospiza melanocorys	Lark Bunting
Molothrus ater obscures	Brown-headed Cowbird
Zenaida macroura marginella	Mourning Dove
Zenaida asiatica mearnsi	White-winged Dove
Falco peregrinus anatum	Peregrine Falcon
Falco mexicanus	Prairie Falcon
Carpodacus mexicanus frontalis	House Finch
Colaptes auratus borealis	Northern Flicker
Polioptila melanura melanura	Black-tailed Gnatcatcher
Circus cyaneus hudsonius	Northern Harrier
Accipiter cooperii	Cooper's Hawk
Buteo jamaicensis calurus	Red-tailed Hawk
Accipiter striatus velox	Sharp-shinned Hawk
Buteo swainsoni	Swainson's Hawk
Archilochus alexandri	Black-chinned Hummingbird
Junco hyemalis hyemalis	Dark-eyed Junco
Falco sparverius sparverius	American Kestrel
Tyrannus vociferans vociferans	Cassin's Kingbird
Tyrannus verticalis	Western Kingbird
Regulus calendula calendula	Ruby-crowned Kinglet
Falco columbarius bendirei	Merlin
Mimus polyglottos leucopterus	Northern Mockingbird
Icterus parisorum	Scott's Oriole
Tyto alba pratincola	Barn Owl
Athene cunicularia hypugaea	Burrowing Owl
Bubo virginianus pallescens	Great-horned Owl
Asio otus wilsonianus	Long-eared Owl
Sayornis saya saya	Say's Phoebe
Cardinalis sinuatus sinuatus	Pyrrhuloxia
Callipepla gambelii gambelii	Gambel's Quail
Callipepla squamata pallid	Scaled Quail
Corvus cryptoleucus	Chihuahuan Raven
Geococcyx californianus	Greater Roadrunner
Turdus migratorius migratorius	American Robin
Sphyrapicus nuchalis	Red-naped Sapsucker
Lanius ludovicianus excubitorides	Loggerhead Shrike
Amphispiza bellineata opuntia	Black-throated Sparrow
Spizella breweri breweri	Brewer's Sparrow
Zpizella passerina arizonae	Chipping Sparrow
Passerella iliaca zaboria	Fox Sparrow
Melospiza lincolnii lincolnii	Lincoln's Sparrow
Amphispiza belli nevadensis	Sage Sparrow
Passerculus sandwichensis nevadensis	Savannah Sparrow

Avian Census Surveys from May and June 2006 (cont.)

Melospiza melodia juddi	Song Sparrow
Pooecetes gramineus confinis	Vesper Sparrow
Zonotrichia leucophrys oriantha	White-crowned Sparrow
Tachycineta thalassina lepida	Violet-green Swallow
Piranga ludoviciana	Western Tanager
Toxostoma crissale crissale	Crissal Thrasher
Toxostoma curvirostre celsum	Curve-billed Thrasher
Pipilo fuscus mesoleucus	Canyon Towhee
Pipilo chlorurus	Green-tailed Towhee
Pipilo maculatus	Spotted Towhee
Auriparus flaviceps ornatus	Verdin
Vermivora celata celata	Orange-crowned Warbler
Dendroica coronata coronata	Yellow-rumped Warbler
Picoides scalaris cactophilus	Ladder-backed Woodpecker
Thryomanes bewickii eremophilus	Bewick's Wren
Campylorhynchus brunneicapillus couesi	Cactus Wren
Salpinctes obsoletus obsoletus	Rock Wren

Christmas Bird Count (specific to the Las Cruces Dam)

Bird (Common Name)	*2006*	*2007*	*2008*
Green-winged Teal	**12**		
Northern Shoveler	**12**		
Northern Harrier	**3**	**2**	**1**
Sharp-shined Hawk		**1**	
Cooper's Hawk	**2**	**2**	**2**
Red-tailed Hawk	**3**	**4**	**4**
American Kestrel	**2**		**1**
Prairie Falcon		**1**	
Scaled Quail		**21**	
Gambel's Quail	**199**	**198**	**130**
Killdeer	**5**		**7**
Black-necked Stilt			**4**
White-winged Dove	**102**	**42**	**77**
Mourning Dove	**124**	**12**	**103**
Greater Roadrunner	**3**	**6**	**6**
Burrowing Owl	**9**	**3**	**3**
Long-eared Owl	**5**		
Barn Owl		**1**	
Red-naped Sapsucker		**1**	
Ladder-backed Woodpecker	**1**		**2**
Northern Flicker (red-shafted)	**3**	**1**	**1**
Say's Phoebe	**10**	**7**	**11**
Loggerhead Shrike	**1**	**1**	
Chihuahuan Raven	**3**	**2**	
American Crow		**1**	
Verdin	**7**	**9**	**7**
Cactus Wren	**3**	**14**	**2**
Rock Wren	**6**	**2**	**2**
Bewick's Wren	**2**	**1**	
Ruby-crowned Kinglet	**2**	**2**	**2**
Black-tailed Gnatcatcher	**2**	**8**	**2**
American Robin	**6**		
Northern Mockingbird	**3**	**5**	**4**
Curve-billed Thrasher		**2**	**1**
Crissal Thrasher	**6**	**4**	**4**
Phainopepla			**1**
Yellow-rump (form?)	**21**	**2**	**2**
Canyon Towhee		**4**	
Black-throated Sparrow	**2**	**3**	**1**
Lincoln's Sparrow	**7**		**8**
White-crowned Sparrow	**6**	**69**	**136**

Christmas Bird Count (specific to the Las Cruces Dam) (cont.)

Pyrrhuloxia	**5**	**6**	**5**
Red-winged Blackbird	**3**	**35**	**22**
Meadowlark sp.	**2**		
House Finch	**55**	**132**	**105**
Lesser Goldfinch		**16**	**2**
House Sparrow		**6**	**35**

ADDENDUM C

Treatment Prescription

Herbicide Application and the Environmental Fate of Chemicals

The preferred herbicides to use are Garlon®4 (for treatment of resprouts) and Garlon® 3A (for initial treatment). These are both selective herbicides which means that they can kill certain groups of plants and have little or no effect on other plants. These herbicides should not be used near surface water or saturated soils. Herbicides would only be used between October and April in order to protect amphibian species from potential exposure and to allow work to take place outside of the avian migratory nesting season. Herbicides would only be used between October and April in order to protect amphibian species from potential exposure and to allow work to take place outside of the avian migratory nesting season.

Garlon® is the commercial version of triclopyr and generally contains one or more inert ingredients. The contents of two triclopyr formulations are: Garlon® 3A: triclopyr (44.4%), and inert ingredients (55.6%) including water, emulsifiers, surfactants, and ethanol (1%); and Garlon ®4: triclopyr (61.6%), and inert ingredients (38.4%) including kerosene. Triclopyr acts by disturbing plant growth. It is absorbed by green bark, leaves and roots and moves throughout the plant. Triclopyr accumulates in the meristem (growth region) of the plant. Surfactants used would include non-ionic surfactants that have been approved for use in aquatic habitats (such as Induce).

Basal bark and cut surface treatments can be done at any time of year. Triclopyr should be applied only when there is little or no hazard of spray drift. It should be applied immediately to the stump of the cut tree (within two hours). Triclopyr is active in the soil, and is absorbed by plant roots. Microorganisms degrade triclopyr rapidly; the average half-life in soil is 46 days. Triclopyr degrades more rapidly under warm, moist conditions. The potential for leaching depends on the soil type, acidity and rainfall conditions. This herbicide is selective to woody plants and has little to no effect on grasses (Parker et al., 2005). It has been certified and labeled to be used near water by the Environmental Protection Agency (EPA, 1998). After use, the public must remain away from the area for 48 hours. Signage would be placed at areas after they have been treated.

Triclopyr is slightly toxic to practically non-toxic to soil microorganisms. Practically nontoxic is defined as a probable lethal oral dose for humans at less than 15 g/kg (Klaassen et al., 1986). Triclopyr is toxic to many plants if applied directly. Even very small amounts of spray may injure some plants. That is why it is to be applied directly to the stump of the tree being treated. The ester form of triclopyr, found in Garlon® 4, is more toxic, but under normal conditions, it rapidly breaks down in water to a less toxic form. Triclopyr is slightly toxic to practically non-toxic to invertebrates. Slightly toxic is defined as a probable lethal oral dose for humans at 5-15 g/kg (Klaassen et al., 1986). Triclopyr and its formulations have not been tested for chronic effects in aquatic animals. Triclopyr is slightly toxic to mammals. In mammals, most triclopyr is excreted, unchanged, in the urine. Triclopyr and its formulations have very low toxicity to birds. Triclopyr is non-toxic to bees. Triclopyr and its formulations have not been tested for chronic 95

effects in terrestrial animals. The exposure levels a person could receive from these sources, as a result of routine operations, are below levels shown to cause harmful effects in laboratory studies. Inert ingredients found in triclopyr products may include water, petroleum solvents, kerosene, surfactants, emulsifiers, and methanol. Methanol, kerosene and petroleum solvents may be a toxic hazard if the pesticide is swallowed. Non-ionic surfactants and emulsifiers are generally low in toxicity. The formulated products are generally less toxic than triclopyr. Garlon® 3A is a skin irritant and a severe eye irritant.

The U.S. Forest Service has evaluated health effects data in the development of both pesticide background statement documents and environmental impact statements for pesticide use on forest lands. These health effects evaluations have taken into consideration the potential for both worker and public exposure from Forest Service operations. This information has been used in assessing health risks and consequently in formulating protective measures to reduce risk to workers and to the public.

It has been found by other agencies in the area currently using these herbicides (MRGCD, OSD and the Bosque del Apache National Wildlife Refuge) that both Garlon® 4 (mixed 25-75% with vegetable oil) or Garlon® 3A (mixed 50-50% with water) have been successful.

Garlon® 4 would be used for initial treatment and has been shown to be more successful in cut-stump treatments (Doug Parker, personal communication). Garlon® 3A would be used for treatment of resprouts once they have grown at least 3 feet in height. Garlon® 3A has been shown to be more effective on smaller stems and resprouts (Doug Parker, personal communication).

Based on the information described above, these herbicides would be used as described. All required permitting and licensure would be obtained by the contractor. Prior to application, all chemicals would be specifically approved per manufacturer's instructions. Mixing and application of these herbicides would be done so in accordance with all manufacturers' instructions and proper personal protective equipment would be worn. Storage and mixing would also be performed following manufacturer's instructions. Storage would not be allowed on site within the bosque. Follow-up inspections and monitoring post-herbicide application would be performed at all locations. All excess herbicide would be disposed of off-site.

ADDENDUM D

Planting Plan

PLANTING PLAN

A map showing location of all proposed restoration measures appears in the DPR, Figure 4.1. This Planting Plan focuses on specific planting designs for the four proposed habitat restoration measures: permanent wetland, improved playa habitat, Chihuahuan Desert arroyo riparian habitat, and cottonwood-willow riparian habitat. A list of proposed species for restoration plantings is below (Table D1).

Permanent Wetland Planting:

The proposed wetland consisting of two one-acre cells would be supplied using reclaimed water provided by the City of Las Cruces. The first cell would have permanent standing water with a central open water area six feet deep. This cell would contain taller, emergent aquatic and wetland species appropriate for constant inundation, including bulrushes (*Schoenoplectus* spp.) in the deeper water and spikerushes (*Eleocharis* spp.), rushes (*Juncus* spp.), and sedges (*Carex* spp.) in the shallower water. A cross-sectional diagram of the proposed pond edge showing depth and planting zones is illustrated in Figure D1. The approximate extent of the shallower and deeper water areas are illustrated in plan view in Figure D-2.

Water would be routed from the first cell to the second cell, a moist-soil wet meadow. This area would have vegetation similar to the shallow-water and fringe areas of the first pond, but would not support bulrushes, which require deeper permanent water. Both wetland cells would be planted with sedges and rushes from plugs set into moist soil. Plugs would be planted at one per square foot. A total of 61, 920 plugs would be planted.

Native riparian shrubs such as coyote willow (*Salix exigua),* seepwillow (*Baccharis* spp.), threeleaf sumac (*Rhus trilobata),* and New Mexico olive (*Forestiera pubescens*) would be planted in sparse clumps around the wetland fringes with native grasses such as vine mesquite (*Panicum obtusum*), saltgrass (*Distichlis spicata*), tobosa (*Pleuraphis mutica*), and scratchgrass muhly (*Muhlenbergia asperifolia*). The shrubs would be "tall pot" containers and the grasses would be 10 cu. in. containers. A total of 300 shrubs (approximately one every seven meters of pond edge) and 6170 grasses (at 2 sq. ft. per plant) would be planted.

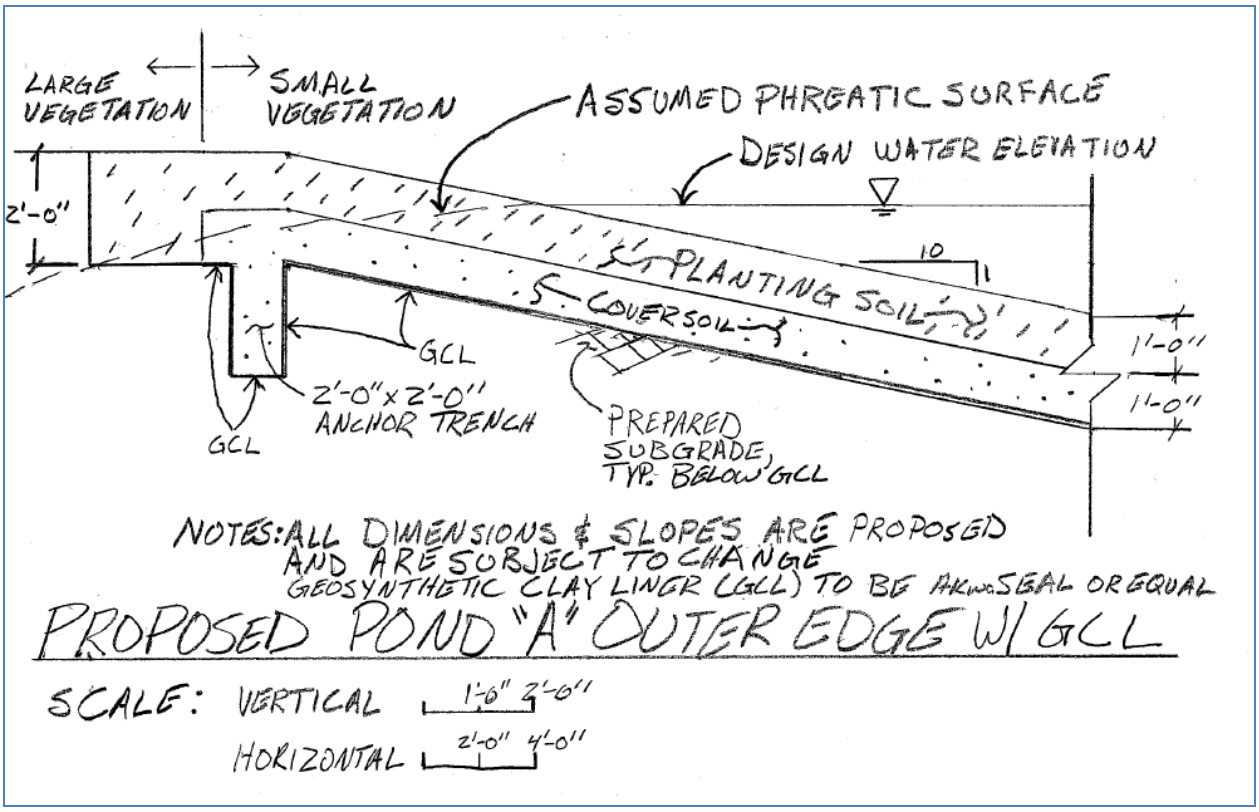


Figure D1. Proposed Pond Design.

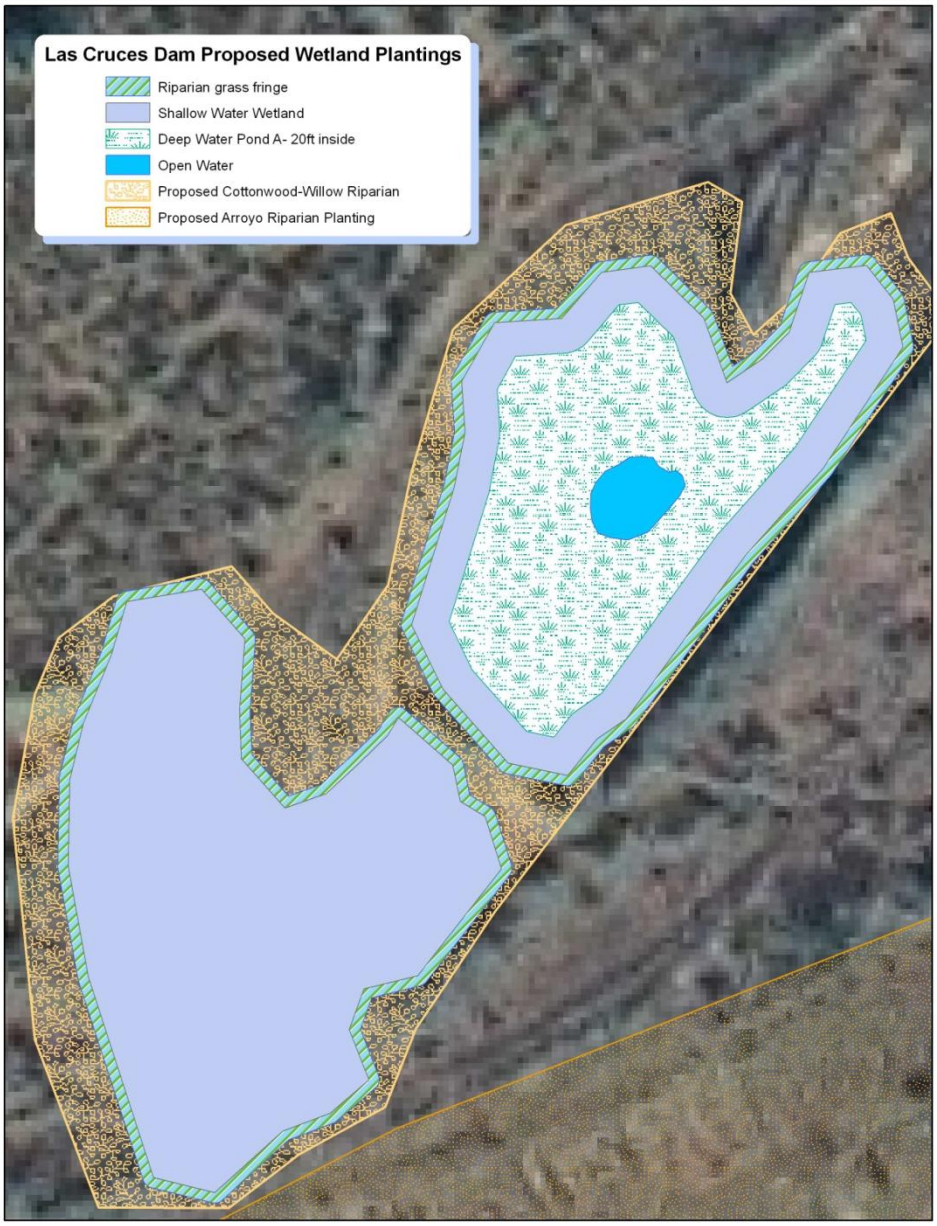


Figure D2. Proposed Wetland Planting Zones. Only the shallower areas of Pond A would be planted. Bulrushes are expected to colonize the deeper water areas.

Improved Playa Habitat

Due to the challenge posed by fluctuating water levels in the playa basins, USACE proposes to use a combination of "plugs" and seeding over a wide zone in these areas. Plugs may be more successful in areas with moist soil, while seeds have the ability to remain dormant until favorable conditions arise. We propose to plant "plugs" in a five-meter wide edge zone around the area of ponded water that exists in the late summer or early fall after monsoon rains have wet the playas. A 5-m buffer was created in GIS and used to calculate the planting area (See Figure D3). At 2-ft. spacing (4 sq. ft./plant), the combined area of 1.25 acres would use 13,650 plants. However, the actual plantings would be more tightly clustered to enable protective cages to be placed around the plugs. In addition to these plantings, 10.2 pounds of native grass seed would be sown. Grasses would be seeded during the monsoon season and repeated during summer and fall the year after the remaining plantings are completed, as needed.

Figure D3. Playa plantings (darker green border).

Chihuahuan Desert Arroyo Riparian Habitat

Arroyo shrubs would be planted in clusters to form mottes, similar to the existing vegetation structure in the Alameda and Las Cruces Arroyos. Species to be planted in these restoration areas would include desert willow (*Chilopsis linearis)*, four-wing saltbush (*Atriplex canescens*), apache plume *(Fallugia paradoxa)*, honey mesquite *(Prosopsis glandulosa)*, burrobrush (*Ambrosia monogyra*); little-leaf sumac (*Rhus microphylla*), and cutleaf brickellbush (*Brickellia laciniata)* with other appropriate species to increase diversity (See Table 1). Container-grown shrubs would be planted at a density of 24 plants per acre, for a total of 1770 shrubs for this measure. The shrubs will be irrigated during the establishment period. Shrubs would be caged with hardware cloth to provide protection from rabbits.

Arroyo riparian mottes would consist of three large shrubs/ small trees (mesquite, desert willow) in a 3-meter on center (OC) triangle. Then 3 small shrubs would be placed at each of the points of a triangle 45 degees offset from the first triangle. Bushes would be 3m OC from the shrubs, forming a cluster. One to four clusters would be planted in a curvilinear manner per motte (Figure D4). Spacing between clusters would be 3m with 6 to 10m between mottes.

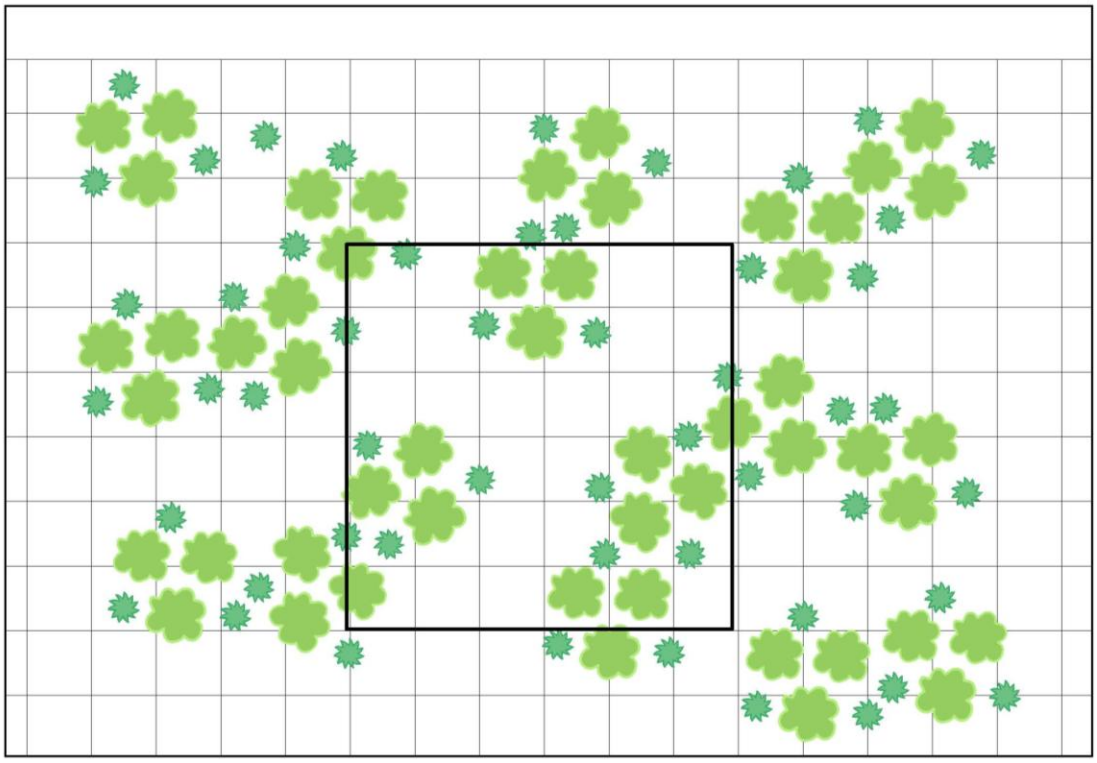


Figure D4. Schematic showing structure of arroyo shrub clusters arranged into mottes.

Cottonwood-Willow Riparian Habitat

Cottonwood poles or container-grown saplings would be planted around the edges of playas and wetlands to form a patchy canopy, with gaps for understory species. The cottonwoods and understory species would be planted on 6-m (19.68-ft.) centers on average (Figure D5). Cottonwoods and understory species totaling 686 plants would be required at this density. Similar to the arroyo shrub plantings, the cottonwood plantings would be arranged in clusters with gaps. Understory shrubs planted in the gaps would include Goodding's willow (*Salix gooddingii*) and coyote willow (*Salix exigua*). Other riparian shrubs would be added for diversity, such as seepwillow (*Baccharis salicifolia*), Torrey's wolfberry (*Lycium torreyi*), or arrow-weed (*Pluchea sericea*). Plants would require watering and protection during their establishment period.

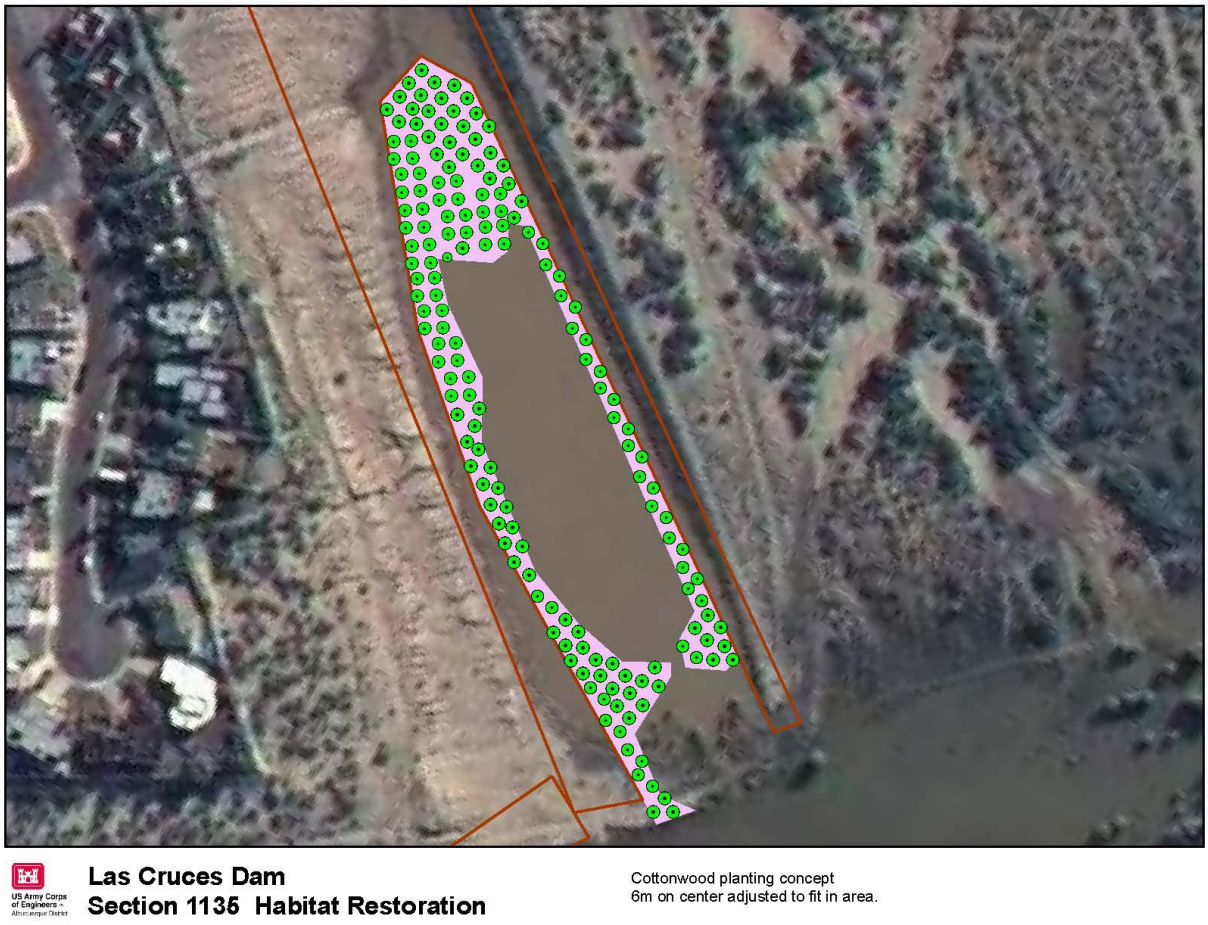


Figure D5. Proposed cottonwood planting around playa

Table D1. Proposed Species list

Plantings for Las Cruces Dam Playa & Wetland - Shallow marsh

Riparian Grass Species
10 cu.in. plants, seed for playas

Scientific name	Common name	Where to plant
Distichlis spicata	Saltgrass	Playa, wetland fringe
Leersia oryzoides	Rice cutgrass	Playa, wetland fringe
Muhlenbergia asperifolia	Scratchgrass muhly	Playa, wetland fringe
Panicum obtusum	Vine mesquite	Playa
Paspalum distichum	Knotgrass	Playa, wetland fringe
Pleuraphis mutica	Tobosa	Playa
Sporobolus airoides	Alkalai sacaton	Playa, wetland fringe
Sporobolus wrightii	Giant sacaton	Playa

Shallow Wetland Plants- moist soil to 2" water
4 cu.in. plants

Scientific name	Common name	
Anemopsis californica (forb)	Yerba manza	wetland
Carex emoryi	Emory's sedge	wetland, playa
Carex aquatilis	Water sedge	wetland, playa
Carex hystricina		wetland, playa
Carex rostrata		wetland, playa
Carex vulpinoidea	Fox sedge	wetland, playa
Cyperus esculentus	nutsedge	playa
Mimulus guttatus (forb)	Yellow monkey flower	wetland
Juncus balticus	wire rush/ Baltic rush	wetland, playa
Juncus bufonius	toad rush	wetland, playa
Juncus ensifolius (J. saximontanus)	Rocky Mt. rush	wetland, playa
Juncus tenuis	path rush	wetland, playa
Juncus torreyi	Torrey rush	wetland, playa
Eleocharis palustris	Creeping spikerush	wetland, playa
Eleocharis parishii	Parish's spikerush	wetland, playa
Equisetum arvense	common horsetail	wetland
Equisetum laevigata	smooth horsetail	wetland
Ranunculus cymbalaria (forb)	marsh buttercup	wetland
Triglochin maritima (forb)	Arrowgrass	playa

Emergent Wetland Plants- 2"- 2' deep
10 cu.in. plants

Scientific name	Common name	
Sagittaria cuneata or *S. latifolia*	Arrowroot	wetland
Schoenoplectus acutus	Hardstem bulrush	wetland
Schoenoplectus americanus	Three square rush	wetland
Schoenoplectus maritimus	Alkalai bulrush	wetland
Schoenoplectus pungens	Common three square	wetland
Schoenoplectus tabernaemontani	Softstem bulrush	wetland

Deep water floating or submerged wetland plants
10 cu.in. plants, or as available

Ceratophyllum demersum	Coontail (sprigs)	wetland
Elodea canadensis	Elodea	wetland
Potamogeton pectinatus	Sago pondweed(tuber)	wetland
Potamogeton foliosus	leafy pondweed	wetland
Potamogeton natans	floating pondweed	wetland
Zannichellia palustris	horned pondweed	wetland

Trees and Shrubs for Cottonwood-Willow and wetland fringe
"tall pots"

Scientific name	**Common name**	
Baccharis salicifolia or *B. glutinosa*	Seepwillow	wetland fringe, cottonwood
Chilopsis linearis	Desert willow	wetland fringe
Fallugia paradoxa	Apache plume	wetland fringe
Forestiera pubescens (F. neomexicana)	New Mexico olive	wetland fringe, cottonwood
Pluchea sericea	arrow-weed	wetland fringe, cottonwood
Populus deltoides var. wislizenii	Rio Grande cottonwood	wetland fringe, cottonwood
Rhus microphylla	Littleleaf sumac	wetland fringe
Rhus trilobata	Three leaf sumac	wetland fringe, cottonwood
Rosa woodsii	Wood's rose	wetland fringe
Salix exigua	Coyote willow	wetland fringe, cottonwood
Salix gooddingii	Gooding's willow	wetland fringe, cottonwood

Shrubs for arroyo riparian			**Comment**
Acacia constricta	catclaw acacia	arroyo	diversity
Acacia neovernicosa	whitethorn acacia	arroyo	diversity
Atriplex canescens	fourwing saltbush	arroyo	dominant
Chilopsis linearis	Desert willow	arroyo	dominant
Condalia spathulata	knifeleaf condalia	arroyo	diversity
Condalia warnockii	Warnock's condalia	arroyo	diversity
Ephedra trifurca or *E. torreyana*	Mormon tea	arroyo	diversity
Fallugia paradoxa	Apache plume	arroyo	dominant
Koeberlinia spinosa	allthorn, crucufixion thorn	arroyo	diversity
Lycium andersonii, L. pallida or *L. torreyi*	wolfberry	arroyo	diversity
Parthenium incanum	marriola	arroyo	diversity
Prosopis glandulosa	honey mesquite	arroyo	dominant
Prosopis pubescens	screwbean mesquite	arroyo	diversity
Psorothamnus scoparius	broom dalea	arroyo	diversity
Rhus microphylla	Littleleaf sumac	arroyo	dominant
Yucca elata	soaptree yucca	arroyo	dominant
Ziziphus obtusifolia	graythorn, lotebush	arroyo	diversity