Environmental Assessment

for the
Middle Rio Grande Bosque Restoration Project

Prepared by

U.S. Army Corps of Engineers
Albuquerque District

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US Army Corps
of Engineers®
Albuquerque District

U.S. ARMY CORPS OF ENGINEERS
ALBUQUERQUE DISTRICT

FINDING OF NO SIGNIFICANT IMPACT
for the
Middle Rio Grande Bosque Restoration Project

The U.S. Army Corps of Engineers (Corps) proposes to restore 916 acres of the Middle Rio Grande bosque by (1) improving hydrologic function by constructing high-flow channels, back water channels, willow swales, and wetlands, and (2) restoring native vegetation and habitat by removing jetty jacks, exotic species, reducing fuel loads, and restoring riparian gallery forest (bosque). The approximate federal cost of the project is $24,809,000.

Design alternatives and the No Action alternative were evaluated to meet the overall purpose and need of the project, which includes improving habitat quality and increasing the amount of native bosque communities, promoting bosque habitat heterogeneity, implementing measures to reestablish fluvial processes in the bosque, creating new wetland habitat, reducing the fire hazard, recreating hydraulic connections between the bosque and river, protecting and enhancing potential habitat for listed species, and creating opportunities for recreational, educational and interpretive features.

Section 404 of the Clean Water Act (CWA) requires analysis under the EPA's 404 (b) (1) Guidelines if the Corps proposes to discharge fill material into water or wetlands of the United States. A 404 (b) (1) Evaluation was completed for this project and is enclosed as Appendix E. The 404 (b)(1) analysis has been completed under Nationwide Permit 33 (Temporary Construction, Access, and Dewatering) because of the potential need to dewater at the bank of the river when constructing the high-flow channels; and under Nationwide Permit 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities) for proposed work in the San Antonio Oxbow to restore wetland function. All conditions under Nationwide Permits 33 and 27 would be adhered to during construction. A water quality certification permit under Section 401 of the CWA would also be required. The Corps would coordinate activities and schedule with the New Mexico Environment Department (NMED) to allow water quality monitoring during project implementation.

Because there are no eligible sites within the Area of Potential Effect, the Proposed Action would result in "No Historic Properties Effected" under the National Registry of Historic Places. On March 9, 2009, the New Mexico Historic Preservation Officer concurred with the Corps determination of "No Historic Properties Effected." Should previously unknown artifacts or other historic properties be encountered during construction, work would cease in the immediate vicinity of the resource. A determination of significance would be made and further consultation on measures to avoid, minimize, and/or mitigate potential adverse effects would take place with the New Mexico State Historic Preservation Office, the U.S. Bureau of Reclamation, Middle Rio Grande Conservancy District, the City of Albuquerque, and with American Indian Tribes that have cultural concerns in the area.

The Corps consulted with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act, and a Biological Opinion was obtained. USFWS concurred with the Corps' statement that the Proposed Action "may affect, but is not likely to adversely affect," the Southwestern Willow Flycatcher. USFWS also concurred with the Corps' statements that the Proposed Action "may affect but is not likely to adversely modify designated Critical Habitat of the Rio Grande silvery minnow. The Proposed Action may affect and is likely to adversely affect the Rio Grande silvery minnow, though it may also provide positive benefits to the species." Therefore, the USFWS issued an incidental take statement for the construction and operation of the Proposed Action. The Corps would implement all reasonable and prudent measures (RPMs) stated in the Biological Opinion during construction in order to minimize take.

All Best Management Practices described in this document would be adhered to during project implementation including: (1) construction sequencing as described in Section 2; (2) sediment management; (3) equipment inspection; (4) compliance with water quality permits; (5) adherence to schedule and best management practices to avoid impacts to endangered, protected, or avian nesting species; (6) equipment cleaning prior to entering and before leaving project areas to avoid transfer of weed seed; (7) adherence to all recommendations in the Fish and Wildlife Coordination Act Report and Biological Opinion; and (8) oversight by a qualified biologist to monitor adherence to these conditions during construction.

The Proposed Action would result in only minor, short-term and temporary adverse impacts to soils; water quality; air quality and noise levels; aesthetics; vegetation; floodplains and wetlands; fish and wildlife; endangered species; socioeconomic considerations; and recreational resources during construction. The long-term benefits of the Proposed Action include a decrease in noxious weeds and increases and improvements to soil moisture; water quality; aesthetics; floodplains and wetlands; native vegetation and biodiversity; native habitat for fish and wildlife; potential habitat for endangered species; and recreational resources. The positive cumulative effects would outweigh short-term adverse impacts. The following elements have been analyzed and would not be adversely affected by the Proposed Action: hydrology; hydraulics and geomorphology; cultural resources; Indian Trust Assets; prime and unique farmland; hazardous, toxic and radioactive wastes; and environmental justice.

The Proposed Action has been coordinated with Federal, State, tribal and local governments with jurisdiction over the ecological, cultural, and hydrologic resources of the project area. Based on these factors and others discussed in the 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 this project, and the Proposed Action is recommended for construction.

6 JUN 11

Date

Jason D. Williams
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1.0 Introduction

1.1 Authorization, Purpose and Need

Authorization

The U.S. Army Corps of Engineers, Albuquerque District (Corps), in cooperation with the Middle Rio Grande Conservancy District (MRGCD) as the local sponsor, and other stakeholders, is proposing an ecosystem restoration project within the Albuquerque Reach of the Middle Rio Grande Bosque (bosque). This reach extends for a distance of approximately 26 miles from the north boundary of the Corrales Bosque Preserve on the west bank (which includes portions of the Pueblo of Sandia on the east bank) to the Pueblo of Isleta on the south. "Bosque" is a Spanish word that is used traditionally in the southwest to refer to a wooded riparian area.

The authority for this study was derived from a series of Congressional actions authorizing studies for projects on the Rio Grande, particularly in the MRG. These authorizations began with the flood control study authorization for the Middle Rio Grande in Section 4 of the Flood Control Act of 1941of Public Law No. 228, 77th Congress, 1st Session, which stated:

> *The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control, to be made under the direction of the Chief of Engineers, in drainage areas of the United States and its territorial possessions, which include the following-named localities ….Rio Grande and tributaries, New Mexico.*

In keeping with that authority, the report of the chief of Engineers on "Rio Grande and Tributaries, New Mexico," dated April 5, 1948, was transmitted to the House of Representatives on June 10, 1949 and published in House Document Numbered 243, Eighty-first Congress, First Session. By resolution dated April 11, 1974, the House Public Works Committee requested that the Board of Engineers for Rivers and Harbors review that report of the Chief of Engineers with particular reference to providing a plan for development, utilization and conservation of water and related land resources of "the metropolitan region of the Rio Grande from Cochiti Lake to Elephant Butte Reservoir," with "Such studies to include appropriate consideration of the needs for protection against floods with particular emphasis on…general recreation facilities, enhancement and control of water quality, enhancement and conservation of fish and wildlife, and other measures for environmental enhancement…"

The project area is maintained according to general guidelines in the Middle Rio Grande Flood Control Acts of 1941 and 1950. It is also within the *Facilities of the Middle Rio Grande Floodway Project* which resulted in the construction of additional levees and dams between Espanola and San Marcial, NM (USACE 2002a, 2003a, 2007b). Section 401 of the Water Resources Development Act of 1986 (Public Law 99-662) dated 17 November 1986, authorized the Middle Rio Grande Flood Control Project from Bernalillo to Belen, New Mexico, Albuquerque Levees (PL 80-858), Cochiti Dam (PL 86-645), and Jemez Dam (PL 80-858). Additional authorization is contained in House of Representatives Resolution 107-258, 2002.

This authorization provides funds to evaluate environmental restoration, to include recreational components.

In response to the subject study authorities, a Reconnaissance study was initiated in March 2002. The results and conclusions of this reconnaissance phase were presented in the Middle Rio Grande Bosque Restoration Section 905(b) Analysis, U.S. Army Corps of Engineers, Albuquerque District, June 2002. The recommendation put forth in that report was that Federal interest exists in proceeding to the feasibility phase of a General Investigation Study. In the fall of 2004, a Feasibility Cost Sharing Agreement was signed between the MRGCD, as the non-Federal Sponsor, and the Corps, that initiated this feasibility study phase.

Purpose and Need

Estimates of riparian habitat loss in the Southwest range from 40% to 90% (Dahl 1990), and desert riparian habitats are considered to be one of this region's most endangered ecosystems (Minckley and Brown 1994, Noss et al. 1995). Decline of natural riparian structure and function of the bosque ecosystem was recognized in the 1980s as a major ecological change in the MRG (Hink and Ohmart 1984; Howe and Knopf, 1991). In ecological terms, the cumulative effects of agriculture, urban development and flood protection measures initiated over the last seven decades have resulted in a major disruption of the original hydrologic regime along the Albuquerque reach of the Middle Rio Grande, and in the ultimate degradation of the bosque ecosystem. This hydrologic regime is key to sustaining and regenerating a variety of ecological components that make up the bosque, and the wildlife it supports. Whereas it is not possible to return the MRG to its pre-flood protection state, there are abundant opportunities to restore function and habitat value within the constraints of current water use restrictions and without imposing flood damages.

The mosaic or patchy distribution of habitats that once made up the bosque has changed dramatically since the 17th Century (Pittenger 2003, Scurlock 1998). With recent changes in land use and settlement, the size and composition of various patches within the bosque have also changed (Scurlock 1998). The existence in recent decades of a continuous bosque forest, extending between the river and the levee, appears to be unprecedented. Many bosque researchers and commentators now believe that, historically, the bosque comprised a dynamic mosaic of riparian wetlands, channels, woodlands, shrub thickets and wet meadows (Pittenger 2003, Crawford et al. 1998). Frequency of flooding, water table elevation and the type of sediment substrate were and continue to be important determining factors of patch type and structure. Though the manmade flood control structures that now regulate the river and bosque must stay in place, for the most part, one of the main goals of the Proposed Action is to reconnect the bosque with the river floodplain, while increasing habitat heterogeneity.

Another problem is the presence, and in many cases dominance, of non-native vegetation. While it is probably impossible to totally eradicate all non-native vegetation within the 26 miles/5,300 acres of the bosque, another purpose for this Proposed Action is to integrate non-native with native species to an acceptable level. Specific project goals, along with a recommended mosaic of species, are further discussed in Section 4.8.

The hydrologic cycle in the MRG, which is delineated as extending south from Cochiti Lake to Elephant Butte Lake, is critical to the function of the bosque cottonwood riparian communities and wetlands. It follows a pattern of high flows during spring snowmelt runoff, and low flows during the fall and winter months. Additional high flows, of short duration, result from late summer thunderstorms. High flows that reach across the floodplain, facilitate nutrient cycling, seed dispersal and seed establishment. This inundation, combined with high water table recharged wetlands, provides for seasonal growth and nurturing of existing plant communities.

Much of this inundation has been reduced, however, because of the disconnection between the river and floodplain stemming from installation of flood control devices. River channelization, combined with installation of dams, levees and jetty jacks, have in effect ‘perched’ the bosque above the river, so that natural overbank flooding no longer occurs. This has also resulted in the systemic loss of high-flow and side channels. ‘Reconnection of function’ can be achieved, however, through development of such restoration features as high flow channels, backwater channels and other features that connect the bosque and the main channel. These features are described below in greater detail.

Based on the hydrologic and ecological problems discussed above, key project purposes and needs of the Proposed Action were developed as follow:

1. Improve habitat quality and increase the amount of native bosque plant communities (i.e. cottonwood, willow, New Mexico olive and other native species), while creating greater stand diversity in terms of stand age, size and composition within the bosque (a mosaic).
2. Promote bosque habitat heterogeneity by recreating pockets of new cottonwood, willow and other native species throughout the Proposed Action Area, where root zones reach the shallow water table.
3. Implement measures to reestablish fluvial processes in the bosque, including removal of non-functional jetty jacks, bank terracing, and high-flow/side channel creation to promote overbank flooding.
4. Create new wetland habitat, while extending and enhancing high quality aquatic habitat in existing wetlands.
5. Reduce the fire hazard in the bosque through the reduction of fuel loads, to include exotic species identified as hazardous.
6. Recreate hydraulic connections between the bosque and the river consistent with operational constraints.
7. Protect, extend and enhance areas of potential habitat for listed species within the existing bosque.
8. Develop and implement a long-term operations and maintenance plan, which incorporates long-term monitoring of proposed restoration features.
9. Coordinate and integrate project implementation and monitoring with other, ongoing restoration and research efforts in the bosque.
10. Create opportunities for educational or interpretive features, while integrating recreational features that are compatible with ecosystem integrity.
11. Continue to engage the public in the restoration of the bosque ecosystem by garnering input and involvement.

1.2 Project Location

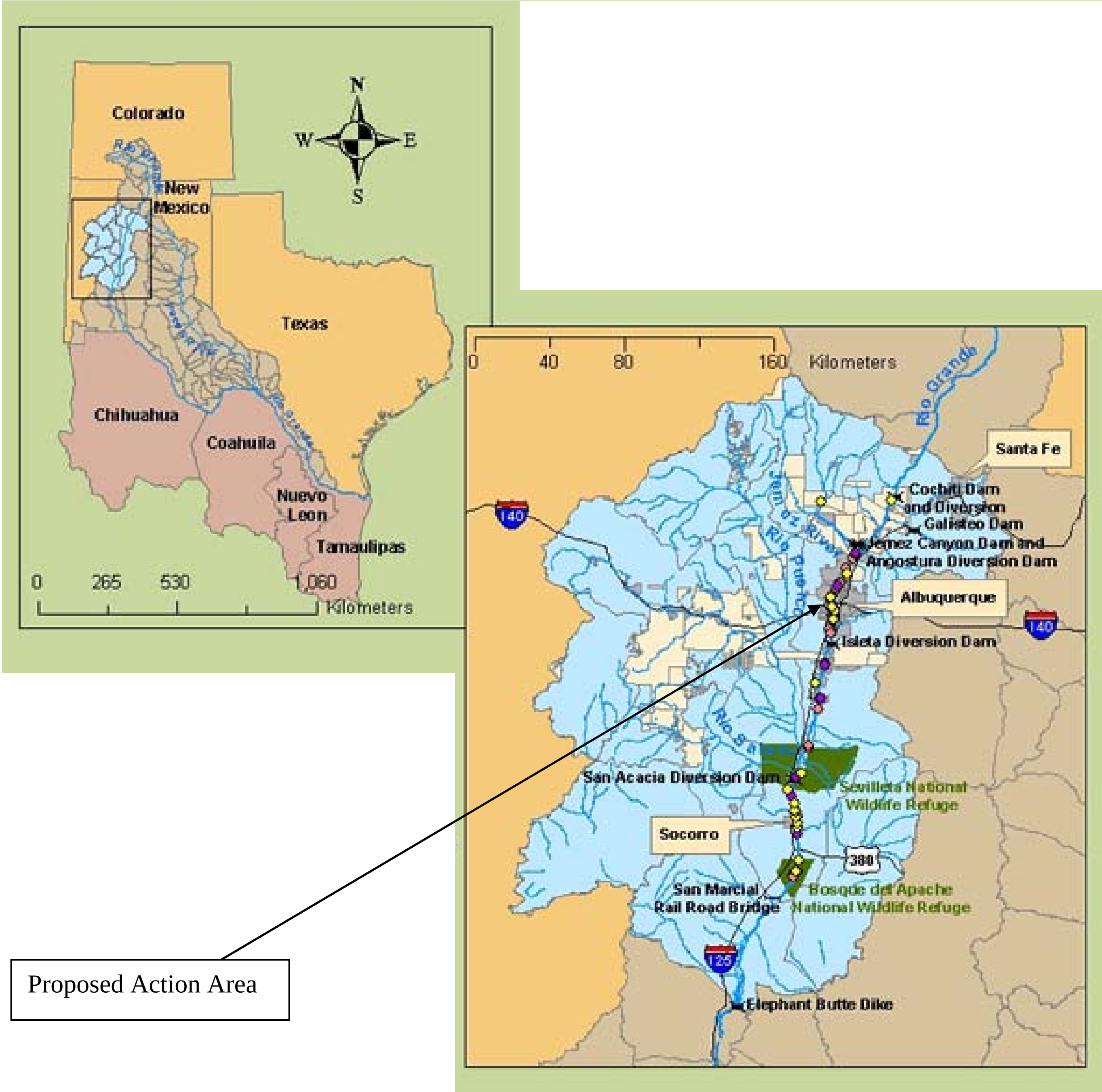
The Middle Rio Grande Bosque is a large riparian corridor that extends through the middle reach of the Rio Grande (Figure 1), in the vicinity of the City of Albuquerque, New Mexico. The Middle Rio Grande extends from Otowi Gage on the north to Elephant Butte Dam on the south.

The Proposed Action Area includes the portion of the bosque within Albuquerque, which was designated as the *Rio Grande Valley State Park* through the Park Act of 1983. This area is cooperatively managed by the City of Albuquerque, Open Space Division (OSD) and the MRGCD. In this manner, the bosque is offered protection as a State Park but without state operating funds, and is administered by OSD and MRGCD through formal agreements.

The Proposed Action Area also includes the bosque within Corrales, which is designated as the *Corrales Bosque Preserve* and is cooperatively managed by the Village of Corrales and the Corrales Bosque Commission and co-managed through an agreement with the MRGCD and the Village. Pueblo of Sandia lands are also located within the Proposed Action Area and are managed by the Pueblo. Both Corrales and Sandia lands are within Sandoval County.

The Proposed Action is also within the *Facilities of the Middle Rio Grande Floodway Project* which resulted in the construction of additional levees and dams between Espanola and San Marcial, NM (USACE 2002a, 2003a, 2007b). Lands within the Middle Rio Grande Project Facilities are managed by the U.S. Bureau of Reclamation (USBR) and MRGCD.

The Northern extent of the Corrales Bosque Preserve forms the north boundary of the Proposed Action Area, while the southern boundary is formed by the northern limits of the Pueblo of Isleta (Figure 2). The east and west boundaries of the Proposed Action Area are the easements of the *Facilities of the Middle Rio Grande Floodway Project* which include the levees, riverside drain, and an easement area between the drain and private property. The levees extend between the bosque and the riverside drain (as shown in Figure 24). The Proposed Action Area extends approximately 26 miles along the river, and is roughly 5,300 acres in size. The bosque that embraces the Proposed Action Area was historically one of the largest cottonwood riparian galleries in the southwestern United States. The Proposed Action Area was broken into five reaches based on hydrologic breaks (usually bridges). A hydrologic break is infrastructure that can change the main flow of the river.



Map reference:
http://www.fws.gov/southwest/mrgbi/maps/Rio_Grande_Basin/index.html

Figure 1. Middle Rio Grande

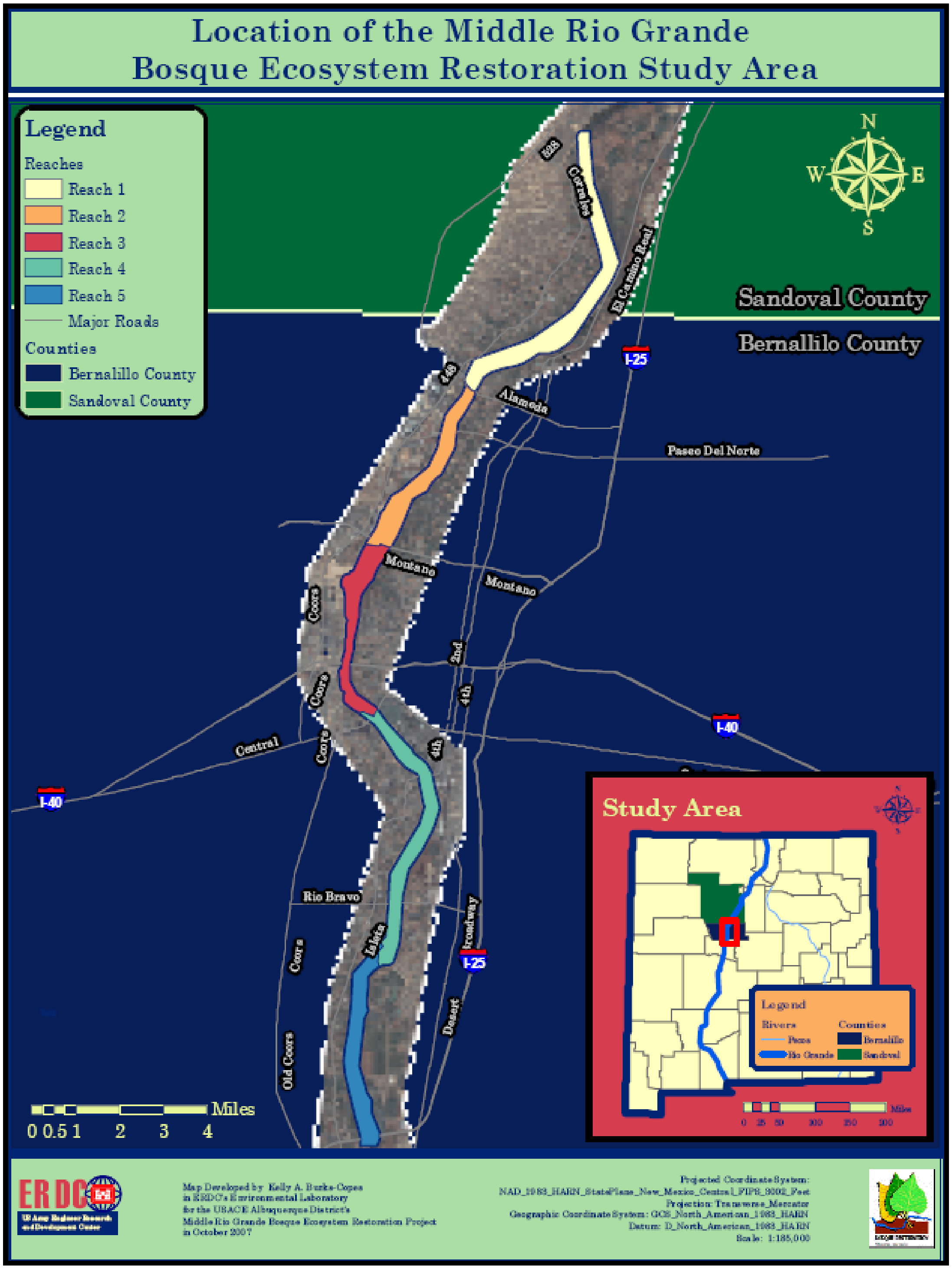


Figure 2. Proposed Action Area

1.3 Public Scoping and Collaboration

Public Scoping

A number of public and governmental coordination meetings were held early on during the Reconnaissance Study phase of this project. Initial concerns for the Proposed Action were discussed and articulated to generate problems and need discussed above. Additional input from Federal, state and local agencies was received through public coordination and project meetings, as well as through quarterly agency coordination meetings. These meetings were attended by MRGCD, OSD, U.S. Bureau of Reclamation (USBR), the U.S. Fish and Wildlife Service (USFWS), the Middle Rio Grande Council of Governments, the Albuquerque Downtown Action Team, City of Albuquerque Planning Department 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 input on issues in the MRG. In February of 2003 a public meeting was held to present restoration efforts beginning in the MRG and to poll public concerns. Input from public scoping is provided in Appendix A

Scoping letters were sent to various public agencies and interested public (see Appendix A) and meetings were held in regard to the project during the planning process. Input was received and is in Appendix A.

Collaboration

Early in the process, an interagency Ecosystem Assessment Team (E-Team) was convened. Representatives from the Corps' Albuquerque District, U. S. Fish and Wildlife Service (USFWS), USBR, New Mexico Interstate Stream Commission (ISC), New Mexico Department of Game and Fish (NMDGF), New Mexico State Forestry Division (NMSFD), Natural Heritage New Mexico (NHNM), USFS Rocky Mountain Research Station (RMRS), MRGCD, OSD, University of New Mexico (UNM), Corrales Bosque Preserve, Village of Corrales and Parametrix consultants actively participated in the assessment process. Scientists from the Corps' Engineer Research Development Center (ERDC) Environmental Laboratory (EL), in turn, facilitated ecological evaluations undertaken by the E-Team. The accompanying planning process is described in great detail in the Feasibility Study Report and in supporting ERDC documentation (available in the Feasibility Study Report Appendices).

1.4 Public Review

Public review of the Draft Environmental Assessment occurred from April 12, 2010 to May 10, 2010. A public meeting was held on April 27, 2010. Numerous comments were received and are available in Appendix I. In summary, most comments required minor clarification in the Environmental Assessment and have been addressed. Some comments deal with the design of the project and those are being addressed at the design level with those stakeholders. The Corps will continue to work with stakeholders and commenting entities during the design process.

1.5 Regulatory Compliance

This Environmental Assessment (EA) was prepared by the U.S. Army Corps of Engineers, Albuquerque District, and is 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

This EA also reflects compliance with all applicable tribal, State of New Mexico and local regulations, statutes, policies, and standards for conserving the environment and environmental resources such as water and air quality, endangered plants and animals, and cultural resources.

A discussion of how the Proposed Action is in compliance with each of these regulations, statutes, and Executive Orders is provided in Section 4.0.

2.0 Descriptions of the Proposed Action and Alternatives

2.1 Future Without Project (No-Action Alternative)

Future conditions without project implementation were projected by the E-Team to characterize the "No Action" alternative and its effects, and to form a baseline for comparison of restoration benefits. Throughout the Middle Rio Grande Valley, the river, floodplain, and associated fish and wildlife populations would be expected, in general, to continue to experience adverse effects from new and ongoing Federal, State, and private water resource development projects. Increasing urbanization and development within the historic floodplain, moreover, would continue to eliminate remnant riparian areas located outside the levees, putting increased pressure on the habitat and wildlife in the riparian zone within the floodway. Local agencies would continue to perform maintenance of non-native vegetation as they are able, but features connecting the bosque and river would not be constructed. Analysis of the No Action alternative is provided in Section 3.

2.2 Alternatives Considered but Eliminated from Further Study

Alternative analysis for the Proposed Action included various combinations of nine alternative restoration measures (described below) within the five project reaches. These combinations created hundreds of alternatives that were analyzed using a Habitat Evaluation Assessment Tool (HEAT) and Incremental Cost Analysis (ICA) as described below.

To evaluate all possible alternatives, the Corps' Project Delivery Team (PDT) worked with the E-Team to develop Habitat Suitability Indices (HSIs) for various vegetation and hydrologic components of the bosque. These HSIs were combined into a Bosque Community Model which was input into the HEAT software.

To obtain a value for the existing habitat in the Proposed Action Area and ultimately forecast improvements in value resulting from any restoration measures, an existing inventory of the habitats within the Proposed Action Area was used. This inventory updated the vegetative cover types within the project area, and is discussed in Section 4.8 Vegetative Communities.

Development of the Bosque Community HSIs, analysis using the HEAT Software and the ICA are provided in the following reports: (*Middle Rio Grande Bosque Ecosystem Restoration Feasibility Study Habitat Assessment Using Habitat Evaluation Procedures (HEP), 2008* and *A Bosque Riparian Community Index Model and a Spatial Heterogeneity Index Model for the Middle Rio Grande, Albuquerque, New Mexico, 2008*). These reports are available in the Appendices of the Feasibility Study Report.

The E-Team implemented a proactive strategy to formulate alternatives tailored to focus on restorative initiatives at a larger, landscape level, with system-wide implications. By definition, features and activities were considered the smallest components of the alternative plans. Features were typically structural elements while activities were often nonstructural actions performed continually or in a periodic fashion to support the restoration effort. Ultimately, nine broad categories of feature/activity types were formulated to modify the land/water interface in an attempt to improve the hydrologic, geomorphic and biologic setting of the bosque ecosystem and restore both the community's structure and function to a sustainable level (Table 1).

Combinations of these features, referred to as management measures, became the building blocks of which the alternative plans were made.

Table 1. Proposed alternative features and activities considered for ecosystem restoration efforts in the Middle Rio Grande Bosque Restoration Project Proposed Action.

Category	Features/Activities	Details
Water Features	Wetland Restoration	Wetlands would be established or restored at appropriate locations to create a diverse and high value habitat. Storm water outfalls were numerous throughout the bosque in the Albuquerque area and would be modified to function as wetlands, increasing diversity of habitat and providing some water quality treatment. There is an existing oxbow wetland that would also be restored to function more naturally. Restoration of wetland habitat was critical to ensuring that the dynamic mosaic of the bosque ecosystem's structure and function was perpetuated.
	Bank Terracing	In several areas, banks of the Rio Grande would be shaved to create a less incised channel and shelves, or destabilized to create sediment sources. Such areas would increase the diversity of both fringe riparian and aquatic habitat.
	High Flow Channels	Excavation of smaller, high flow channels to convey waters through the bosque during typical spring flows would occur and would include scallops and backwater channels where possible. This would mimic the historic hydrograph and recreate connections between the bosque and the Rio Grande.
	Willow Swales	A number of areas had also been identified for installation of moist soil willow swales that would serve a dual purpose of reestablishing connectivity between the bosque and the river, as well as providing shrub, mid-canopy habitat - an integral piece of the bosque ecosystem mosaic.
Vegetative	Riparian Gallery Forest Mosaic Restoration	A primary element of the restoration would be the planting and reestablishment of cottonwood/willow gallery forest communities within the bosque. Areas would be cleared of exotic species and replanted with native species of the cottonwood riparian gallery forest. Especially important would be the reestablishment of the mid-canopy vegetation and open grasslands/savannahs to ensure that the dynamic mosaic of the bosque ecosystem was restored.
	Exotic Species Removal	A key element in the restoration of the bosque focuses on the removal of exotic plant species. Salt cedar, Siberian elm, tree of heaven and Russian olive are foreign exotic species that invaded parts of the bosque, forcing out key native species of willow and cottonwood. In addition, removal of exotics would potentially allow the water table to return to higher levels in this area of the Rio Grande bosque. Removal of exotics would enhance the potential to reestablish native species over the long term. Exotic removal is considered a precondition for the restoration of natural processes in the bosque. Removal of exotics would also help decrease fuel loads because they comprise most of the understory in denser areas of the bosque.
		TABLE CONTINUED ON NEXT PAGE

	Fuel Load Reduction	Another key element to enhancing the health of the bosque would be fuel load reduction. Fuel load reduction entails removing dead and down wood and excess leaf litter within the cottonwood gallery forest. When the flood disturbance regime was still functional, much of this material would have been removed by periodic flooding. Much of this material represented a fire hazard, and in many instances encroached on recreation systems and limited the surveillance necessary for security within the bosque. Fuel load removal would advance a number of purpose and needs of the Proposed Action.
Physical Removal	Jetty Jack Removal	Another important measure proposed in alternative development was the removal of jetty jacks. Jetty jacks were originally used to stabilize banks and control floods within the Middle Rio Grande floodplain. Jetty jacks would be removed wherever possible and left only where they were critical to levee stabilization. Jetty jacks often prevent recreational, management and/or emergency access.

A total of 56 alternative sub-plans were considered for different reaches during final analysis as a basis for identifying alternatives, and ultimately a Proposed Action. Thirteen alternative sub-plans were considered for Reach 1, thirteen for Reach 2, eight for Reach 3, eleven for Reach 4, and eleven for Reach 5. In addition, recreational use of the bosque would be improved by creating designated trails with benches, signs and other interpretive features.

2.3 Proposed Action

The Proposed Action represents the most cost-effective aggregation of restoration sub-plans or alternatives, and the aggregation of sub-plans that best meet the purpose and needs of the Proposed Action. Through implementation of the Proposed Action, approximately 916 acres of the bosque would be restored by enhancing hydrologic function and restoring native vegetation and habitat (see Figures 3-7). The restoration components of the Proposed Action are based on that alternative identified as the Preliminary Preferred Alternative (Best Buy #7) generated by the Incremental Cost Analysis (ICA (see the Ecological Appendix of the Feasibility Study Report for a detail account of the ICA). The following paragraphs describe individual activities, treatments, measures or undertakings combined into sub-plans for individual reaches and, ultimately, combined as project alternatives embracing all reaches.

Table 2 presents the quantity of restoration, in acreages, that would be accomplished by implementing by the Proposed Action(s) for each reach. A summary of the Proposed Action, to include its constituent features, is provided below.

Figure 3. Proposed Action, Reach 1

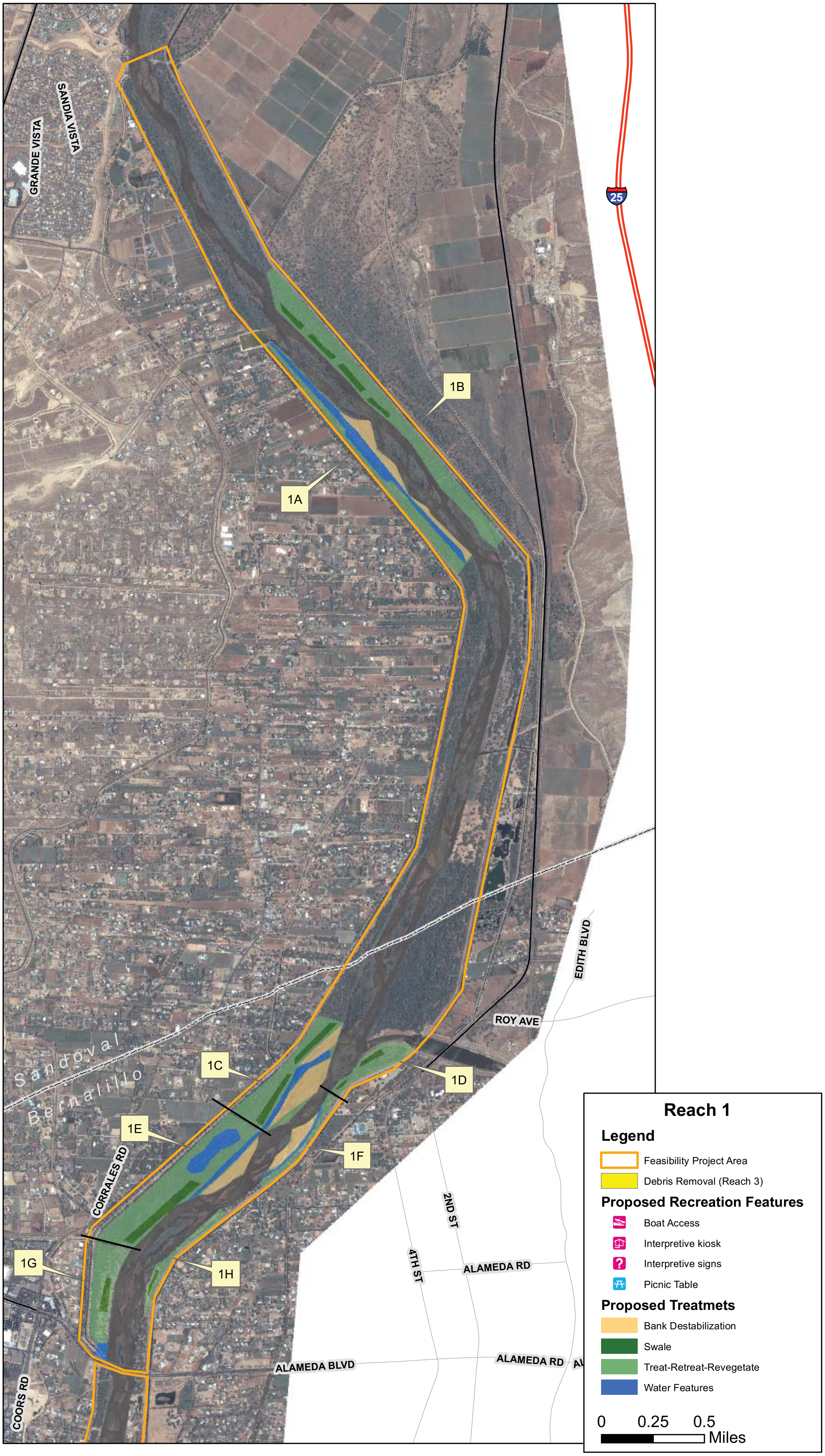


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Figure 4. Proposed Action, Reach 2

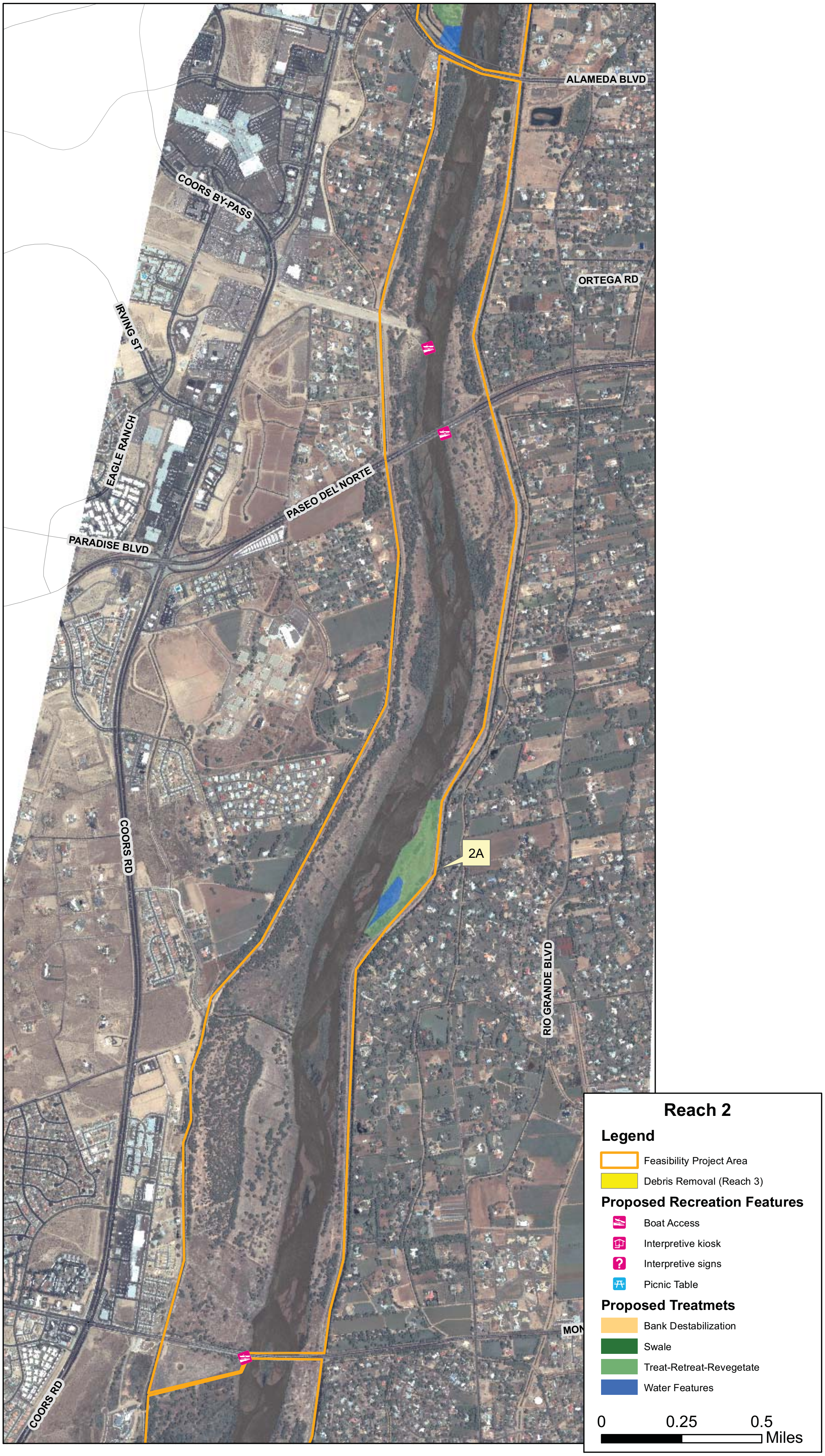

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Figure 5. Proposed Action, Reach 3

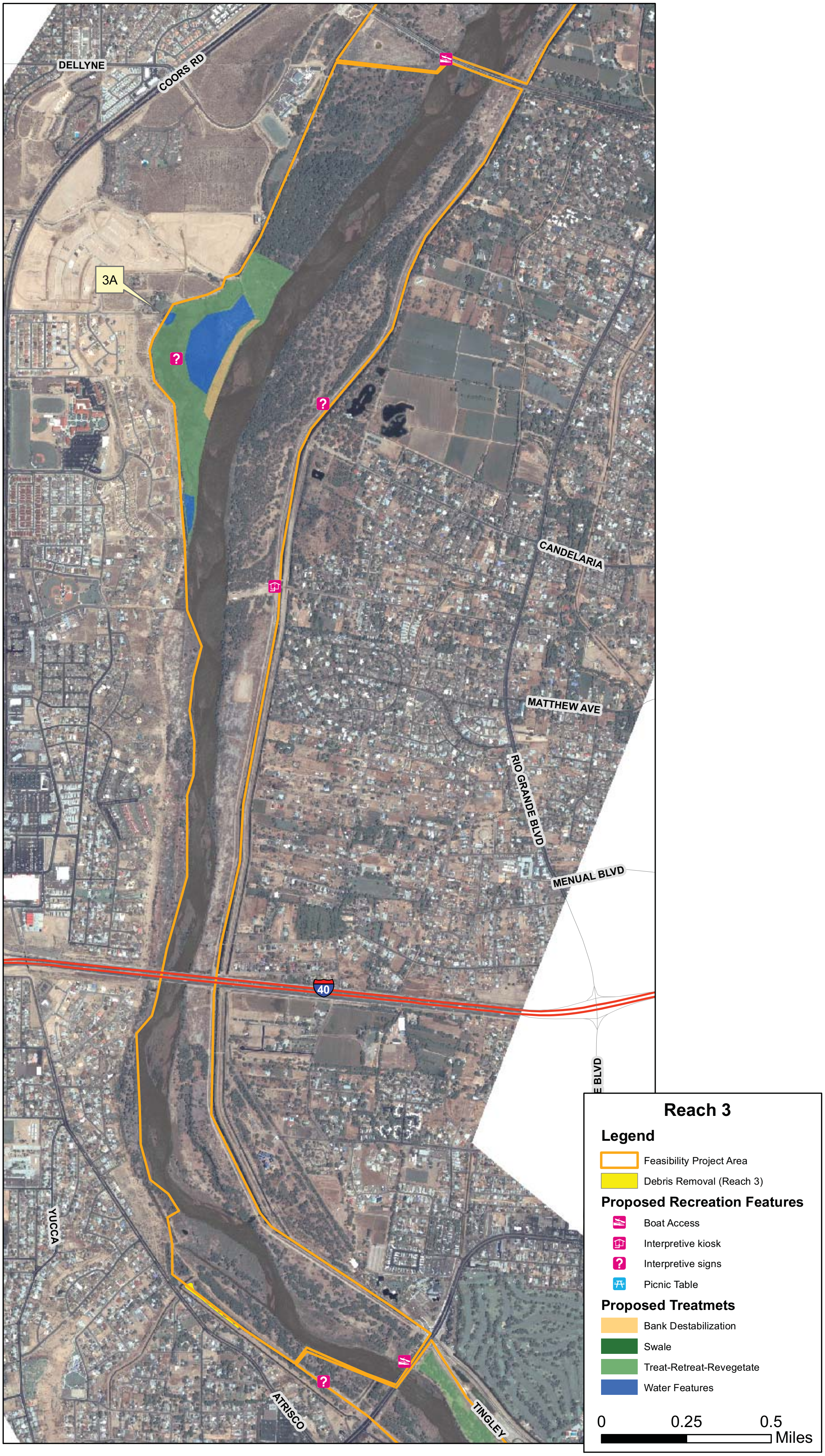

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Figure 6. Proposed Action, Reach 4

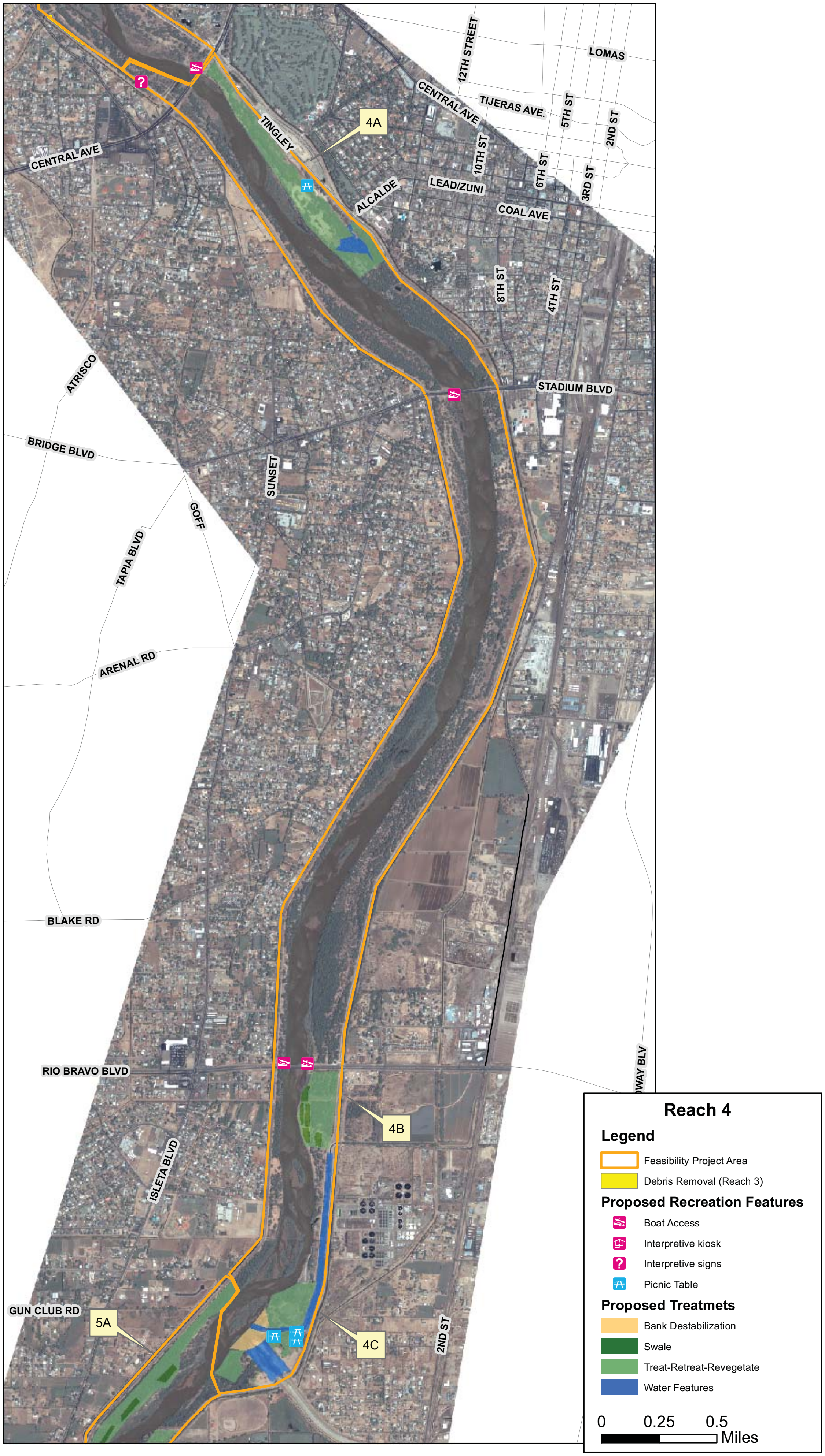

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Figure 7. Proposed Action, Reach 5

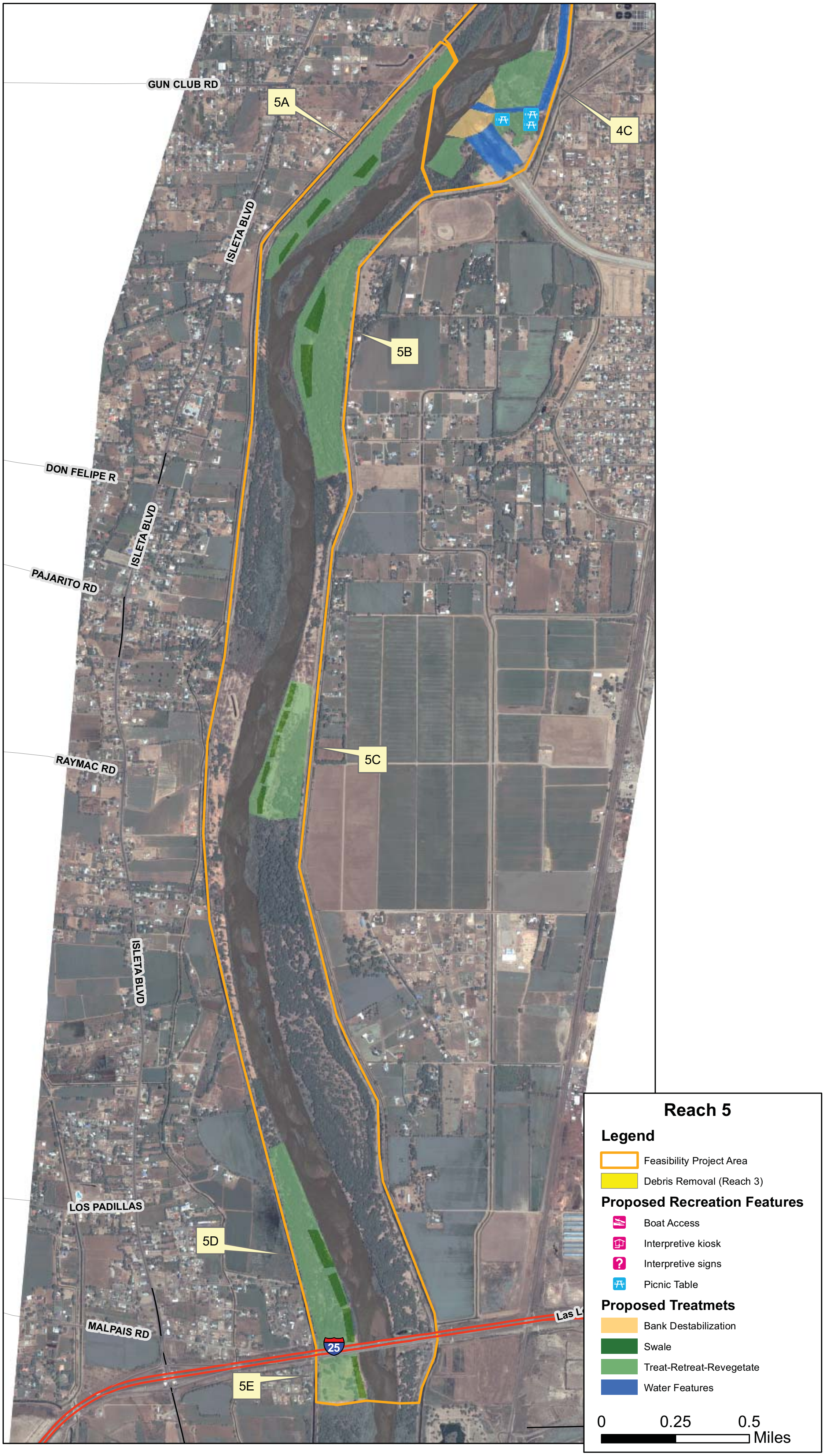

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Table 2. Restoration outputs generated by the Proposed Action.

Project Reach	Proposed Treatment	Quantity	Units	Total AAHUs Created	Average Annual Cost per AAHU
	Bank Destabillization	60	acres		
	Swales and Trenches	48	acres		
Reach 1	Water Features	62	acres	**222**	**$3,969**
Plan J	Treat Retreat Revegetation	449	acres		
	Jetty Jack Removal	2,672	units		
	Bank Destabillization	0	acres		
	Swales and Trenches	0	acres		
Reach 2	Water Features	4	acres	**139**	**$372**
Plan F	Treat Retreat Revegetation	23	acres		
	Jetty Jack Removal	1,000	units		
	Bank Destabillization	5	acres		
	Swales and Trenches	0	acres		
Reach 3	Water Features	20	acres	**100**	**$1,336**
Plan A	Treat Retreat Revegetation	88	acres		
	Jetty Jack Removal	800	units		
	Bank Destabillization	13	acres		
	Swales and Trenches	12	acres		
Reach 4	Water Features	33	acres	**62**	**$3,414**
Plan H	Treat Retreat Revegetation	143	acres		
	Jetty Jack Removal	0	units		
	Bank Destabillization	0	acres		
	Swales and Trenches	26	acres		
Reach 5	Water Features	0	acres	**155**	**$998**
Plan G	Treat Retreat Revegetation	215	acres		
	Jetty Jack Removal	0	units		
Totals	Bank Destabillization	78	acres		
	Swales and Trenches	85	acres		
	Water Features	119	acres	678	
	Treat Retreat Revegetation	918	acres		
	Jetty Jack Removal	4,472	units		

Jetty Jack Removal

The jetty jacks (Figure 8) within the Proposed Action Area are either owned or are, otherwise, under the authority of the Corps, the USBR or the MRGCD. In a cooperative effort, the three agencies have reviewed the Albuquerque Reach to evaluate whether jetty jack removal would conflict with flood control and erosion management. Jetty jack removals have been approved in most locations, with only a few exceptions. Exceptions are typically in areas where the active river channel has migrated to an alignment very close to the levee, such that only a very narrow overbank buffer remain between the active river flow and the levee toe. Such bank line jetty jacks that are to be removed will be mitigated with some form of bio-stabilization method, such as willow swales, to prevent excessive migration of the river channel toward the levee. Typically, however, these bank line jetty jacks must remain fully intact. Any broken cable or snapped/cut wires resulting from this work or the recent activity of others would be repaired. Additionally, where tieback lines are removed, new anchors would be installed as needed to insure that the remaining lines of jetty jacks cannot migrate from their current position. If only one or two jetty jacks within a continuous line are removed, the remaining jacks would be reconnected with a buried steel cable. Tieback lines (roughly perpendicular to the river) would not be removed without also placing a buried anchor (known as a “deadman”) to replace the tieback line.

The Contractor would be responsible for safe disposal of all jetty jack materials after they are removed from the work site. Ongoing inspections as well as a final inspection will be conducted to insure that the requirements as described above are met.

The Corps Hydrology and Hydraulics Section has determined that the jetty jacks identified for removal in the Proposed Action can be removed with a low hydraulic risk based on implementation of the proposed restoration methods and techniques for this project.

Figure 8. Jetty jacks within the bosque

Exotic Species/Fuel Load Reduction and Riparian Gallery Forest Mosaic Restoration

Non-native plant removal would facilitate restoration efforts by eliminating the chief competition to native trees, shrubs, forbs and grasses. Non-native plant removal would also reduce the fire hazard, while enhancing aesthetic and recreational aspects of the bosque.

In many areas, continued maintenance and repeated treatment of invasives for stump sprouting, and removal of juvenile volunteer non-natives, would be necessary. This would be provided for under the operations and maintenance portion of the project.

Both the removal of jetty jacks, where needed, and the thinning of non-native vegetation/reduction of fuel loads would need to occur prior to implementing the remaining activities/features discussed below.

Specific treatment methods are as follows:
A number of protocols for reducing fuel loads and treating non-native vegetation have been, and are being, utilized in the MRG and throughout the Southwest. These methods include both manual and mechanical treatment methods, which are described below. Follow-up treatment with herbicides, or root ripping (raking approximately 6-12 inches into the ground in order to remove roots), are also options. Removal of non-native vegetative species, would take place between August 15 and April 15 of each year, when possible, to avoid bird nesting seasons and requirements, notably, under the Migratory Bird Act, which severely constrain activities with the potential to impact nesting birds.

1. Manual treatment - Using this method, dead material would be piled up and/or processed by cutting into small pieces using a chain saw. Large material would be hauled off, with some resources for use as fire wood. Smaller material would be chipped, using a chipper, on site. Chips would either be tilled into the ground prior to revegetation or hauled off, depending on their density. No more than 2 inches of chipped material would be left on site. The stump of any live non-native trees that is cut would be treated immediately with herbicide, if not entirely removed. This method would be used in areas where the bosque is not very wide and equipment would not fit, or areas where there are a large number of native trees and shrubs to protect.

2. Mechanical treatment - Mechanical control entails the removal of aerial portions of the tree (trunk and stems) by large machinery such as a tree shear or large mulching equipment. Both dead material and live non-native trees would be treated mechanically. Where possible, trees would be removed with the root-ball intact. Otherwise, the stump would be treated immediately with herbicide. Material would be processed as stated above: large material would be hauled off and smaller material would be chipped.

3. Combination treatment - The most efficient approach for treatment of dead material and non-native vegetation (and the most frequently used in the MRG where a fair amount of native species are mixed in with non-native) is a combination of manual treatment, mechanical treatment and use of herbicide. Some areas may be very dense, and the use of manual methods allows them to be opened up for machinery access. Mechanical equipment can then take over while hand crews move ahead of machinery to keep areas

open enough to work in without damaging native vegetation to remain. The procedure to be implemented at each location would be evaluated on a site-by-site basis.

Once initial removal of non-native species has occurred, or in areas where OSD crews have already removed standing non-native vegetation as part of their routine operations and maintenance, resprouting of non-native vegetation would occur. These resprouts would be treated with either herbicide or by root-ripping prior to revegetating the area with native species. Thinning and removal of non-native vegetation under this Proposed Action would include herbicide treatment in many locations. Herbicide application would be used where root ripping is not an option. Herbicide would be immediately applied to the plant using a backpack sprayer, hand application with a brush, or other equipment that allows direct application.

Riparian Gallery Forest Mosaic Restoration

The overall restoration strategy for the Riparian Gallery Forest Mosaic Restoration measures is to revegetate all areas within the Proposed Action Areas utilizing native species. The strategy is to revegetate the bosque with shrubs and juvenile trees to re-create the lost native understory in the bosque forest woodland areas, and the lost native shrub thickets in open areas. At the same time, gaps are to be left in between the revegetated areas to create edge habitat, the richest type of habitat, and to create firebreaks to limit the potential for catastrophic fire. Native plant species, preferably from local genetic stock, would be used during revegetation. Planting strategies to target a riparian gallery forest mosaic would include the following revegetation techniques:

1) **Seeding** with native grasses and forbs, such as Indian rice grass (*Achnatherum hymenoides*), galleta grass (*Pleuraphis jamesii*), side oats grama (*Bouteloua curtipendula*), blue grama (*Bouteloua gracilis*), sand dropseed (*Sporobolus cryptandrus*), and sunflower (*Helianthus annuus*) and in wetter areas, yerba mansa (*Anemopsis californicus*), emory sedge (*Carex emoryi*), and salt grass (*Distichlis stricta*). Seeding involves sowing seed via methods such as broadcasting, crimp and drill or hydro-mulching. Other than the gel in the hydro mulch, no irrigation would be applied. Timing of seeding would be critical to the establishment of the vegetative cover. Late summer is usually the best time. Wood debris, such as large logs that remain after thinning, would be placed strategically to provide additional habitat once seeding is completed.

2) **Bare root or container planting** with native shrubs, such as New Mexico olive (*Forestiera pubescens*), four wing saltbush (*Atriplex canescens*), chamisa (*Ericameria nauseosus*), false indigo (*Amorpha fruticosa*), golden currant (*Ribes aureum*), three leaf sumac (*Rhus trilobata*), pale wolfberry (*Lycium pallidum*), and in wetter areas, coyote willow (*Salix exigua*), black willow (*Salix nigra* var. *gooddingii*), and Willow Baccharis (*Baccharis salicifolia*) would be an important strategy for establishing woody plants. Bare root planting refers to planting a plant directly in the ground without a rootball. Most of the native shrubs listed above are grown in tall pots, which provide a longer and more established root system, and have been found to support excellent seedling survival (USDA NRCS PMC, 2001). Container planting refers to planting small plants in small containers. A watering tube would be placed alongside the shrub plant material and

would be watered through the first summer. Coyote willows can be planted directly in wet areas as live sticks. Shrubs would be planted at various densities depending on what is currently at the location. If no native understory vegetation exists at a location, then shrub planting density would be higher (500 stems per acre or more). If there is existing native vegetation, then a lower density of native shrubs would be installed (100-500 stems per acre as needed). Shrubs would be planted in the fall and trees would be planted in the winter.

3) **Plug planting** would be used to plant wetland and other moist soil plants within created water features. Species that could be provided as plugs include yerba mansa (*Anemopsis californica*), native sedge (*Carex* spp.), native rush (*Scirpus* spp.), and saltgrass (*Distichlis stricta*). Plug planting refers to insertion of small seedlings with the soil or growth medium attached. Plugs are planted directly into moist soils on the edge of water features (wetlands, high-flow channels, etc.).

4) **Pole planting** of native trees, such as the Rio Grande cottonwood (*Populus deltoides* spp. *wislizenii*), Goodding's willow (*Salix gooddingii*) and peach leaf willow (*Salix amygdaloides*). Pole planting is the technique most frequently used for restoration of riparian areas. Many of the pilot projects in the bosque have utilized pole planting, and according to AOSD, they have a 90 percent success rate (Tony Barron, Pers. comm., 2002). Branches of cottonwoods and willows, 10 feet to 15 feet in length, are slipped into holes that have been augered through the soil to the water table. Little maintenance is required beyond taking precautions to protect the young trees from beavers. Trees would be planted at a fairly low density since cottonwoods exist throughout the Proposed Action Area. They would be supplemented in some areas as needed but at a very low density (10-50 stem per acre). Willow trees are lacking in some areas of the Proposed Action Area and would be planted at a higher density in those areas (25-75 stems per acre).

Planting strategies would not include planting larger plants, such as balled and burlapped or container trees, because they would not be successful in the Proposed Action Area without significant irrigation.

Seeding would be applied wherever restoration occurs. In firebreak areas, seeding is the only revegetation strategy proposed.

Maintenance and adaptive management would be important to the long-term success of the revegetated areas. Ongoing removal of non-native stump sprouts and volunteers would be necessary in all planted areas. In firebreak areas, the vegetation would have to be mowed or "brush-hogged" (another mowing method that removes standing vegetation) periodically, in order to maintain the function as a firebreak and to keep out woody plants.

These different planting strategies would be combined in order to create the target mosaic mixture of different ecosystem types (bosque forest, grass meadow, wet features). A typical potential bosque forest patch is shown in Figure 9. Another bosque forest with a smaller structure (more of a shrub community) is shown in Figure 10. These strategies are in line with those suggested in the Environmental Enhancement Plan (City of Albuquerque, 2005).

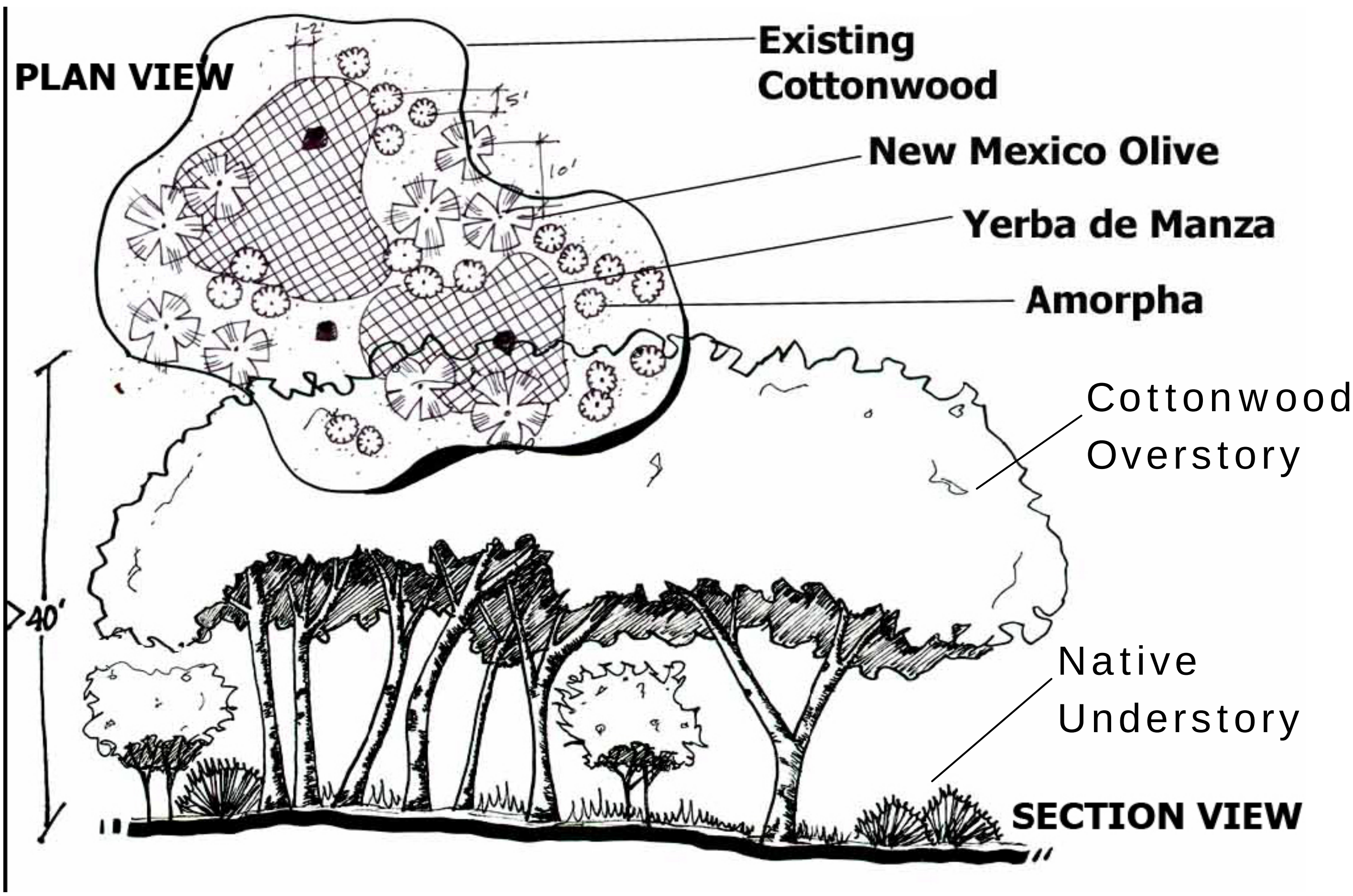


Figure 9. Schematic of a bosque forest

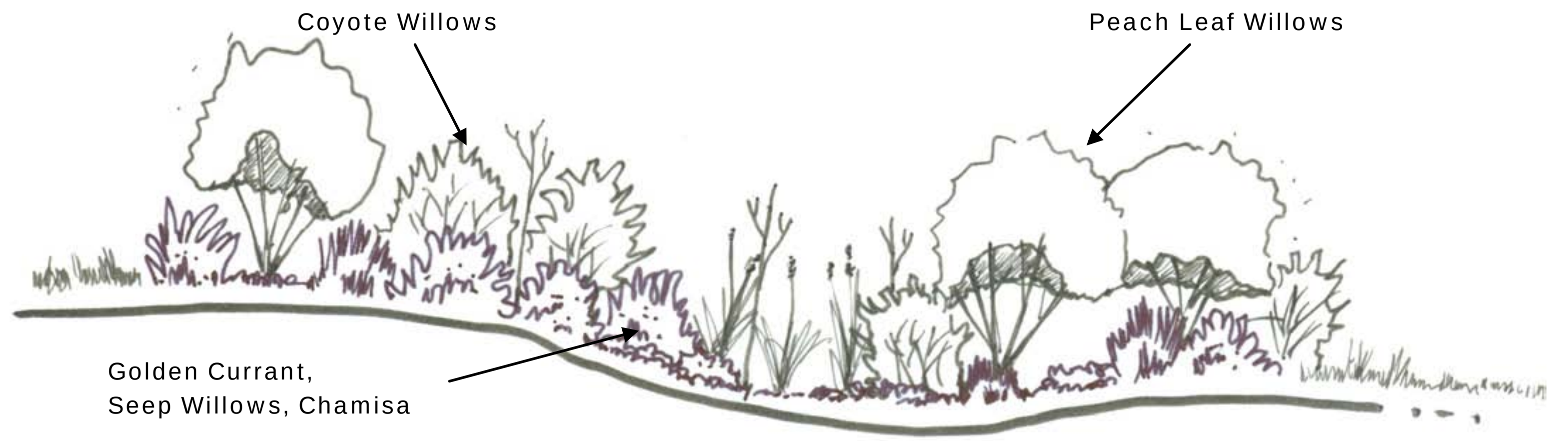


Figure 10. Schematic Design of a shrub community

Water Features

Establishment of healthy stands of cottonwoods and other native species requires water, preferably in the form of flooding for brief periods of time, or until the roots are mature enough to reach essential fluids and nutrients on their own. The purposes of the water-related features described in this section are to attempt to mimic natural periods of inundation in specific areas under certain conditions. This would create a hospitable environment for propagation of native vegetation and produce wetted areas that would increase the diversity of habitat types.

There are a number of water features that were considered and will be discussed below. These include wetland restoration, bank terracing, construction of high flow channels, and construction of willow swales.

Wetland Restoration

Wetland restoration would take place in various forms of habitat. Wetland restoration would focus on development of *open water wetlands*, *wetlands* utilizing storm drain outfall areas, *marsh wetlands,* or *wet meadows*. Wetland features were considered in all reaches of the Proposed Action Area.

An *open water wetland* would be similar to that constructed at the Albuquerque Biological Park Wetland (Figure 11). Such wetlands provide open water habitat for migrating and local waterfowl and aquatic habitat for numerous species.

Figure 11. Albuquerque Biological Park Wetlands, October 2005

Wetland habitat utilizing and restructuring drainage outfalls would be constructed/enhanced in areas where storm water outfalls exist but currently do not create or utilize the potential to create habitat. Some simple modifications to existing outfalls would provide several benefits. The design would focus on connecting the outfall through the bosque to the river, providing wetland and/or moist soil habitat along the way. Each area would be designed differently depending on the outfall size. This would create linear wetland habitat with vegetation along the sides that could create additional habitat for various songbirds, small mammals, amphibians, reptiles, and fish species.

A *marsh wetland* would have fluctuating water levels (usually 1-5 feet) and various vegetative species. These areas can be created by lowering the ground level and/or creating a connection with surface water flows (such as the example shown in Figure 12, where water from Lea Lake travels through a channel into the wetland area at the Bottomless Lakes State Park near Roswell, NM).

Figure 12. Bottomless Lakes State Park wetlands, August 2008

A *wet meadow* habitat is similar to a marsh wetland, but has much shallower standing water, and is created by allowing flow from a deeper wetland area (such as an open water wetland) flow out into an existing dry area or by lowering an area to the shallow groundwater table. This creates marshy or moist soil habitat, usually only about 6 inches deep with water. An example of a wet meadow exists at the Albuquerque Biological Park Wetland shown below (Figure 13).

Figure 13. Albuquerque Biological Park Wetlands Wet Meadow, May 2007

Bank Terracing

Bank terracing or bank lowering involves the removal of vegetation and excavation of soils adjacent to the main channel to enhance the potential for overbank flooding (Tetra Tech, 2004). This technique (Figure 14) has been utilized in various locations of the Middle Rio Grande, mostly for creation of potential habitat for the Rio Grande silvery minnow by the Middle Rio Grande Endangered Species Collaborative Program (MRGESCP). As the banks are destabilized, it creates a greater connection with the river. As the river moves through these areas, it both scours and creates most soil for vegetation. In many cases, coyote willow will fill in these areas creating riparian shrub habitat that provides habitat for birds, small mammals and herpetofauna. The opportunity to devegetate and destabilize banks would restore this habitat, facilitate overbank flows and provide sediment for the natural geomorphic system. Bank terracing has the potential to restore this habitat, facilitate overbank flows and provide sediment for the natural geomorphic system. This potential expansion into the floodplain could have benefits to aquatic and terrestrial species. An example of an area that was destabilized in this fashion (as part of an MRGESCP project implemented by the New Mexico Interstate Stream Commission) is shown in Figure 15. Various locations were analyzed for bank terracing potential.

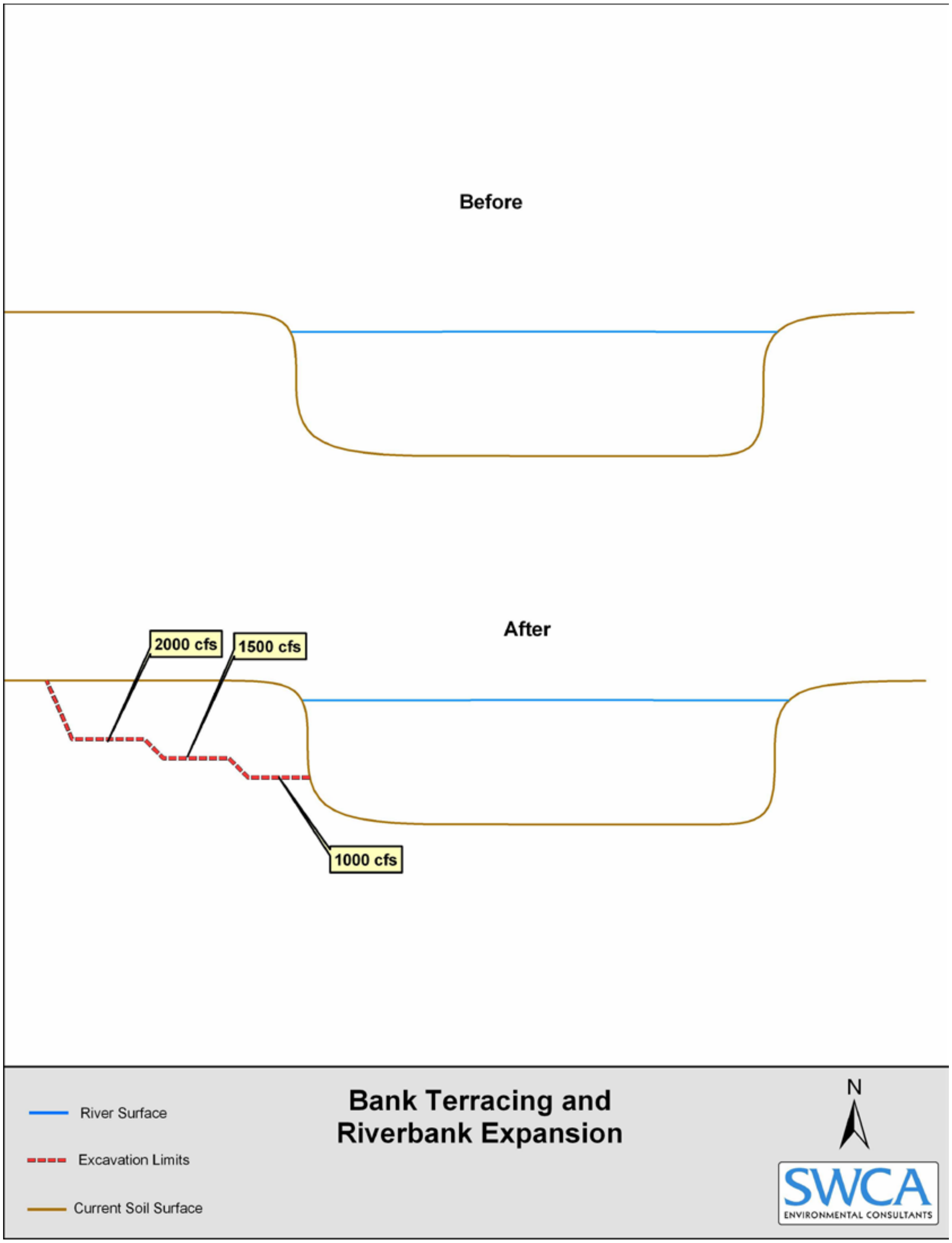


Figure 14. Schematic of bank terracing (SWCA, 2006)

Figure 15. Bank terracing at Tingley Bar

High-Flow Channels/Backwater Channels

Under historic flood flow regimes, high-flow channels were once an integral part of the river form and function. Evidence of former channels is present in many locations within the Proposed Action Area. The objective of this measure is to re-establish the connections between the river and the bosque by creating a situation in which side channels would become inundated at flows between 2,500 – 3,500 cfs. Actions necessary for this feature typically include dredging the sediment out of the upstream and downstream portions of the remnant high-flow channels in order to re-establish the bosque-river connection, clearing out debris and non-native plants and revegetating with native plants to increase the habitat quality within the bosque. High-flow channels would deliver much-needed water to bosque vegetation and increase potential water-based habitats for animals. Scallops and backwater channels would be constructed as part of or within the high-flow channels when possible. The Rio Grande Nature Center Habitat Restoration Project is an example of a recent high-flow channel feature (Figure 16).

Figure 16. South end of Rio Grande Nature Center high flow channel exiting to river

Figure 17 is a schematic design and provides a conceptual cross-section design of a typical high-flow channel. The figure also provides some generic information about the revegetation plan for these measures. Appropriate sediment removal regimes, crossings where necessary for fire and restricted access issues would need to be determined during design development.

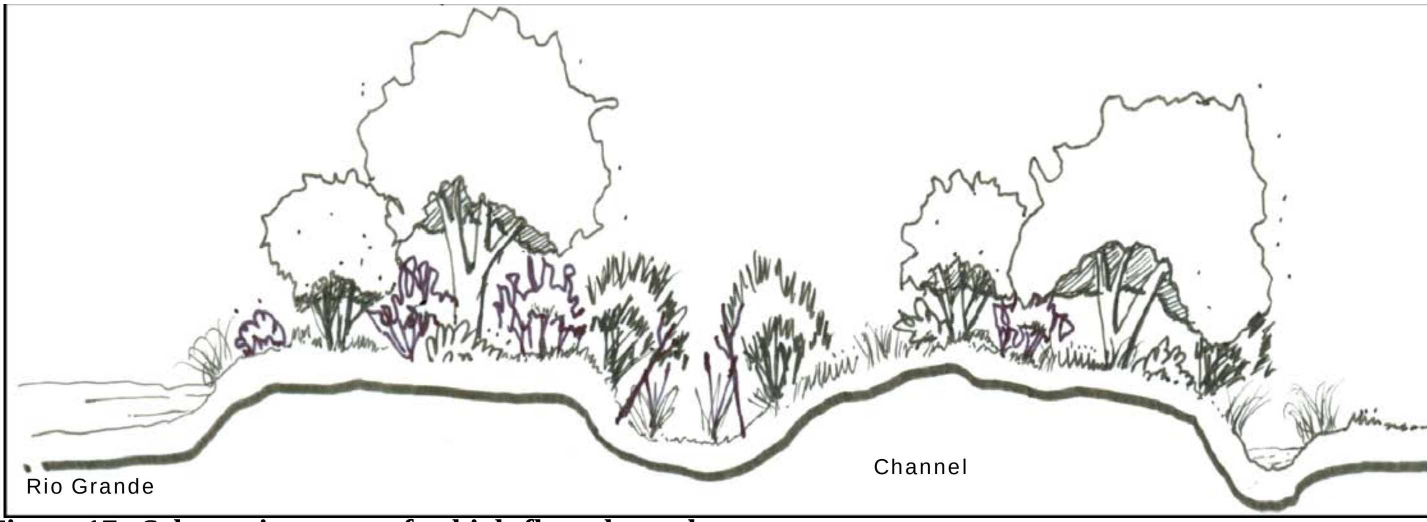


Figure 17. Schematic concept for high-flow channels

For the construction of bankline terracing, high flow channels and/or backwaters, an earthen dam (the last 1-3 feet of the bank) are left in place during construction. No material extends into the river. This last piece of bank is removed last in order to limit inputs of sediment as well as other potential impacts to silvery minnow. The area of disturbance in wetted habitat that may be occupied by silvery minnow is limited to the inlet and outlet of each high flow channel. Each of those areas is approximately 10 by 150 ft in dimension; thus, construction disturbance associated with each high flow channel is approximately 3,000 ft^2 or (0.07 acre). This is further described below under Project Implementation.

Willow Swales

The willow swale feature entails optimizing the depressions created by removal of non-native vegetation, dumped debris and jetty jacks to provide microenvironments in which native plants can thrive due to the decreased distance to the water table and moist soils. In certain areas of the bosque, the depth-to-water table is minimal and even slight excavations expose water. Willow swales also help create vegetative habitat where establishment of native plants or seed would be challenging due to soil type or depth to groundwater. Depending upon the location, there could be a series of willow swales that become progressively drier with increasing distance from the river or water table. Once established, native plants would thrive in these depressions. The established swales at the Zoo Burn area, I-40, and the Brown Burn are good examples of this strategy (Figure 18). This feature would create both wet meadow and shrub habitat.

Figure 18. Willow swale at the Brown Burn, South of Rio Bravo Blvd.

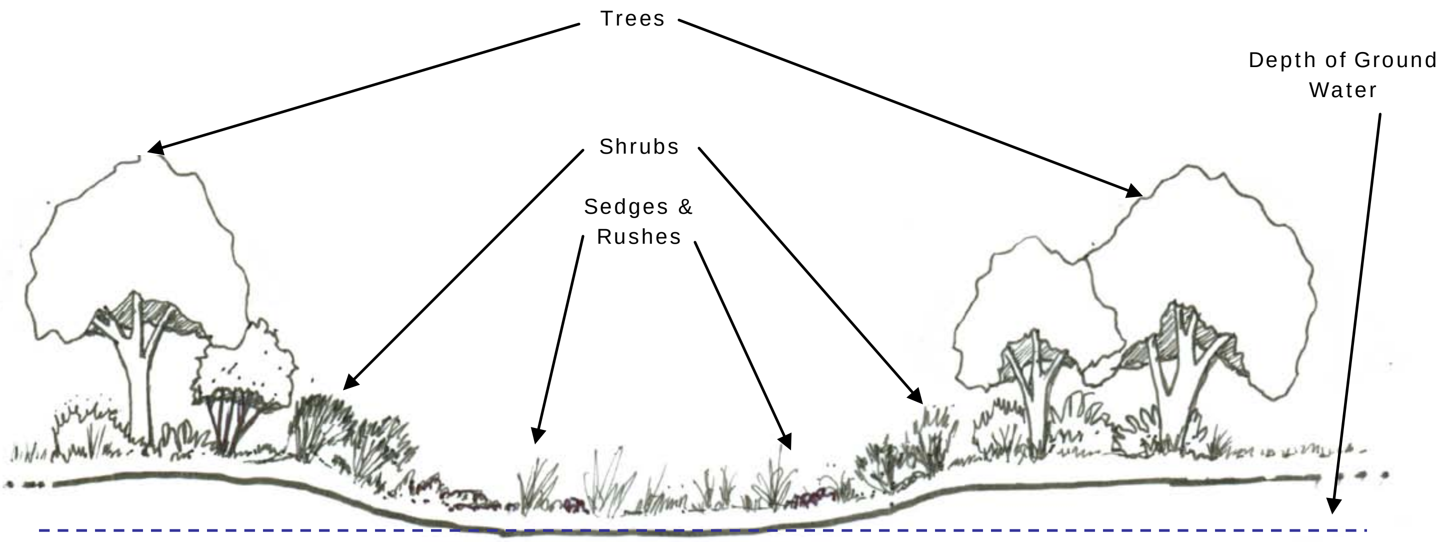


Figure 19. Schematic concept of willow swale

Figure 19 is a schematic design for a swale including a conceptual cross-section. The figure also provides some generic information about the revegetation plan for these measures. A series of depressions, approximately a half acre in size, would be created within a 5 to 10 acre area. The number of depressions within each swale would be determined by site-specific conditions.

Project Implementation

Due to the scope of the project and anticipated availability of funding, it is estimated that implementation of the Proposed Action would take place over a period of three to five years. The Proposed Action would be phased to make the most efficient use of available funds, and to phase tasks that require sequential implementation. Whereas bank terracing and high-flow channel building at any one action area can be accomplished in a relatively short time (a few months), for example, this activity would only take place at one or two areas at a time to minimize impacts to water quality. Removal of non-native species and revegetation with natives is, generally, a multiple year effort. Once initial removal takes place, follow-up treatment is required 6 months to a year later to eliminate trees that resprout from roots or stumps. Planting of native species is not prudent until such follow-up treatments have been performed. In some areas, removal of non-native species, or jetty jacks, would also be required to allow access to construct other features.

Access to all work areas would occur along the levee, and staging would occur in adjacent open areas made available by the sponsor, MRGCD. Staging could also take place within the bosque if other areas are not available. Additional access and subsidiary staging areas required to facilitate construction activities would be coordinated with local land managers.

Construction of all features would be scheduled during the typical low flow seasons on the MRG (Fall and Winter). Exotic species/fuel load reduction would take place first, followed by construction of water features. Recreation features would come last. Water features would be constructed within the bosque, and only later connected to the river to reduce sediment inputs into the river. If active flows continue adjacent to the inlet/outlet of given water features (for example the high flow channels), said active flows may need to be diverted with a port-a-dam or similar device. Active flows may need to be diverted temporarily with a port-a-dam or similar device during construction of water features. Excess soil generated by the construction of these features would be used for the construction of access ramps and turn-arounds off of the levee. Any remaining material would be made available to local management agencies (MRGCD, USBR and OSD) for their use. Material would be hauled to local areas for use, or stockpiled at their facilities for future use. Best Management Practices (BMPs) would be employed throughout the project to protect natural and cultural resources. Specific BMPs are discussed in Section 4.

Project Costs

The Total Project Cost estimate below includes the design and implementation phases (Table 3).

Table 3. Project Costs

Phase	Total Cost
Construction of Restoration Features	$22,890,200
Construction of Recreation Facilities	$1,918,800
TOTAL	$24,809,000

Note: Costs for the alternatives were based on historical costs of similar and like projects and include a contingency of approximately 20 percent

Monitoring, Adaptive Management and Maintenance

Recent Corps 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:

> *(1) 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*
> *(2) specify that the monitoring shall continue until such time as the Secretary 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, as performance feedback may generate new insights on ecosystem response and provides 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 pre-project conditions.

Monitoring also provides the feedback needed to establish protocols and make adjustments where and when necessary to achieve the desired results. Monitoring of the Corps' Bosque Wildfire and Albuquerque Biological Park Wetlands projects (described in Section 4.21 below) has provided information that has been useful in developing goals and alternatives for this project. Monitoring from those projects will also aid in design.

Project specific monitoring would be performed before and after construction (see See Appendix F for the complete Monitoring and Adaptive Management Plan). Monitoring would be used to guide adaptive management of proposed projects and to guide future restoration designs.

3.0 The Affected Environment and Foreseeable Effects of the No-Action Alternative

This section discusses conditions of pertinent resources that would likely be affected if No Action is implemented under the Middle Rio Grande Bosque Restoration Project.

3.1 Physiography, Geology, Soils

The MRG is a wide floodplain of fertile bottomland (USDA 1977). These fertile soils and shallow water tables support vegetation as well as a variety of resident and migratory wildlife. The RGV is a productive agricultural area that contributes to the quality of life and economies of the urban areas of Albuquerque, Corrales, and Bernalillo, New Mexico, as well as several other smaller communities. The Rio Grande follows a well-defined geologic feature called the Rio Grande graben. The Rio Grande graben contains several thousand feet of poorly consolidated sediment of the Santa Fe Group of middle Miocene to Pleistocene age.

The terrain in the area is characterized by gently sloping plains to the West with abrupt drop forming a mesa or bluff overlooking the floodplain. To the East the Sandia and Manzano Mountains run parallel to the river with a peak elevation of 10, 447 ft and foothills at 6,400 ft. From the foothills the alluvial plain drops nearly 1,400 ft over 5 to 10 miles to the Rio Grande floodplain. The general soil conditions in the floodplain are deep, nearly level, well-drained soils that are formed in recent alluvium of the Rio Grande. Water tables in the floodplain are typically four to five feet in depth and permeability is moderate (USDA 1977).

There would be no change to physiography, geology, or soils under the No Action Alterative.

3.2 Climate

Climate in the MRG is classified as semi-arid. The average maximum temperature is 70ºF and the average minimum temperature is 44ºF. The average annual precipitation is 7.88 inches. Summer is the rainy season. Half of the annual precipitation falls during the period July to October, typically as brief summer rain storms. The snow season in the Albuquerque area generally extends from November to early in April, but snow seldom stays on the ground for more than one day. The average frost-free season at Albuquerque is 190 days, from mid-April to late in October. Relative humidity averages less than 50 percent and generally less than 20 percent on hot sunny afternoons. Winds blow most frequently from the north in winter, and from the south along the river valley in summer. Wind speed averages nearly nine miles per hour for the year.

Climate Change

Warming temperatures have already produced observable changes in the hydrologic cycle and sea level. Impacts of warming temperatures are already evident: (1) reservoir management in regions such as the mountainous West where snow pack is an important form of water storage and which 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. There is a potential for severe droughts and increasing flood risks in the future.

It is difficult to predict or quantify the effects of various possible climate change conditions. 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 in to our understanding of the effects of climate change on water resources, including quantity and quality, and in evaluating associated uncertainties and risks required for more informed decision making.

While good evidence exists to support the occurrence of climate change, study of how the change might affect this region and the study area of the MRG has been limited. However, some references exist. A study was performed by Hurd and Coonrod 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 Bosque ecosystem would continue. 'Under severe climate change scenarios, runoff could be reduced by 30%' (Hurd and Coonrod, 2007). Therefore, the river and the Bosque are expected to remain disconnected. For the Future Without Project, measures to reconnect the Bosque and the river would not be developed and the floodway would remain disconnected. Because climate change is unpredictable with unknown direct effects, no evidence currently exists to suggest a change in the current trend toward a Bosque of declining quality.

3.3 Hydrology, Hydraulics and Geomorphology

3.3.1 Hydrology

The river morphology of the MRG was once that of a wide, shallow braided channel characterized by high sediment loads and frequent flood events (USACE 2003). The channel over the last several hundred years has moved across or flooded in its entirety what is now the 500-year flood zone. Today, the Rio Grande in the Albuquerque area is no longer a braided channel nor is the river able to meander across the original floodplain.

Intensive grazing and logging in the watershed of the Rio Grande increased sediment input into the stream and by 1850 the rate of channel aggradation began to accelerate (Scurlock, 1998). By the early 1900s, concurrent with increased water diversions, aggradation of the river bed resulted in channel widening and formation of large mid-channel bars that were colonized by cottonwood (Scurlock, 1998). It is likely that increased sediment supply caused a major shift in channel morphology and large-scale channel instability (*cf.* Schumm and Meyer, 1979). Flooding increased in frequency and magnitude due to changes in watershed runoff characteristics (Scurlock, 1998). Changes in channel alignment and rapid bank erosion occurred during flood stage because of the aggraded channel and lack of riparian vegetation, which rendered stream banks susceptible to accelerated rates of erosion (Scurlock, 1998). Aggradation in the

Albuquerque reach of the Rio Grande was at a maximum rate of about 2 ft/50 yrs (0.6 m/50 yrs) prior to construction of dams in the drainage basin (Lagasse, 1981). A 1922 U.S. Reclamation Service map of the project area shows extensive sand bars and a paucity of riparian vegetation, much of which is noted as “brush”, with very little indication of cottonwood forest.

The MRG hydrology has been altered dramatically by flood control dams. Historic annual peak discharges have changed from peak flows of over 20,000 cubic feet per second (cfs) prior to World War II to peak flows of less than 10,000 cfs after the construction of Cochiti Dam in 1973. The post Cochiti average annual peak discharge has been affected as well and would be discussed in more detail later in this text.

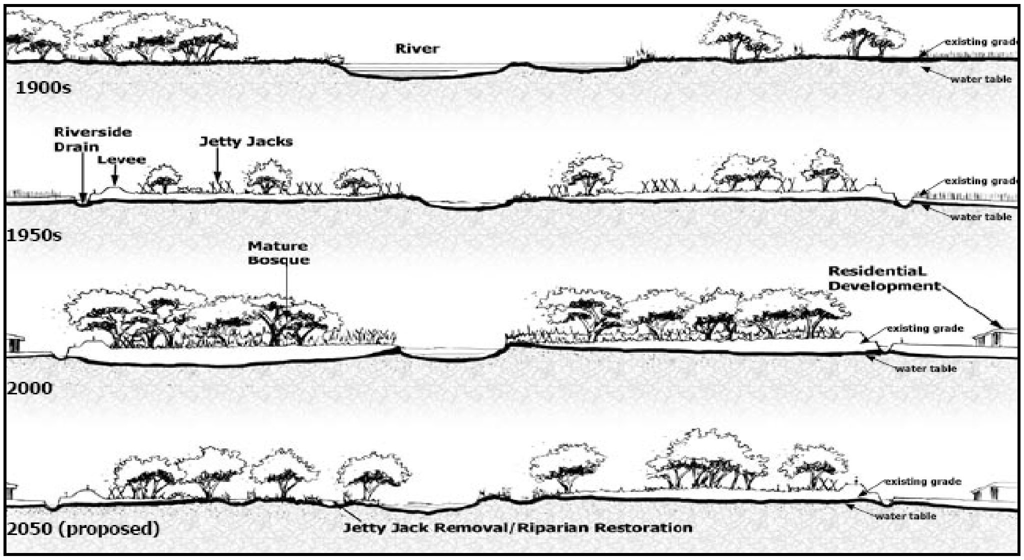


Figure 20. Flood protection projects (e.g., levees, riverside drains and jetty jacks) have reduced the Rio Grande’s original floodplain to fraction of its size in the Proposed Action Area (USACE 2003a).

The change in seasonal discharges has also impacted channel-forming processes. Discharge is the dominant variable that affects channel morphology, but sediment transport, channel bed & bank material and other hydraulic factors are also important influences. Historically, the wide shallow channel was described as a sand-bed stream (Nordin and Beverage 1965) with a braided pattern (Lane and Borland 1953) likely resulting from sediment overload (Woodson 1961). The river followed a pattern of scouring and filling during floods and was in an aggrading regime (accumulating sediment). Flood hazards associated with the aggrading riverbed prompted the building of levees along the floodway. However, the levee system confined the sediment and increased the rate of aggradation in the floodway. Additionally, channel stabilization works which included jetty jacks installed during the 1950s and 1960s contributed to building up and stabilizing the over-bank areas where the bosque currently exists. Construction of dams at Jemez Canyon (1953), Abiquiu (1963), Galisteo Creek (1970), and Cochiti (1973) were expected to slow aggradation or reverse the trend and promote degradation in the MRG. The flood control improvements have reduced the sediment load in the MRG and accomplished flood control purpose and needs for much of the river valley. This has caused changes in the geomorphology of the Rio Grande through the Albuquerque reach and affected the conveyance capacity of the active river channel. The result of these changes has been a reduction in the frequency of over-banking flows into the Rio Grande bosque.

The Rio Grande is now confined as a result of the many water resource activities previously described and by the construction of the Albuquerque Levees Projects built in the mid 1950's and the Corrales Levee Project built in 1996. The average width of the floodway area between the levees is 1,500 ft (457 m; Lagasse, 1981), compared to a historic floodplain width in the project area of about 13,120 ft (4,000 m; U.S. Reclamation Service topographic map, 1922).

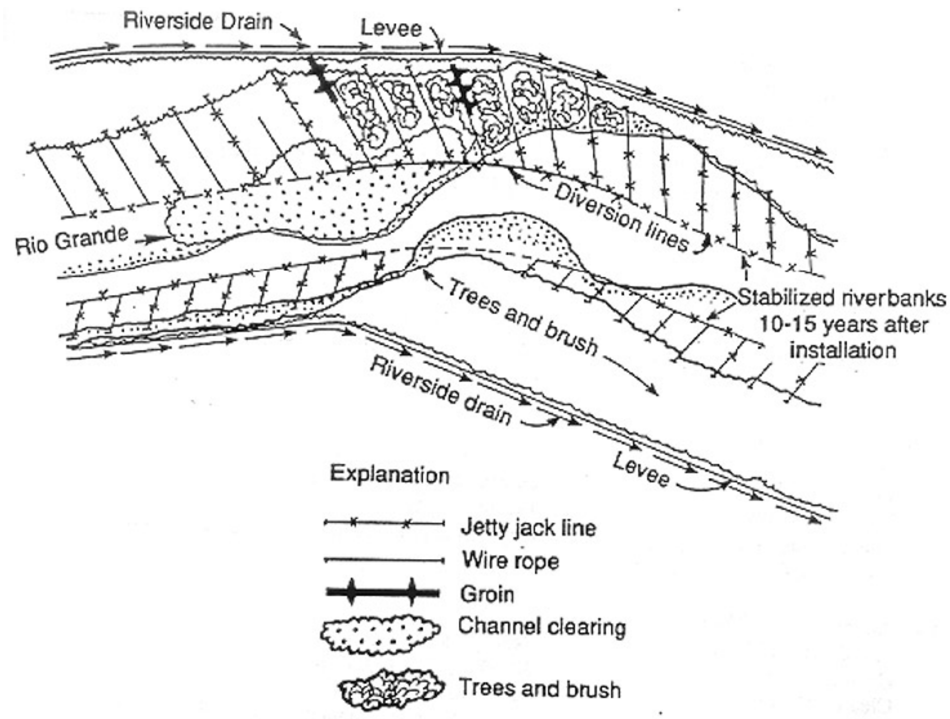


Figure 21. Alterations to the Rio Grande channel and the bosque

Cochiti Dam began regulating flow on the Rio Grande in 1974. The following page (Table 4) gives a comparison of daily average peak flow for the "Rio Grande at Albuquerque" gage versus unregulated daily average peak flows for Albuquerque given in the HEC Report. Only floods generated by snowmelt and rainfall upstream of the reservoirs were included in this comparison. All flows are given in cubic feet per second (cfs).

Table 4. Comparison of Daily Average Peak Flows for the Gage at Albuquerque

Year	Daily Average Peak Flow (in cfs)	Unregulated Daily Average Peak Flow (in cfs)
1975	5800	8848
1976	3170	4103
1978	4320	5528
1979	7870	15873
1980	7130	11023
1982	4620	6680
1983	6970	11965
1984	8260	13433
1985	8650	16503
1986	4490	8052
1987	5990	10881
1989	3670	4798
1992	5360	7916
1993	6960	10314
1994	5230	10070
1995	6370	9413
1997	5430	8171
1998	3940	4708
1999	4520	6018
2001	4730	5528

Table 4 indicates that were it not for the regulation of upstream flows, the Rio Grande at the Albuquerque gage would have experienced spring flows of 10,000 cfs or greater a total of eight (8) times between 1975 and 2001. This is consistent with the pre-Cochiti Dam flow record which shows that from 1942 to 1973 spring flows reached or exceeded 10,000 cfs a total of seven (7) times at the Albuquerque gage. The gage record shows that flows of 10,000 cfs or greater were never reached at the Albuquerque gage during the post-Cochiti Dam period (1974 to present). The results of the HEC Report show that flow releases from Cochiti Dam can be regulated to 7,000 cfs for flows generated by snowmelt and rainfall upstream of the reservoirs for any event up to the 200 year frequency event. In the 200 year frequency event the HEC Report predicts a spillway flow resulting in a total combined discharge of 10,000 cfs.

For comparative purposes, Figure 22, below shows the 1987 hydrograph taken from the gage record. This hydrograph was selected because were it not for the effects of regulated flow from Cochiti Dam, this hydrograph would have reached a peak flow of 10,881 cfs resulting in widespread overbank flows at Albuquerque.

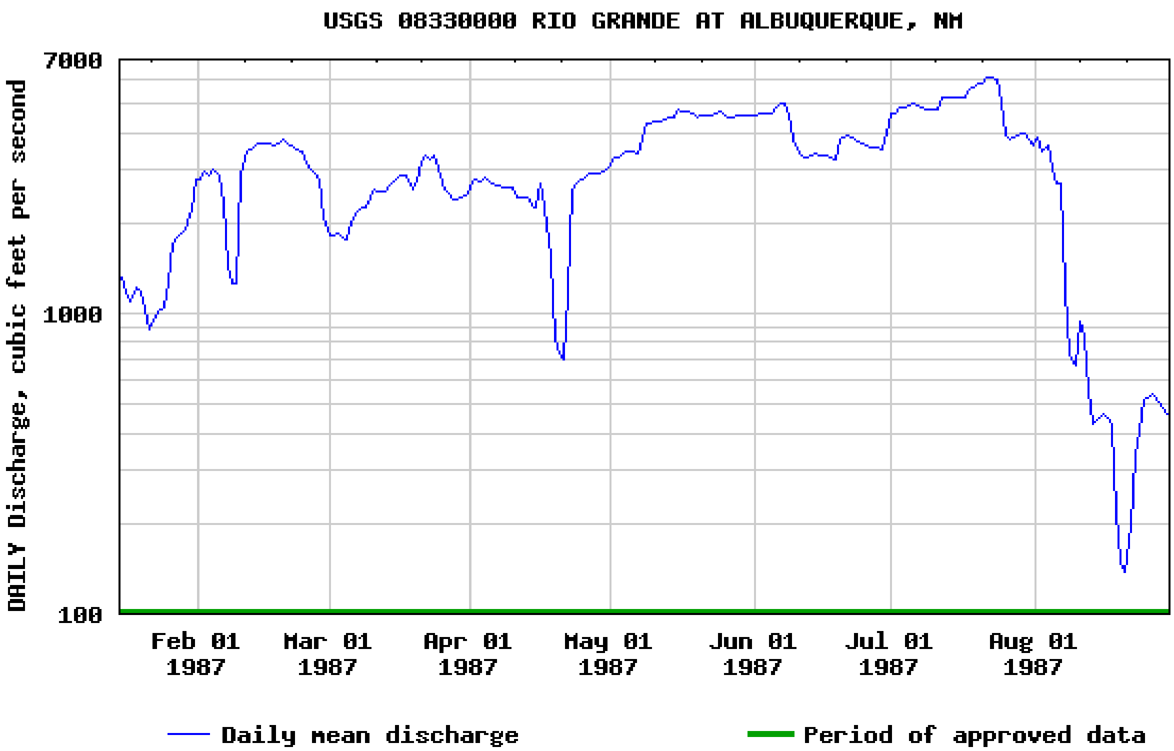


Figure 22. 1987 Hydrograph for USGS Gage at Albuquerque

However, from the FLO-2D analysis, as described in the following section, it is unlikely that significant overbank flow would be experienced if the 1987 hydrograph were to occur under the existing conditions. In fact, the spring 2005 hydrograph was similar in peak flow and resulted in relatively limited overbank flows. The 2005 hydrograph is shown below in Figure 23.

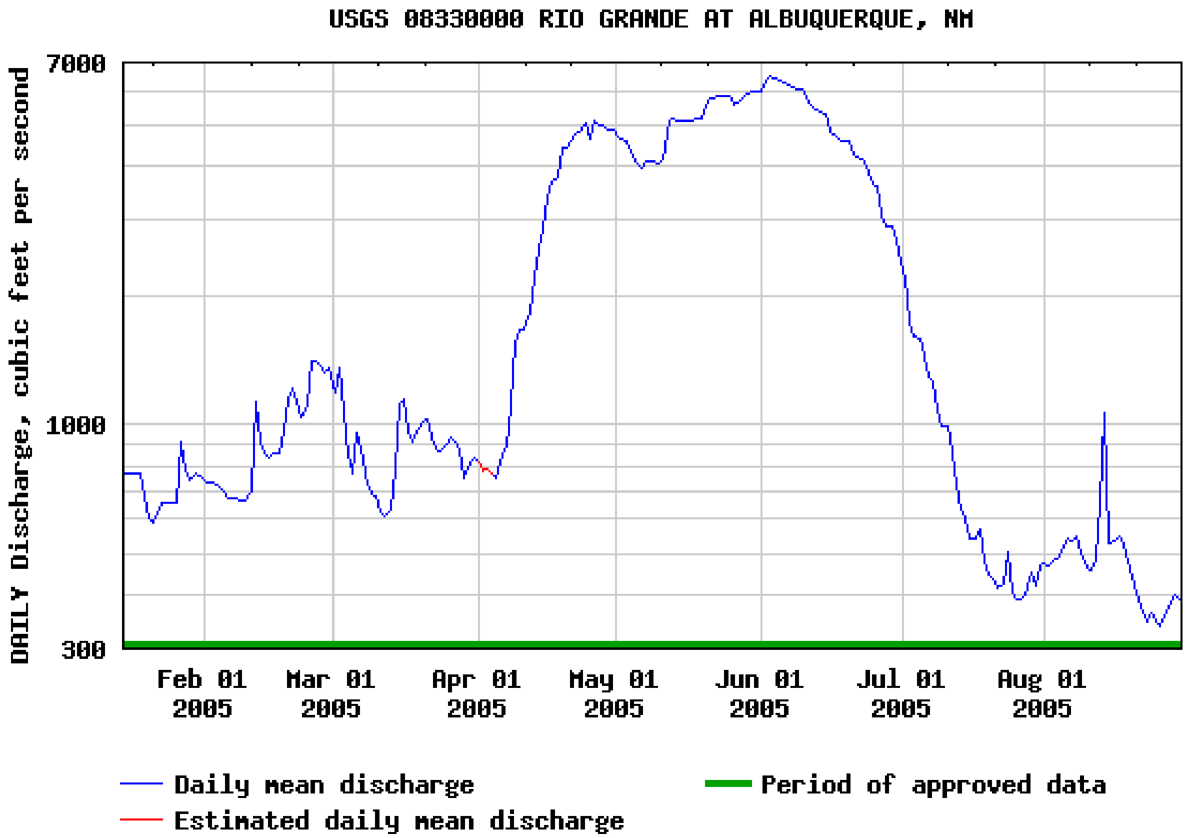


Figure 23. 2005 Hydrograph for USGS Gage at Albuquerque

According to Table 4 above, the unregulated flow for 1987 would have been 10,881 cfs. This would perhaps be comparable to the 1949 hydrograph with a peak daily flow of 10,556 cfs. This flow rate could cause widespread overbank flows through the Rio Grande bosque under existing conditions based on the results from the FLO-2D analysis. The 1949 hydrograph is shown in Figure 24, below:

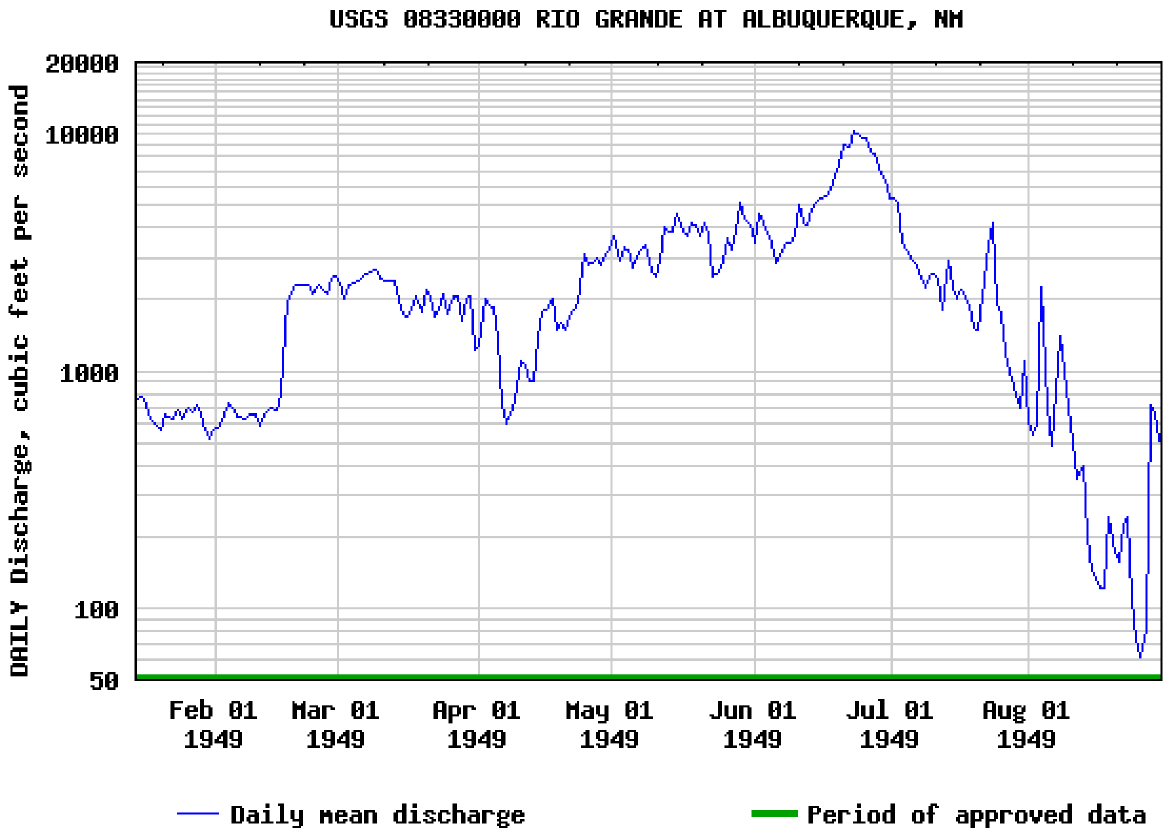


Figure 24. 1949 Hydrograph for USGS Gage at Albuquerque

When the results of the HEC Report are combined with the results of the FLO-2D analysis, evidence is provided that watershed regulation has significantly reduced overbank flows throughout the Proposed Action Area. This is also consistent with observations made during recently occurring high flow events through the Proposed Action Area.

FLO-2D modeling was conducted using the 250-foot grid to evaluate the depth, extent and duration of overbank inundation for the "No Action Plan". This analysis was conducted for initial channel conditions (Year 0) and for future channel conditions to evaluate the effects of aggradation or degradation on overbank inundation 5, 20, 30 and 50 years into the future. Results from this analysis provide baseline conditions for comparison with the restoration alternatives investigated.

Four hydrologic events (or Hydrologic Scenarios) were modeled to evaluate baseline conditions and other project alternatives (Table 5). Hydrologic Scenarios 1 and 2 are modeled for Year 0 and all future conditions whereas Hydrologic Scenarios 3 and 4 were modeled for Year 0 only. Hydrologic Scenario 3, the 10,000 cfs high flow hydrograph was only modeled for the purpose of determining the effect of a high flow release through the project area under existing conditions.

Table 5	**Summary of Hydrologic Scenarios.**	
Hydrologic Scenario	Description	Peak Discharge (cfs)
1	Active channel-full flow	6,000
2	Post-Cochiti annual spring hydrograph	3,770
3	10,000 cfs post-Cochiti hydrograph	10,000
4	100-year snowmelt post-Cochiti hydrograph	7,750

3.3.2 Geomorphology

To reflect future channel conditions in the project reach, changes in the channel cross sections associated with aggradation/degradation 5, 20, 30 and 50 years after project implementation were estimated using a HEC-6T model of the reach (MEI, 2007). The calibrated HEC-6T model was completed after the baseline conditions channel stability analysis was conducted. It was used to predict the amount of aggradation/degradation because it is considered a more appropriate model for predicting aggradation/degradation and because of its much shorter computation times compared to FLO-2D.

To facilitate the modeling, a 50-year mean-daily flow record was developed based on flow records at the Central Avenue Gage at Albuquerque for the post-Cochiti Dam period. Since the post-Cochiti Dam period of record includes only 30 years of record (WY1974 to WY2004), the additional 20 years of data were developed by repeating the record for WY1985 to WY2004. This period was selected for the extended period because the average mean daily flow was very similar to the longer-term, post-Cochiti average mean daily flow (1,349 cfs for the period from WY1985-WY2004 versus 1,340 cfs for the entire 30-year period).

The HEC-6T model was run over the entire 50-year period, and cross-sectional geometry at 5, 20, 30, and 50 years was evaluated to determine aggradation/degradation changes throughout the reach. Because of the uncertainty in how each specific cross section would change as the aggradation or degradation occurs, the model results were used to estimate a representative change in cross-sectional depth within each segment of the reach that exhibits consistent aggradation/degradation trends based on the detailed model results. Figures 20 and 21 show the predicted change in cross-sectional area from the model results and the assigned representative changes in channel depths for the 5- and 50-year conditions. The HEC-6T analysis indicates that both aggradational and degradational trends occur along the reach in Year 5. Over time, the aggradational areas shown in Year 5 change to stable or slightly degradational at Years 20 and 30, and there is a slight degradational trend along the entire project reach over the 50-year simulation. The manner in which the individual cross sections in the FLO-2D model were adjusted to the representative changes in channel depths for each of the indicated time periods is illustrated in Figure 25.

The results presented above agree with the previous sediment-continuity analysis performed for the baseline conditions. Results from that sediment-continuity analysis indicated a slight net degradational tendency for the overall study reach for all of the individual storm hydrographs

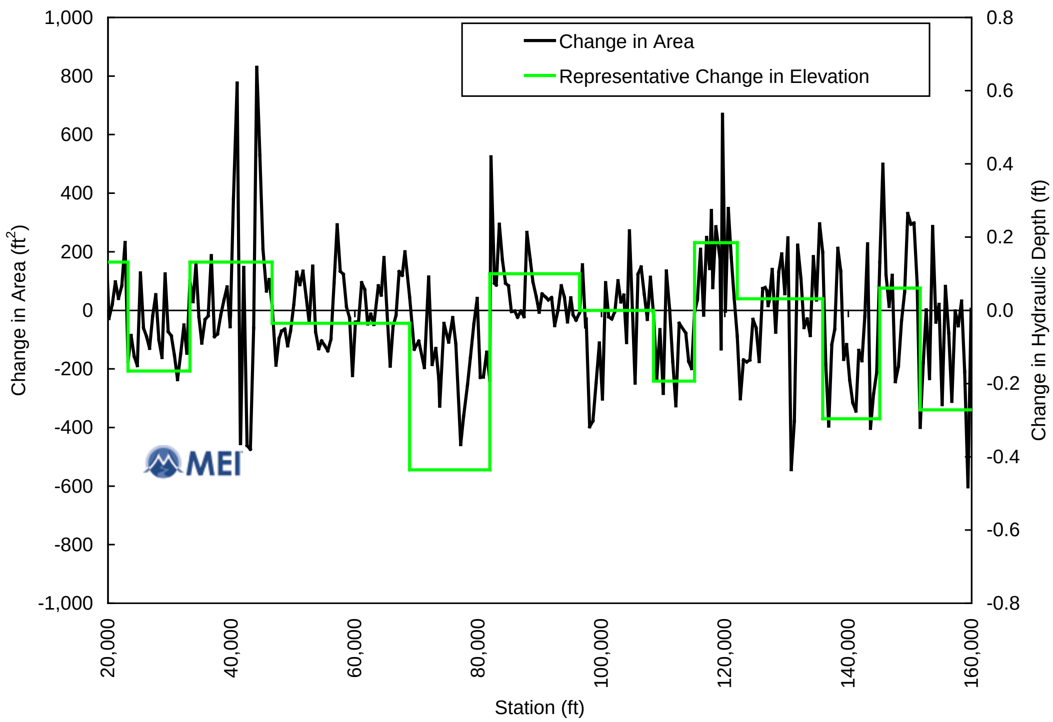


Figure 25. Predicted change in channel cross-sectional area at Year 5 and representative change in channel elevation.

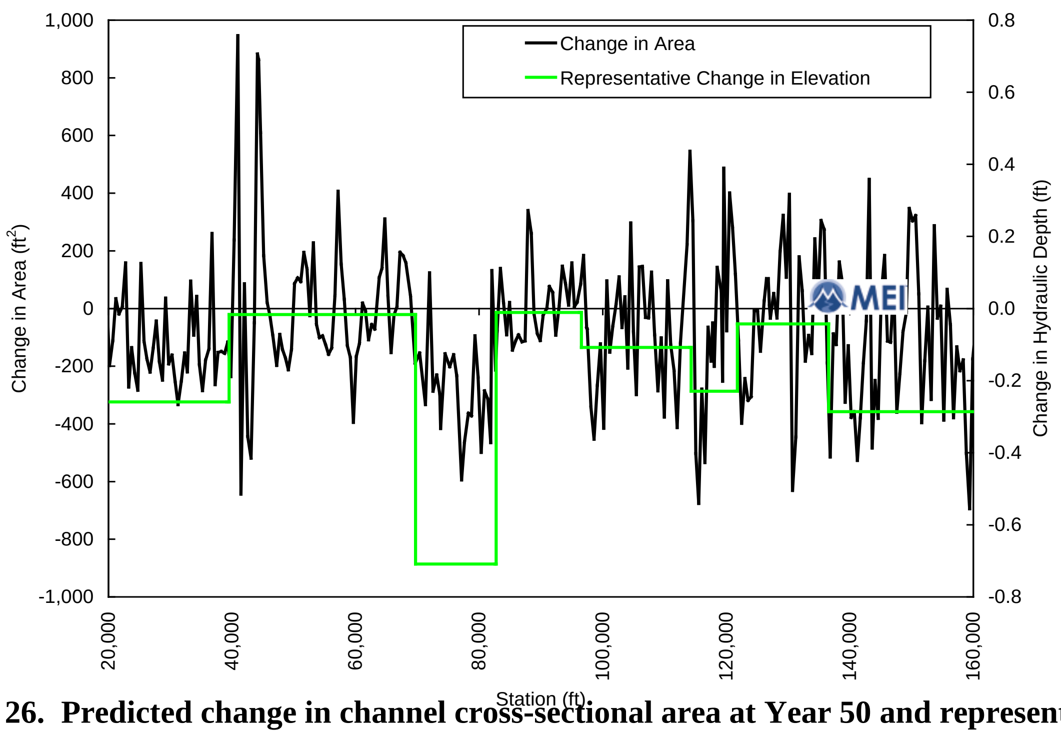


Figure 26. Predicted change in channel cross-sectional area at Year 50 and representative change in channel elevation.

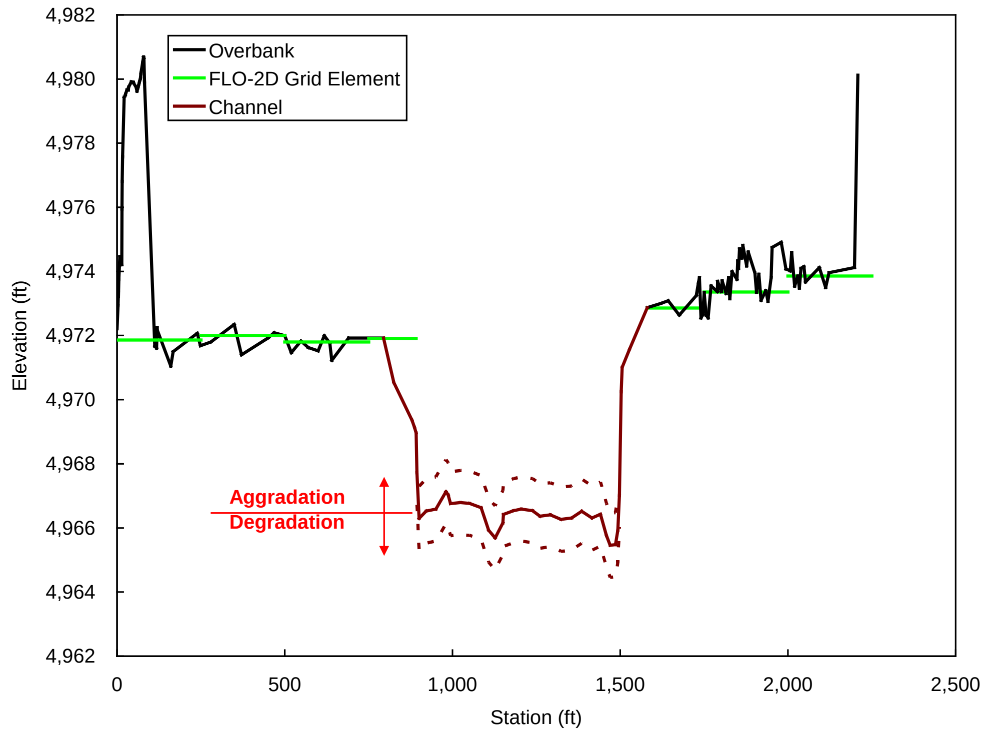


Figure 27. Schematic representation of development of the FLO-2D channel cross-sectional geometry for the 5-, 20-, 30-, and 50-year scenarios by applying the representative elevation change.

that were analyzed. Therefore, it could be surmised that in the absence of any restoration efforts, the occurrence of overbanking would continue to be infrequent for the future No Action condition.

The amount of overbank inundation predicted by the FLO-2D model for each simulation under the "No Action Plan" was estimated for each subreach based on the number of inundated grid elements (Table 6). The following sections summarize the results of these simulations.

Table 6. Summary of areas of inundation for Existing Conditions and No Action (Years 0, 5, 20, 30 and 50) (acres).								
Hydrology Scenario	Description	Future Channel Condition (year)	Reach					
			1	2	3	4	5	Total
	Channel Full Conditions	0	77.2	41.3	25.2	34.4	75.6	253.7
		5	78.0	41.1	23.9	34.0	74.0	251.0
		20	76.7	40.9	23.5	32.0	73.5	246.6
		30	76.7	40.7	23.3	32.0	74.6	247.3
1		50	75.9	40.7	23.7	30.0	73.6	243.9
	Annual Spring Runoff	0	45.2	23.1	7.7	4.0	7.9	87.9
		5	45.2	23.0	7.9	4.0	8.0	88.1
		20	43.6	22.1	8.3	6.7	5.7	86.4
		30	43.9	22.8	7.9	7.0	6.3	87.9
2		50	43.2	22.3	7.9	6.8	6.1	86.3
3	10,000 cfs Hydrograph	0	181.9	125.6	82.2	233.7	412.9	1036.3
4	100-Year Peak Snowmelt	0	84.4	59.9	14.6	133.4	364.9	657.2

3.3.2.1 Channel Full Conditions

The channel-full flow simulations (6,000 cfs) indicate that the area of overbank inundation would decrease slightly in Subreaches 1 through 5 in “No Action” compared to existing conditions (Table 5). Approximately 75.9 acres, 40.7 acres, 23.7 acres, 30 acres and 73.6 acres are inundated in Subreaches 1 through 5, respectively, in Year 50 as compared to 77.2 acres, 41.3 acres, 25.2 acres, 34.4 acres and 75.6 acres inundated in Subreaches 1 through 5, respectively for the Year 0 condition. The extent and maximum depth of inundation for this scenario are shown in the Hydrology & Hydraulics Appendix of the Feasibility Study Report.

3.3.2.2 Average Annual Flow Hydrograph

The average annual flow simulations indicate that the area of overbank inundation would increase slightly in Subreaches 3 & 4 and decrease slightly in Subreaches 1, 2 & 5 in “No Action” compared to existing conditions (Table 5). Approximately 43.2 acres, 22.3 acres, 7.9 acres, 6.8 acres and 6.1 acres are inundated in Subreaches 1 through 5, respectively in Year 50 as compared to 45.2 acres, 23.1 acres, 7.7 acres, 4.0 acres and 7.9 acres inundated in Subreaches 1 through 5, respectively, for the Year 0 condition. The extent, maximum depth and duration of inundation for this scenario are shown in the Hydrology & Hydraulics Appendix of the Feasibility Study Report.

3.3.2.3 10,000 cfs Hydrograph
The 10,000 cfs hydrograph was simulated for the Year 0 conditions only. This hydrology scenario was modeled for the purpose of determining the effect of a high flow release through the project area under existing conditions. Approximately 181.9 acres, 125.6 acres, 82.2 acres, 233.7 acres and 412.9 acres are inundated in Subreaches 1 through 5, respectively, for the Year 0 condition (Table 5). The extent, maximum depth and duration of inundation for this scenario are shown in the Hydrology & Hydraulics Appendix of the Feasibility Study Report.

3.3.2.4 100-Year Snowmelt Hydrograph
The 100-year snowmelt hydrograph was simulated for the Year 0 condition only. Approximately 84.4 acres, 59.9 acres, 14.6 acres, 133.4 acres and 364.9 acres are inundated in Subreaches 1 through 5, respectively, for the Year 0 condition (Table). The extent, maximum depth and duration of inundation for this scenario are shown in the Hydrology & Hydraulics Appendix of the Feasibility Study Report.

With the limiting factors of institutional / jurisdictional controls, the seasonal flow patterns and on-going channel maintenance activities are not likely to change in the future. The results presented above agree with the previous sediment-continuity analysis performed for the baseline conditions. Results from that sediment-continuity analysis indicated a slight net degradational tendency for the overall study reach for all of the individual storm hydrographs that were analyzed. Therefore, it could be surmised that in the absence of any restoration efforts, the occurrence of overbanking would continue to be infrequent for the future without project condition.

3.4 Water Depletions

The Rio Grande Compact, in effect, limits the amount of surface water that can be depleted in the Middle Rio Grande based upon the natural flow of the river measured at the Otowi gage near Los Alamos (Rio Grande Compact, 1939). In addition, the New Mexico State Engineer has determined the Middle Rio Grande to be fully appropriated. Therefore, any increase in water use in one area of the river must be offset by a reduced use in another area of the river. The State Engineer requires that increases in water use from new habitat restoration projects must be offset by purchased or leased water rights. Work performed within the river channel within the Rio Grande Floodway is exempt from this policy (NMISC, 2007). The definition of 'Floodway' in this case is a 600-foot corridor centered on the midline of the river. Therefore, water use within this 600-foot corridor is not deemed an 'increase in water use' and does not require offsetting, but increases in water depletions from any part of a habitat restoration project that falls outside of the 600-foot floodway must be offset. The New Mexico State Water Plan (Office of the State Engineer/Interstate Stream Commission, 2003) further states "State Engineer permits are required for all habitat restoration activities that result in increased depletions of water."

However, the New Mexico State Engineer “maintains that habitat restoration projects implemented by the Bureau of Reclamation, Army Corps of Engineers, or ISC in the Middle Rio Grande floodway do not require water rights permits because of those agencies’ respective flood control and compact delivery statutory roles” (NMISC, 2007).

There would be no change to Water Depletions under the No Action Alternative.

3.5 Water Quality

Under the No Action Alternative, there would be no potential improvement to water quality through the creation of wetlands (especially those that would utilize and increase water quality at storm drain outfall structures). The potential wetland and willow swale habitats would also assist with water quality that may have increased issues due to an increase in human population. Native plants could assist in removing nutrients having a negative effect on water quality due to an increase in non-point source pollution as well.

3.6 Air Quality and Noise

There would be no effect to air quality and noise under the No Action Alternative.

3.7 Aesthetics

The National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) regulations identify aesthetics on one of the elements that must be considered in determining the effects of a project. Aesthetics include the presence and appearance of landforms, water surfaces, vegetation and human created features relative to the surroundings and settings of the area. The presence of native species of plants and animals could also be evaluated as aesthetics. These features are primary characteristics of an area or project that determine visual character and the manner in which people view the setting. Aesthetics analysis considers the existing and future appearance, or perception of views, of the project site and areas surround the site, as well as viewer sensitivity.

Aesthetics of the bosque may be characterized as ranging from poor to high quality. In areas where fires have occurred and burn restoration (removal of burned and dead trees) has not been implemented, the aesthetics would be considered poor as the bare, burned ground and standing dead trees dominates the view.

In other areas, non-native vegetation has been thinned and dead material has been reduced. Some areas have been replanted with native vegetation (such as cottonwood, willow, New Mexico olive, etc.) as well. Maintenance efforts are ongoing to keep non-native vegetation to a minimum, but resprouting from roots or stumps has occurred in all areas that have been treated. In these areas, the aesthetics would generally be characterized as medium to high (Corps- ERDC 2008). The view is dominated by cottonwoods, with clear views of the river, sometimes obstructed by jetty jacks.

In areas where the bosque is functioning as a healthy ecosystem, aesthetics would be considered medium to high. The area is dominated by Cottonwoods and native understory vegetation, obstructing the view of the river.

Under the No Action Alternative, it can be expected that the Proposed Action Area would continue to deteriorate aesthetically according to both conventional scenic vista and proposed vibrant ecology standards. In addition to failing to mitigate impacts to the aesthetic experience of the bosque, increased cottonwood mortality and increased non-native populations would limit visibility and mobility and likely lead to an increase in the number of unsightly homeless encampments, dumping activities and damaging fires. Under the No Action Alternative, points for viewing the bosque and its natural features and environs would become increasingly limited. Some efforts by local agencies and other initiatives may assist in improving aesthetics, but not to the level and amount that is proposed by this project.

3.8 Vegetation Communities

Historic Conditions

Loss of conditions necessary for regeneration of native riparian plants and increasing abundance of nonnative species were identified in river systems throughout the western U.S. beginning in the mid-1970s, with main-stem impoundments typically identified as the primary factor driving alteration of ecosystem structure and function (Fenner et al., 1985; Howe and Knopf, 1991). Impoundments alter the hydrograph and reduce sediment supply in downstream reaches and cause channel incision and narrowing of the floodplain (Williams and Wolman, 1984). Installation of jetty jacks, levee construction, sediment and vegetation removal, and irrigation diversions have exacerbated these effects in the Proposed Action Area (Crawford et al., 1993). Changes wrought by impoundments and channel modifications in the Proposed Action Area have created a riparian ecosystem organized by autogenic factors, including plant succession and invasion by nonnative species, and novel allogenic factors such as fire. Conversely, the naturally functioning bosque ecosystem was structured largely by fluvial geomorphic processes (cf. Déscamps et al., 1988).

A major change in vegetation dynamics in the bosque ecosystem has been loss of meander cut-off, meander migration, and flood scour processes, which were a driving force in the dynamics of the naturally functioning system. These processes removed existing vegetation and created new sites for founding of plant communities. Sediment deposition in the project area is now restricted to several, largely ephemeral, mid-channel bars and transitory lateral bars proximal to the river. Meander cut-off and lateral meander migration no longer occur. Bare soil sites are now created primarily through mechanical disturbance or fire; typically in areas no longer subject to periodic inundation and with relatively dry soil moisture regimes.

The frequency and duration of inundation, in addition to moisture requirements for establishment and persistence, also influences the structure of riparian vegetation (Wheeler and Kapp, 1978; Kozlowski, 1984). Riparian plant species vary in their tolerance to inundation and resulting anoxic conditions (Amlin and Rood, 2001). Growth and regeneration of many riparian tree species declines with increasing hydroperiod, and permanent inundation results in eventual loss of tree cover in most riparian ecosystems (Hughes, 1990). Seedlings are particularly sensitive to inundation and tolerance of plants generally increases with age (Jones et al., 1994).

Moisture gradients are a major determinant of the distribution of riparian plant species (Weaver, 1960; Bush and Van Auken, 1984; Tanner, 1986). Soil texture affects moisture regime. Sands drain quickly and, thus, anoxic conditions occur only with high water tables or extended inundation. Fine-particle soils, which are deposited in areas of low current velocity, have high water-holding capacity and slow drainage. Fine-grained soils may accumulate at arroyo mouths on the floodplain, behind natural levees, and in oxbows (Hughes, 1990).

Soil moisture levels and depth to ground water on floodplain sites are influenced primarily by surface topography, the variation of which is created through fluvial-geomorphic processes (Malanson, 1993). The limits of riparian vegetation are controlled by depth to the water table (Hughes, 1990). Moisture in upper soil layers is a primary influence on establishment of tree species while ground water levels are important for their persistence (Dawson and Ehleringer, 1991). Soil moisture has a major influence on seed germination and seedling survival of cottonwood (Moss, 1938; Bradley and Smith, 1986; Mahoney and Rood, 1993) and willow (Taylor et al., 1999; Dixon, 2003).

Salt cedar is now a prominent colonizer of exposed, bare soil sites in the bosque (Smith et al., 2002). While individual cottonwood seedlings have a greater competitive effect relative to salt cedar seedlings under ideal soil moisture conditions (Sher et al., 2000), the competitive effect is lost under conditions of water stress (Segelquist et al., 1993) or elevated salinity (Busch and Smith, 1995). Salt cedar produces seed for several months beginning in late spring (Ware and Penfound, 1949; Horton et al., 1960) and therefore colonizes bare, moist-soil sites throughout the summer. Cottonwood, on the other hand, produces seed only for a short time in the spring and seed remains viable for only about month and a half under ideal conditions (Horton et al., 1960). The flowering and fruiting phenology of salt cedar allows seedlings to establish on and dominate open sites wetted by runoff, rainfall, or river flows during the summer, precluding the possibility for cottonwood establishment on potentially suitable sites the following spring. Salt cedar also becomes established in the understory of mature cottonwood stands in the Proposed Action Area where there is sufficient light (Crawford et al., 1996).

Russian olive is established by seed in the understory of mature cottonwood stands and also colonizes openings along the river, often forming dense stands (Hink and Ohmart, 1984; Sivinski et al., 1990). Russian olive is also shade tolerant and can survive in areas where cottonwood canopy exists. Seeds germinate in moist to dry sites and the plant sprouts readily from the root crown after damage to or removal of above-ground portions of the plant (Sivinski et al., 1990). Russian olive was present in the understory in 1981 (Hink and Ohmart, 1984) and continues to increase in the bosque in the Proposed Action Area (Sivinski et al., 1990).

Several other nonnative tree species, in addition to salt cedar and Russian olive, are at least locally common, if not abundant, in the overstory. These species are Siberian Elm, Tree of Heaven, and Russian Mulberry (*Morus alba* var. *tatarica*). All three species are shade-tolerant and readily colonize disturbed sites (Crawford et al., 1996; Sivinski et al., 1990). Siberian Elm was rare in the bosque in 1981 when it was found only at very low densities, ranging from less than 0.5 tree/acre to 3 trees/acre (Hink and Ohmart, 1984). However, Siberian Elm had become increasingly abundant by 1990 (Sivinski et al. 1990) and is now very common in the overstory. This species produces large seed crops and is ubiquitous in the project area as seedlings, saplings, and mature trees. It sprouts readily from the root crown. Siberian Elm seed will germinate under normal rainfall conditions and does not require moist or saturated soils (Sivinski et al., 1990). Tree of heaven and Russian Mulberry are more localized in their distribution in the project area than Salt Cedar, Russian Olive, or Siberian Elm. Both of these species typically colonize disturbed areas, such as along levees and in severely burned sites (Sivinski et al., 1990).

Fire was virtually unknown in naturally functioning, low-elevation riparian ecosystems of the Southwest (Busch and Smith, 1993; Stuever, 1997). However, fuel accumulations coupled with mainly human-caused ignitions have introduced fire as a major disturbance mechanism in the bosque ecosystem (Stuever, 1997). While Cottonwood is highly susceptible to fire-induced mortality (Stuever, 1997), salt cedar re-sprouts vigorously following fire (Busch and Smith, 1993; Busch, 1995). Cottonwood and Willow (*Salix* spp.) are poorly adapted to fire and lack an efficient post-fire re-sprouting mechanism such as that found in salt cedar (Busch and Smith, 1993).

Post-fire soils have significantly higher salinity than soils of unburned areas, which may suppress growth of Cottonwood and Willow seedlings and allow establishment of Salt Cedar seedlings (Busch and Smith, 1993). Salt cedar has a higher salinity tolerance than willow and cottonwood and adjusts to high salinity sites through accumulation of salts and osmotic adjustment, whereas Willow and Cottonwood exclude ions at the root endodermis (Busch and Smith, 1995). Salt Cedar uses the absorbed ions to maintain turgor pressure at low water potential and also exudes salts through special glands, allowing it to tolerate higher salinities and water stress than Cottonwood and Willow (Busch and Smith, 1995). Halophytes, such as Salt Cedar, may salinize soils when well supplied with moisture to reduce water uptake and transpiration (Busch and Smith, 1995).

More Recent and Current Conditions

Two large fires occurred in the bosque in Albuquerque in June 2003 burning 253 acres. Since that time, OSD has initiated an extensive thinning project in order to prevent fires in the Albuquerque area. Unfortunately, two more fires occurred in 2004 -- one between Rio Bravo and Interstate-25 (I-25) on both sides of the river burning approximately 63 acres and the other south of Bridge Blvd. on the east side of the river, burning approximately 18 acres. Prior to these recent fires and in between them, the City had been thinning most areas within the Rio Grande Valley State Park (RGVSP). To date, the majority of the bosque acres in the RGVSP have been “treated” in some way to reduce fire hazards by the OSD, Ciudad Soil and Water Conservation District (SWCD), the Corps (through the Bosque Wildfire Project) and other agencies and private organizations. This makes up the majority of the acreage within the Proposed Action Area but as stated above, some bosque lands in the Proposed Action Area are within the Pueblo of Sandia and Corrales Bosque Preserve.

Areas treated within the RGVSP have been variably managed; some were lightly thinned while other areas were cleared of all non-native vegetation and dead material, depending on the level of fuel reduction required for the site. Clearing activities have greatly reduced the acreage of dense non-native woodlands while mature cottonwood stands are largely devoid of understory vegetation. However, Russian olive and salt cedar have begun sprouting from the root crowns of cut trees in treated stands.

To obtain a value of the existing habitat in the Proposed Action Area and ultimately forecast the improvement in value resulting from any restoration measures an existing inventory of the habitats within the Proposed Action Area was used. The "Middle Rio Grande Biological Survey" completed by Hink and Ohmart in 1984 described the plant communities within the Proposed Action Area's riparian zone and provided detailed information on species composition and the structure of cover types (Types I-VI). Six general plant vegetation categories were developed by Hink and Ohmart (1984), based on several parameters including; height and density of the vegetation and the makeup of the mid and understory or lower layers. The cover types for the Proposed Action Area were updated in 2005 and used as the baseline vegetative information. A detailed description of the cover types and analysis is provided in the Feasibility Study.

For purposes of analysis of vegetation in the Proposed Action Area, these six cover types (which were changed to 1-6) were subsequently divided into "Treated" (T) for areas where dead and down material was removed and/or selective thinning of non-native vegetation has occurred, and "Untreated" (U) categories indicating the condition of "fire management" within their boundaries (Figure 28). Therefore, in addition to these six vegetation types, four of them were subdivided into T or U as appropriate. They are Types 2T, 2U, 4T, 4U, 6T, and 6U. A 'wet' (W) descriptor also added for Type 6 yielding a Type 6W category. Therefore, there were 10 categories overall.

Figure 28. Untreated forests (left) carry extensive fuel loads susceptible to catastrophic fires.

At baseline, 3,495 acres of bosque habitat were associated with the Bosque Community HSI across the entire project area. Reaches 1 and 4 held the largest numbers of forested acres (1,090 and 726 acres respectively). Reach 3 had the smallest bosque holdings (just 502 acres). Overall, the Proposed Action Area generated 1,575 habitat units (HU's) across all reaches. The baseline HU's within the reaches ranged from 225 units in Reach 2 to 541 units in Reach 1 (Table 7). The maximum HSI score possible was 1.0. Given the total number of applicable bosque acres at baseline (i.e., 3,495 acres), one could derive the optimal conditions and outputs by multiplying the quantity and quality to generate the highest possible outcome (3,495 acres x 1.0 HSI = 3,495 units). By comparing the actual situation to this optimum, the E-Team determined at what level the ecosystem was functioning. In this case, the watershed was operating at approximately 45 percent of its potential habitat suitability (i.e., total habitat outputs across all reaches÷ possible outputs). Using this same approach, the E-team considered the operational functionality of the five reaches. The individual performances ranged from 40 percent (Reach 2) to 50 percent in Reach 1. Clearly, there were opportunities for improvements – in other words, all the reaches were prime candidates for restoration/rehabilitation activities in terms of the vegetative community structure and functionality.

Table 7. Baseline tabular HSI results for the Bosque Community.					
Reach Name	HSI Model Component	Life Requisite Suitability Index (LRSI)	Habitat Suitability Index (HSI)	Applicable Acres	Baseline Habitat Units (HUs)
Reach 1	BIOTA	0.41	0.50	1,090	541
	LANDSCAPE	0.76			
	WATER	0.32			
Reach 2	BIOTA	0.39	0.40	561	225
	LANDSCAPE	0.54			
	WATER	0.28			
Reach 3	BIOTA	0.38	0.41	502	206
	LANDSCAPE	0.59			
	WATER	0.26			
Reach 4	BIOTA	0.41	0.42	726	307
	LANDSCAPE	0.53			
	WATER	0.33			
Reach 5	BIOTA	0.37	0.48	616	296
	LANDSCAPE	0.75			
	WATER	0.33			

Continued isolation of riparian vegetation in the Proposed Action Area from fluvial geomorphic processes would eventually result in complete dominance of the plant communities by non-native plant species including salt cedar, Russian olive, Siberian elm, white mulberry, and tree of heaven. Current vegetation management techniques such as understory clearing and planting of native species may temporarily reset patches of bosque to more natural structural states, but gradual replacement by non-native species could continue to occur unless the function of the bosque ecosystem and structure of the dynamic mosaic is restored. Eventual conversion of the bosque to a non-native-plant-dominated ecosystem uninfluenced by hydrologic processes, with fire as the new main disturbance mechanism, would diminish habitat suitability and quality for many native animal species. Larger scale plantings, bank terracing or high flow channel creation would not likely occur due to financial limitations. Some maintenance activities would likely continue by other agencies or private organizations. Some areas have been planted with native shrubs and trees through other projects. This native vegetation would continue to grow and provide some additional habitat for wildlife.

Inundation of the bosque would remain infrequent and limited without modifications to high-flow channels and bank terracing. Without the inundation the key component of a functioning bosque would remain absent limiting native plant recruitment, nutrient cycling and recharge of the shallow aquifer. Existing wetlands would continue to diminish and remain isolated from other similar habitats as they are now.

3.9 Floodplains and Wetlands

Wetlands consist of marshes, wet meadows, and seasonal ponds that typically support hydrophytic plants such as cattails, sedges and rushes. Wet meadows were the most extensive habitat type in Middle Rio Grande valley prior to the construction of the MRGCD drains and ditches. From 1918 to present, wetland-associated habitats have undergone a 93% reduction (Hink and Ohmart, 1984; Scurlock, 1998). Wetlands are an integral component of the bosque ecosystem, not only increasing its diversity but also enhancing the value of surrounding plant communities for wildlife. Wetlands have experienced the greatest historical decline of any floodplain plant community. 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).

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is at or near the surface or the land is covered by shallow water (Cowardin et al. 1979). Saturation with water determines the nature of soil development and, in turn, types of plant and animals inhabiting these areas. Wetlands occurring within the riparian zone may be dominated by the same plant species common in bosque; however, wetlands exhibit wetter soils and support many additional plant and animal species.

Historically, the Rio Grande channel wandered widely throughout the floodplain and abandoned channels often contained sufficient ground water discharge to support marshes (cienegas), sloughs (esteros), and oxbow lakes (charcos; Scurlock 1998, Ackerly 1999). Currently, the extent of wetland plant communities within the Middle Rio Grande reach has been significantly reduced. The ground water elevation throughout the valley was significantly lowered by the construction of drains in the 1930s. Wetland areas throughout the floodplain have been directly displaced by agricultural and urban development. Irrigation and flood control operations have reduced the magnitude of discharges within the floodway -- especially during the spring runoff period -- and limit the extent of overbank flooding.

Jurisdictional wetlands (relative to Section 404 of the Clean water Act) do occur in the Proposed Action Area. Most wetlands within the floodway have developed in areas with a high groundwater table. Those in shallow basins or relatively far from the river are likely seasonally or temporarily flooded; that is, inundated during the majority, or just a portion, of the growing season, respectively. Within the Rio Grande floodway, most islands, point bars and side channels are periodically inundated by river flows and support marsh, meadow or shrub wetland communities.

Abandoned channels or depressions deep enough to intersect the regional ground water table often support permanently or semi-permanently flooded ponds and marshes. The San Antonio Oxbow is an example of this type within the Proposed Action Area, and is one of the largest wetland complexes in the Middle Rio Grande valley. This wetland's water regime is influenced by shallow groundwater, and surface water from the Rio Grande, San Antonio Arroyo, and the riverside drain.

Under the No Action Alternative, additional wetlands and reconnection within the floodplain would not occur. There would be a continued loss of wetland habitat and connection between the river and bosque without the project.

3.10 Fish and Wildlife

An estimated 407 species of vertebrates may occur in aquatic, semi-aquatic, or riparian habitat in Bernalillo and Sandoval Counties, based on a query of the Biota Information System of New Mexico (accessed March 2008). This estimate includes 24 species of fish, 11 amphibian taxa, 39 species of reptiles, 279 species of birds, and 54 mammalian taxa (Pittenger 2003). Birds are the most important group, based on number of taxa, comprising 69 percent of all vertebrate species in the estimate.

Herptile abundance and diversity was found to be greatest in habitats that lacked dense canopy cover and that were characterized by sandy soils and sparse ground cover (Hink and Ohmart 1984). Many of the species found in the bosque were representative of drier upland habitats. Hink and Ohmart (1984) did describe a distinct assemblage of species associated with denser vegetation cover in mesic or hydric habitats. Common species included tiger salamander (*Ambystoma tigrinum*), western chorus frog (*Pseudocris triseriata*), bullfrog (*Rana catesbeiana*), northern leopard frog (*Rana pipiens*), Great Plains skink (*Eumeces obsoletus*), New Mexico garter snake (*Thamnophis sirtalis dorsalis*), western painted turtle (*Chrysemys picta bellii*), and spiny softshell turtle (*Trionyx spiniferus*). Recent studies done by Bateman et. al (2008) found that eastern fence lizards (*Sceloporus undulatus*) and New Mexico whiptails (*Cnemidophorus neomexicanus*) increased in relative abundance after non-native plants were removed. Another common species found in the 2008 study is Woodhouse's toad (*Bufo woodhousii*). The study indicated that perhaps, removing non-native plants in the understory allows more opportunities for heliothermic lizards to bask in areas where light does penetrate the cottonwood canopy.

Small mammals were found to be more abundant in moister, densely vegetated habitats and those with dense coyote willow than at drier sites (Hink and Ohmart 1984). Dominant species differed between various habitat types however, so that a variety of habitats increases the diversity of small mammals in the study area.

Hink and Ohmart (1984) recorded 277 species of birds in the bosque ecosystem. Highest bird densities and species diversity were found in edge habitat vegetation with a cottonwood overstory and an understory of Russian olive or (Hink and Ohmart 1984). Studies done by Finch and Hawksworth (2006) indicate that bird densities of the mid-story nest guild show declining trends following treatment and removal of invasive plant species. Removal of some invasive plant species reduces the availability of nesting and foraging substrates for bird species that use the mid-story layer of habitat. Emergent marsh and other wetland habitats also had relatively high bird density and species richness. Thirty of the 46 species of breeding birds found in the bosque used cottonwood forest habitat. No bird species showed a strong preference for Russian Olive stands (Hink and Ohmart 1984). However, when Russian Olive was present as a component of the understory in Cottonwood stands, it appeared to influence the quality of those stands for birds. Therefore the higher bird densities appear to relate to the structure of the habitat rather than species of plant making up that component.

The MRG is a major migratory flyway for avian species (Yong and Finch, 2002). Hundreds of species migrate through and nest within the Proposed Action Area. More recent bird sampling in Rio Grande Valley State Park found 62 species in winter and 90 during the breeding season (Stahlecker and Cox 1997). Of the 90 bird species found in summer in Rio Grande Valley State Park, only 31 were found in the Proposed Action Area, of which 15 were considered to be nesting there (Stahlecker and Cox 1997). The greatest number of species and highest bird density in both winter and summer was found in emergent marsh habitat.

Red-tailed Hawk (*Buteo jamaicensis*) and Cooper's Hawk (*Accipiter cooperii*) were reported as common raptors along the river in winter (Stahlecker and Cox 1997). Cooper's Hawk and Great-horned Owl also occur as nesting birds in the Proposed Action Area (W. DeRagon, personal communication 2003). Twenty-eight stick nests were found in the Proposed Action Area in Spring 2003. All of the stick nests were located in Rio Grande Cottonwood; none was found in Siberian Elm. Stick nests in the Proposed Action Area are used by Great-horned Owl, Cooper's Hawk, Red-tailed Hawk, and American Crow.

Hawks Aloft, under contract with the Corps, USBR, and USFWS has monitored avian use in the Albuquerque Reach of the Middle Rio Grande bosque for the past eight years (Hawks Aloft, 2008, 2008a). The information has provided insight as to changes in avian communities due to past and current exotic species/fuel load reduction efforts. This has provided useful information to continued updating of species present as well as input on potential alternatives and restoration features that were considered under this Proposed Action. Recommendations provided in these reports include analysis of developing selective thinning at each site including leaving some non-native vegetation which provide habitat and food for birds (such as Russian olive and mulberry). These recommendations would be considered at each area prior to thinning efforts.

The Bald Eagle (*Haliaeetus* leucocephalus) is also known to be present in the project area and is protected under the Bald Eagle Protection Act of 1940. This bird species uses the Proposed Action Area as it migrates between the northern border and the Gila, lower Rio Grande, middle Pecos, and Canadian river valleys in New Mexico (Hubbard 1985a). Suitable foraging habitat is characterized by open expanses of water with abundant prey, such as waterfowl and fish, and large trees or snags for perch sites. Bald Eagle may occur in winter along the Rio Grande, particularly to the north and south of the Proposed Action Area (Stahlecker and Cox 1997). Winter roosts do exist within the Proposed Action Area.

Common fish species in the project area include river carpsucker (*Carpiodes carpio*), flathead chub (*Platygobio gracilis*), mosquitofish (*Gambusia affinis*), and red shiner (*Cyprinella lutrensis*; Platania, 1993). Less common fish species in the project area include longnose dace (*Rhinichthys cataractae*), channel catfish (*Ictalurus punctatus*), fathead minnow (*Pimephales* *promelas*), white sucker (*Catostomus commersoni*), and the federally listed Rio Grande silvery minnow (*Hybognathus amarus*).

The peak nesting season for birds is April 15 through August 15. The Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703, et seq.) is the primary legislation in the United States established to conserve migratory birds (USFWS, 2004). The list of the species protected by the MBTA appears in title 50, section 10.13, of the Code of Federal Regulations (50 CFR 10.13). The MBTA prohibits taking, killing, or possessing of migratory birds unless permitted by regulations promulgated by the Secretary of the Interior. The U. S. Fish and Wildlife Service (USFWS) and the Department of Justice are the Federal agencies responsible for administering and enforcing the statute.

A Memorandum of Agreement (MOA) between the Federal Aviation Administration, the U.S. Air Force, the U.S. Army, the U.S. Environmental Protection Agency, the USFWS, and the U.S. Department of Agriculture to *Address Aircraft-Wildlife Strikes* was signed by the Department of the Army in 2002. The agreement was signed in reference to Advisory Circular (AC) 150/5200-33 (1997). Criteria were developed for siting wildlife attractants for a distance of 5,000 feet for airports serving piston-powered aircraft and 10,000 feet for airports serving turbine-powered aircraft. The Proposed Action is within approximately 12,000 feet of the Albuquerque International Airport at the south end of the project boundaries.

With a trend towards larger dominance of non-native plant species abundance of some species would increase at the expense of overall diversity in the bosque. Those species preferring the dense, low and mid-story habitat structure would benefit while those preferring open mature cottonwood stands with open mid and understory would become less common. If native bosque patches became smaller and distances between patches larger, some wildlife species may be lost to the area altogether. The overall trend would be for a less heterogeneous habitat favoring only a portion of the existing animal species. Likewise migratory species relying on varying age stands of cottonwood bosque, wetlands, or open meadow would be forces to travel farther possible bypassing the MRG near Albuquerque to find favorable habitat.

The lack of connectivity between the river and floodplain would also favor upland species that are fairly common in the region while the more rare floodplain species would remain scarce.

3.11 Endangered and Protected Species

Three agencies who have primary responsibility for the conservation of animal and plant species in New Mexico are the USFWS, under authority of the Endangered Species Act (ESA) of 1973 (as amended); the New Mexico Department of Game and Fish, under the authority of the Wildlife Conservation Act of 1974; and the New Mexico Energy, Mineral and Natural Resources Department, under authority of the New Mexico Endangered Plant Species Act and Rule No. NMFRCD 91-1. Each agency maintains a list of animal and or plant species that have been classified, or are candidates for classification, as endangered or threatened based on present status and potential threat to future survival and recruitment. Ten species have the potential to occur in the Proposed Action Area and fall in these categories. Five of these are Federally listed and one is a candidate for listing under the Federal Endangered Species Act (ESA): Rio Grande silvery minnow (*Hybognathus amarus)* (RGSM), Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (SWFL), Black-footed ferret (*Mustela nigripes*), Mexican Spotted Owl (*Strix occidentalis lucida*), and Rio Grande cutthroat trout (*Oncorhynchus clarki virginalis*). The Yellow-Billed Cuckoo (*Coccyzus americanus*) (YBCC) is listed as a candidate species. The river within the Proposed Action Area is also designated as Critical Habitat under the ESA for the RGSM. That is, the USFWS has determined that these habitats are critical to the continued existence and recovery of these species.

The remaining four species are state-listed: Neotropic Cormorant (*Phalacrocorax brasilianus*, state threatened), Common Black-hawk (*Buteogallus anthracinus anthracinus*, state-threatened), Bell's Vireo (*Vireo bellii*, state-threatened), and New Mexican meadow jumping mouse (*Zapus hudsonius luteus*, state-threatened).

Table 8. Special status species with the potential to occur in the Proposed Action Area.

Common Name	Scientific Name	State or Federal	Date of Listing	Critical Habitat	Habitat Type	Presence in Project Area
Black-footed ferret	*Mustela nigripes*	Federal Endangered	1967	No	Plains Mesa	No
Mexican spotted owl	*Strix occidentalis lucida*	Federal threatened	1993	Yes, but NOT in project area	Subalpine coniferous forest	No
Rio Grande cutthroat trout	*Oncorhynchus clarki virginalis*	Federal Candidate	Review began in 1991	No	Aquatic	Not detected
Rio Grande silvery minnow	*Hybognathus amarus*	Federal	1994	Yes, in project area	Aquatic	Yes
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Federal	1995	Yes, but NOT in project area	Dense riparian	As migrant only
Yellow-billed Cuckoo	*Coccyzus americanus*	Federal Candidate	Review began in 1991	No	Riparian	Yes, has been detected

Three of the federally listed species, the RGSM, SWFL and YBCC, have been documented in the Proposed Action Area, and will be further discussed below.

Rio Grande Silvery Minnow –

Rio Grande Silvery Minnow (*Hybognathus amarus*) (RGSM) historically occurred in the Rio Grande drainage in New Mexico and Texas (Lee et al., 1980; Propst, 1999). The species was historically one of the most abundant and widespread fishes in the Rio Grande drainage (Bestgen and Platania, 1991). In New Mexico, historic range of the species included the Rio Chama from

Abiquiu to the Rio Grande confluence, the main stem of the Rio Grande from Velarde downstream to the New Mexico-Texas state line, and the Pecos River downstream from Santa Rosa (Sublette et al., 1990). RGSM was extirpated from the Rio Grande downstream of the Pecos River by 1961 and Pecos River proper by the mid-1970s. The species was also extirpated from the Rio Grande upstream from Cochiti Dam and downstream from Elephant Butte Reservoir. One of the greatest threats to its survival is poor water quality (Utton Transboundary Resources Center, 2004). Currently, RGSM is present only in the Rio Grande between Cochiti Reservoir and the upper end of Elephant Butte Reservoir, which represents less than 10% of its historic distribution (Bestgen and Platania, 1991; Propst, 1999). Abundance of RGSM has declined markedly from 1994 to the present time and the population has become concentrated in the reach of the Rio Grande between San Acacia Diversion Dam and the headwaters of Elephant Butte Reservoir. Over the 2004 and 2005 monitoring season, a large population of RGSM was found in the Albuquerque Reach of the MRG. Critical Habitat has been designated for the RGSM and is within the project area.

RGSM is a pelagic-broadcast spawner, producing nonadhesive, semi-buoyant eggs (Platania and Altenbach, 1998). Spawning is initiated by elevated stream discharge and occurs primarily in the late spring and early summer, when water temperatures are 68^{o}F to 75^{o}F (Propst, 1999). Females may produce three to 18 clutches of eggs, each clutch numbering from 200 to 300 eggs. Growth to maturation occurs in about two months. RGSM typically live only about one year, with less than 10% of the adult population surviving to up to two years (Platania and Altenbach, 1998; Propst, 1999). Habitat used by adult RGSM is characterized by silty to sandy substrate, depths of 8 in to 2.6 ft, and slow to moderate current velocity, 0 ft/sec to 0.98 ft/sec; (Dudley and Platania, 1997). Habitats with slow current velocity and associated cover are used in winter. RGSM feed on algae and detritus (Propst, 1999; USFWS, 1999, 2010). Major threats to persistence of RGSM include diminution of river flows and dewatering by surface water diversions and dam regulation, modification of aquatic habitats that result in faster current velocities and narrower channels, and introduction of nonnative fishes (USFWS, 1999, 2010). Recovery of RGSM requires stabilizing the population in the MRG and reestablishing the species in suitable habitats within its historic range (USFWS, 1999, 2010).

Dudley and Platania (1997) documented habitat preferences of RGSM. They found that individuals were most commonly collected in shallow water (<40 centimeters [cm]) with low water velocities (<10 cm/second [cm/s]) and small substrate size, primarily silt and sand. Low-velocity habitats, such as backwaters and scallops, provide nursery areas for larvae (Dudley and Platania 1997, Massong et al. 2004), which grow rapidly in these areas. Restoration efforts that increase the availability of these habitat conditions would benefit RGSM. In addition to the quantity of preferred habitat, food availability may be influenced directly by river restoration activities. RGSM are herbivores that eat primarily diatoms, cyanobacteria, and green algae associated with sand or silt substrates in shallow areas of the river channel (Shirey 2004).

Recent research (Pease et al 2006; Porter and Massong 2004, 2006; Bureau of Reclamation; SWCA 2007) indicates nursery habitat on inundated point bars, islands, and the floodplain provide essential conditions for spawning, with survival of RGSM eggs and larvae. Increased recruitment during average spring flow result in increased fall populations (USACE, 2007a), supporting the value of habitat restoration and hydrograph management for producing RGSM in the river.

Currently, *Hybognathus amarus* is the only remaining endemic minnow with semi-buoyant eggs in the MRG. The pelagic spawning speckled chub (*Extrarius aestivalus*), Rio Grande shiner (*Notropis jemezanus*), phantom shiner (*Notropis orca*), and bluntnose shiner (*Notropis simus simus*) are either extinct or have been extirpated from the MRG (Bestgen and Platania 1991).

The remaining population of the Silvery Minnow is restricted to approximately 5 percent of its historic range. Every year since 1996, there has been at least one drying event in the river that has negatively affected the silvery minnow population. The population is unable to expand its distribution because poor habitat quality and Cochiti Dam prevent upstream movement and Elephant Butte Reservoir blocks downstream movement (USFWS, 1999, 2010). Augmentation of silvery minnows with captive-reared fish would continue, however, continued monitoring and evaluation of these fish is necessary to obtain information regarding the survival and movement of individuals.

Several habitat restoration projects have been completed in the Albuquerque reach through the MRGESCP. These projects include two woody debris installation projects to encourage the development of pools and wintering habitat, and a river bar modification project south of the I-40 Bridge designed to create side and backwater channels on an existing bar as well as modify the top surface of the bar to create habitat over a range of flows. Additionally, in 2005, the ISC started a multi-year habitat restoration program that implements several island, bar, and bank line modification techniques throughout the Albuquerque Reach. Approximately 24 acres of habitat were restored in the Phase I. Phase II is scheduled to have begun in winter 2008. In April 2008, the Corps completed the Rio Grande Nature Center Habitat Restoration Project reconnecting an ephemeral side channel to the river for silvery minnow habitat.

Various conservation efforts have also been undertaken in the past and others are currently being carried out in the MRG. Silvery minnow abundance has increased since 2003 population levels as a result of several years with average spring flows. The increased abundance of silvery minnow from 2004-2007 is a positive sign. Releases of captive-reared RGSM have been made at Central bridge, which is within the Proposed Action Area.

Aquatic habitat in the Proposed Action Area is directly influenced by stream discharge volumes, patterns and sediment supply. Bank erosivity, and thus direct sediment input from the Proposed Action Area and local channel dynamics, is unlikely to change without implementation of the Project. Other agency initiatives have created potential habitat for the RGSM (as discussed in Section 4.21 below). These are but a few projects within the 20-mile Proposed Action Area, creating some additional beneficial habitat for the minnow. But, under the No Action Alternative, existing aquatic habitat conditions would remain largely unchanged.

Southwestern Willow Flycatcher–

The Southwestern Willow Flycatcher (flycatcher) is found in the U.S. from May until September. It winters in southern Mexico, Central America, and northern South America (Unitt, 1987). In New Mexico, the Southwestern Willow Flycatcher is distributed in nine drainages (Gila, Rio Grande, Rio Chama, Coyote Creek, Nutria Creek, Rio Grande de Ranchos, Zuni, Bluewater Creek, and San Francisco). The flycatcher is an endangered species on the U.S. Fish and Wildlife Service Endangered Species List and critical habitat has been designated in the MRG, though not in the Proposed Action Area. As of 1996, it was estimated that there were only about 400 Southwestern Willow Flycatchers in New Mexico, representing about 42% of the total population of the subspecies (Southwestern Willow Flycatcher Recovery Team, 2002). Southwestern Willow Flycatchers occur in riparian habitats along rivers, streams, or other wetlands, where dense growth of willows (*Salix* spp.), *Baccharis*, arrow weed (*Pluchea* sp.), saltcedar or other plants are present, often with a scattered overstory of cottonwood (Unitt 1987; Sogge et al., 1997; Finch and Stoleson, 2000). These riparian communities provide nesting and foraging habitat. Throughout the range of Southwestern Willow Flycatcher, these riparian habitats tend to be rare, widely separated, small and often linear locales, separated by vast expanses of arid lands. The Southwestern Willow Flycatcher is endangered by extensive loss and modification of suitable riparian habitat and other factors, including brood parasitism by the Brown-Headed Cowbird (*Molothrus ater;* Unitt, 1987).

The Southwestern Willow Flycatcher is an obligate riparian species and nests in thickets associated with streams and other wetlands where dense growth of willow, Russian olive, saltcedar, or other shrubs is present. Nests are frequently associated with an overstory of scattered cottonwood. Southwestern Willow Flycatchers nest in thickets of trees and shrubs approximately 6 to 23 feet in height or taller, with a densely vegetated understory approximately 12 feet or more in height. Surface water or saturated soil is usually present beneath or next to occupied thickets (Muiznieks et al. 1994). At some nest sites, surface water may be present early in the breeding season with only damp soil present by late June or early July (Muiznieks et al. 1994). Habitats not selected for nesting include narrow (less than 30 feet wide) riparian strips, small willow patches, and stands with low stem density. Suitable habitat adjacent to high gradient streams does not appear to be used for nesting. Areas not utilized for nesting may still be used during migration.

Breeding pairs have been found within the MRG from Elephant Butte Reservoir upstream to the vicinity of Española. Southwestern Willow Flycatchers begin arriving in New Mexico in early May. Breeding activity begins immediately and young may fledge as soon as late June. Late nests and re-nesting attempts may not fledge young until late summer (Sogge et al. 1997).

Occupied and potential Southwestern Willow Flycatcher nesting habitat occurs within the MRG. Occupied and potential habitat is primarily composed of riparian shrubs and trees, chiefly Goodding's willow and peachleaf willow, Rio Grande Cottonwood, Coyote Willow, and Salt Cedar. The nearest known breeding Southwestern Willow Flycatchers from the project area occurs along the Rio Grande at Isleta Pueblo. Potential habitat exists adjacent to the Proposed

Action Area. Designated Critical Habitat was determined for SWFL in November 2005 but is not in the project area.

Willow Flycatcher surveys were conducted at locations within the Proposed Action Area that contained potentially suitable breeding habitat (as identified with USFWS) per the standard protocol (Sogge et al., 1997, as amended). These surveys were conducted in 2004-2006 under the Bosque Wildfire Project. Specific sites have been surveyed since that time under this and other projects: the Tingley Bar was surveyed under the Albuquerque Biological Park, and the San Antonio Oxbow has been surveyed each year as part of this Proposed Action.

Southwestern Willow Flycatcher has been detected at the Tingley Bar site in 2004 and 2005. Both detections were during the first survey period (in May). Single individuals responded to the tape play-back at two locations within the site. These locations were approximately 800 feet apart. The first individual was heard and observed singing in a clump of saltcedar (*Tamarix chinensis*) along the riverbank. The second individual was heard singing in a dense clump of tall coyote willow (*Salix exigua*) on the river bar, about 150 feet from the edge of the river. No additional observations of Willow Flycatcher occurred at this location and it is presumed that these individuals were migrants.

SWFL has also been detected at the San Antonio Oxbow in 2007 and 2008 during the first survey period (May). No additional observations were made during the remainder of the survey period. Therefore, it is presumed that these individuals were also migrants.

Yellow-billed Cuckoo-

Wetlands and native woody riparian vegetation would continue to decline in the Proposed Action Area with the No Action Alternative, further diminishing habitat suitability for these species and contributing to their decline. Again, other agency initiatives (such as those under the MRGESCP discussed in Section 4.21) may propose projects to benefit the Southwestern Willow Flycatcher in this area though none are known at this time.

The breeding range of Yellow-Billed Cuckoo (*Coccyzus americanus occidentalis*) extends from California and northern Utah eastward to Southwestern Quebec and south to Mexico. Yellow-Billed Cuckoo has declined precipitously throughout its range in southern Canada, the United States, and northern Mexico. The number of breeding birds has declined by about 42% in the eastern United States (Elphick et al., 2001). It is nearly extinct west of the Continental Divide, having disappeared from British Columbia in the 1920's, from Washington in the 1930's, from Oregon in the 1940's, and from northern-most California in the 1950's. It is extremely rare in the interior West. Its only remaining western "strongholds" are three small populations in California, scattered populations in Arizona (especially on the San Pedro River) and New Mexico (especially the Gila River), and an unknown number of birds in northern Mexico (Center for Biological Diversity, 2000). The species winters in South America (DeGraaf et al., 1991).

The Yellow-Billed Cuckoo was initially listed as a candidate species in 1991. A recent *Review of Native Species that are Candidates for Listing as Endangered or Threatened* (Federal

Register, December 10, 2008) provides additional information on this species. New Mexico is listed as a State where the species is known to occur. In New Mexico, the species was historically rare Statewide, but common in riparian areas along the Pecos and Rio Grande, as well as uncommon to common locally along portions of the Gila, San Francisco and San Juan rivers (Bailey 1928; Hubbard 1978). Current information is inadequate to judge trends, but the species was fairly common in the mid-1980s along the Rio Grande between Albuquerque and Elephant Butte Reservoir, and along the Pecos River in southeastern New Mexico. Numbers may have increased there in response to tamarisk (Tamarix spp.) colonization of riparian areas formerly devoid of riparian vegetation (Howe 1986). A review on the status of the species in New Mexico concluded that the species would likely decline in the future due to loss of riparian woodlands (Howe 1986). In the eastern third of the state, nonnative salt cedar has provided habitat for approximately 1000 pairs of yellow-billed cuckoos in historically unforested areas. Efforts are underway to remove the salt cedar, through spraying and subsequent removal (Howe 2004), resulting in a substantial loss of cuckoo habitat. In the western portion of the state, damage to native riparian habitat is occurring. Along the Rio Grande, understory is being removed to reduce fire risk, and land is being converted to agriculture. Throughout New Mexico, grazing is impacting the quality of riparian habitat available to yellow-billed cuckoos (Howe 2004).

Yellow-Billed Cuckoo nests in dense riparian shrub habitat in stands typically at least 25 acres in size (Elphick et al., 2001). They arrive in New Mexico beginning in late April and early May and nest from late May through August (Howe, 1986). Mature cottonwood forest with well-developed willow understory appear to be important characteristics of habitat for Yellow-Billed Cuckoo (Buffington et al., 1997; Gaines and Laymon, 1984). While willows appear to be a preferred nest tree, the species will also nest in dense saltcedar stands (Howe, 1986). Nests are constructed of sticks and are located in dense foliage. Yellow-Billed Cuckoo may nest up to three times a year, with a clutch size of two to six eggs. They may occasionally parasitize nests of other birds, particularly when food is abundant. Yellow-Billed Cuckoo feeds primarily on caterpillars but will also consume bird eggs, frogs, lizards, berries, and other fruits (Erlich et al., 1988). Yellow-Billed Cuckoo forages primarily in the foliage layer of shrubby and woody vegetation. Populations fluctuate markedly in response to variation in caterpillar abundance. Population declines resulting from loss or disturbance of riparian habitat have been consistently reported in the West (Finch, 1992). Both Hink and Ohmart (1984) and Stahlecker and Cox (1997) reported Yellow-Billed Cuckoo as a nesting bird in the bosque of the Middle Rio Grande.

Yellow-billed Cuckoo was not heard or observed at any of the sites surveyed for SWFL survey.

Without initiation of this project, an increase in potential native riparian habitat to benefit the Cuckoo would not be implemented.

3.12 Cultural Resources

The following cultural resources text covers three areas: a brief culture history background on previous historic and archaeological work with references, archaeological work for the current project, and management recommendations.

Cultural History

Considerable information is available from archaeological resources within the Middle Rio Grande Valley. Archaeological sites in the valley span nearly the entire known period of human occupation in North America covering approximately 12,000 years. Culture history for the Middle Rio Grande is described chronologically as including the Paleoindian (10,000 to 6,000 years BC), Archaic (6,000 years BC to AD 400), Puebloan (400 to 1600 AD), and Historic Periods (1600 AD to Recent). Paleoindian and Archaic sites are represented by lithic scatters with some diagnostic artifacts and a few habitation sites. In the project area, the prehistoric Puebloan Period generally follows what is known as the Rio Grande Valley Sequence. The Puebloan Period is characterized by increasing population sizes, migrations of peoples, more sedentism and aggregation of peoples into larger villages, an increasing dependence on horticulture and agriculture, and a more intense and efficient use of the environment. Many smaller groups, however, remain nomadic. Small pithouse villages, larger above-ground roomblocks, and huge adobe pueblos with scattered fieldhouses become common. These permanent villages and base camps are primarily located near reliable water sources. This includes areas along the Rio Grande, on ridges, gravel terraces, or alluvial slopes adjacent to major arroyos, and occasionally in the vicinity of playas. Other sites, such as temporary camps, resource procurement stations, and many of the undated lithic sites, are found scattered throughout the region. As sedentism increases, so does the use of water management techniques and surface water flow control features, and local and long distance trade is important. The Protohistoric Period includes population movements as groups try to adjust to the encroachments of other tribes as European exploration begins and tribes try to relocate. Diseases new to the Americas spread across the landscape causing disruption to tribal lifeways. The Historic Period in the Southwest began with the 1540 Spanish *entrada*. Eventually the Spanish colonized the Rio Grande Valley in the 1600s. Horticulture, agriculture, and ranching are intensified as European culture began to dominate and manage the area.

For an understanding of the Rio Grande Floodway in the Albuquerque area, the following historic text is adapted from Everhart (2004a, 2004b):

> The Middle Rio Grande Conservancy District (MRGCD) was organized in 1925 under the State's 1923 Conservancy Act to deal with the severe flooding, waterlogged lands, and failing irrigation facilities (Ackerly *et al*. 1997:20-21; Scurlock 1998:281; Wozniak 1987:134; Biebel 1986:15-16). By 1928, a reclamation, flood control, and irrigation plan was developed (Burkholder 1928) and between 1930 and 1934 major portions of the plan, including flood control levees, riverside drainage canals, and irrigation ditches and diversions, were constructed by the MRGCD (Ackerly *et al*. 1997:21; Scurlock 1998:281; Wozniak 1987:134-138; Berry and Lewis 1997:12-15). The new facilities were to provide for the efficient delivery of irrigation water, prevent flood hazards and provide flood protection measures, regulate the Rio Grande channel and stream flows and provide drains to reclaim land that had become saturated and saline from high groundwater levels (Ackerly *et al*. 1997:20-21). The development and rehabilitation work conducted by the MRGCD had impacts to the whole Middle

Rio Grande area (Ackerly *et al*. 1997:20-24; Biebel 1986:15-16). MRGCD construction incorporated "…about 70 independent community ditches in to a single [irrigation] system" (Ackerly *et al*. 1997:29; Burkholder [1928:25] and Linford [1956:292] in Wozniak 1987:130, 138). The extreme upstream portion and original headings of numerous historic acequias were cut off from the downstream portions of their ditch alignments by the construction of the flood control levees and riverside drains. During the Depression and continuing into the war years, funding the construction and maintenance of MRGCD's structures and equipment became a never-ending problem (Ackerly *et al*. 1997:20-24, 26, 57; Biebel 1986:15-16, 22-23; Welsh 1985:110-111, 166; Wozniak 1987:138-143).

The Flood Control Act of 1948 authorized several projects in New Mexico and called for a comprehensive plan for the Rio Grande, and recommended other projects "…to control the heavy sedimentation of the river, and to upgrade the present irrigation systems to gain efficiency" (Crawford *et al*. 1993:26; Welsh 1985:115; Ackerly *et al*. 1997:57). At about the same time, a "…memorandum of agreement [was] signed between the Interior secretary and the Chief of Engineers on 25 July 1947" that "…delineated the areas of responsibility for the Corps and Reclamation in the Rio Grande basin" (Welsh 1985:115; Wozniak 1987:143).

By 1950, "The levees built with MRGCD money suffered from extensive erosion" (Welsh 1985:166). Starting in 1951 the Corps and the Bureau of Reclamation began a comprehensive Rio Grande Floodway project, authorized in 1950, that constructed and rehabilitated flood control levees and installed thousands of Kellner jetty-jacks to armor the river banks and maintain the Floodway (Crawford *et al*. 1993:26-27; Ackerly *et al*. 1997:57-58; Welsh 1985:166; Scurlock 1998:282, 328, 354). The major channel modification project to maintain channel capacity was completed by the Bureau in 1959 and "The Corps of Engineers reconstructed the levee-riverside drains in the Albuquerque area in 1958" with most of the Corps and Reclamation work being completed between 1962 and 1964 (Ackerly *et al*. 1997:57-58; Scurlock 1998:282, 354; Crawford *et al*. 1993:43).

Numerous archaeological surveys have been conducted and histories written regarding the long human occupation of the Albuquerque area. Some general archaeological and historic references and overviews include: Ackerly *et al*. (1997), Biebel (1986), Cordell (1997, 1984, 1979), Crawford *et al*. (1993), DeWitt (1978), Holmes (1998), Judge (1973), Julyan (1996), Kelley (1974), Marshall and Marshall (1990), Nostrand (1992), Ortiz (1983, 1979), Polk *et al*. (1999), Poore and Montgomery (1987), Sánchez (1998), Sargeant (1987), Sargeant and Davis (1986), Scurlock (1998, 1982), Simmons *et al*. (1989), Simmons (1988, 1982), Stuart and Gauthier (1984), Tainter and Levine (1987), Wendorf and Reed (1955), Williams (1986), and Wozniak (1987). Additional references regarding land grants and El Camino Real de Tierra Adentro National Historic Trail include BLM (1999), NPS/BLM (2002), and GAO (2001).

Until recently, very few cultural resources surveys had been conducted within the riparian/bosque areas, i.e., within the Rio Grande's confined floodplain between the flood control levees. The Corps had initiated planning for riparian restoration within the Albuquerque area in Bernalillo and Sandoval County's bosque a number of years ago. Restoration work, however, was pushed to the forefront subsequent to two bosque wildfires that occurred in the summer of 2003. Recent archaeological work in the bosque includes M. Marshall (2003), Everhart (2004a, 2004b), Estes (2005), Walt, Marshall and Musello (2005), Marshall and Walt (2006), as well as one report for flood control levee rehabilitation by Kneebone (1993) with an addendum by Kneebone and Everhart (1997). Other archaeological work in the area has primarily been associated with cultural resources compliance and management requirements, and for specific projects such as highway construction and maintenance, and installation of utility lines such as Koczan (1991), Marshall (1991), and Schmader (1994, 1990). General histories on Middle Rio Grande Flood Protection Projects between Corrales and San Marcial have been prepared by Dodge and Santillanes (2007) and Berry and Lewis (1997). Information regarding Albuquerque District Corps of Engineers' history and projects may be found in Welsh (1997, 1985). The Ackerly *et al*. (1997) and Wozniak (1987) reports, prepared for the Bureau of Reclamation and the New Mexico Historic Preservation Division, provide significant overviews regarding the development of irrigation in the middle Rio Grande valley and both include a substantial list of references. Burkholder (1928) provides information regarding the initial plan for flood control, drainage, and irrigation work by the Middle Rio Grande Conservancy District. The above reports and references provide a significant amount of culture history information for the project area; therefore, a detailed culture history is not provided in this document.

Historic properties in the form of earthen structures related to irrigation canals (acequias) and drainage ditches as well as wooden bridge pilings are known to occur within the Rio Grande Floodway project area. These historic period structures are in a deflated condition but are still identifiable after being abandoned for approximately 70 years. The without project alternative would be a continuance of the existing situation and there would be some impact to these structures by high river flows and natural weathering. There is the possibility of destructive flooding within the Floodway channel that could significantly affect and possibly destroy these structures; however, flooding has been very infrequent due to the existing flood control dams and modern water management practices. Therefore, the without project alternative is considered to have a negligible effect to the existing condition of these historic properties. Likewise American Indian traditional cultural properties (TCPs) known to occur within the Rio Grande Floodway would not be affected.

3.13 Socioeconomic Environment and Environmental Justice

Socioeconomic resources include population and economic activity, as reflected by personal income, employment distribution, and unemployment (USACE 2002, 2003a, 2007, 2008a,b). The Proposed Action is in both Bernalillo and Sandoval Counties, therefore, Bernalillo and Sandoval Counties serve as the Region of Influence in which most impacts can be expected to occur, and the state and region serve as regions of comparison. Specific information for recreation in the local area and Region of Influence are relevant and presented here.

First, the population in Bernalillo County was estimated at 573,675 in 2002 (USACE 2002, 2003a, 2007, 2008a,b and references therein). It is approximately 1,166 square miles with 477 persons per square mile, and is generally urban in character. In 1999, Bernalillo County had a per capita personal income (PCPI) of $20,790. In 2003, the median income of households in Albuquerque was $40,061. For more details on the economic status of the region, refer to the District's reports (USACE 2002, 2003a, 2007, 2008a,b).

The total population of Sandoval County in 2000 was 89,908 (USACE 2002, 2003a, 2007, 2008a,b and references therein), and it can be considered generally rural in character. The Town of Bernalillo and City of Rio Rancho had populations of 6,611 and 51,765, respectively, in 2000. Sandoval County is roughly 3,709 square miles, with approximately 24.2 persons per square mile (Figure 29). In 2000, Sandoval County had a PCPI of $22,247. This PCPI ranked 5th in the State of New Mexico, and was 101 percent of the State of New Mexico average, $21,931, and was 75% of the national average, $29,469. The average annual growth rate for the State of New Mexico was 3.9 percent and for the nation was 4.2 percent (U.S. Census Bureau 2008 a,b).

The existing conditions of neighborhoods adjacent to the bosque are likely to remain comparable to the present situation. As such, the neighborhoods would not benefit from potential improvements in quality of life and possibilities for redevelopment stemming from restoration and additional recreation opportunities. The bosque would be less likely to play a key role in redevelopment of the area and it would have an increasingly lower value as a tourist attraction. Some improvements may be made by local agencies if this project were not implemented. Without the project, homeless encampments in the Proposed Action Area are likely to increase, thereby increasing the potential for fire and illegal activities.

3.14 Land Use

Land use in the bosque is limited today to a floodway with passive recreation and educational uses. Historically, the bosque had a rich legacy as a cultural landscape, which has already been described in detail above. Most of the historic uses such as wood cutting and agriculture have either been outlawed or displaced to adjacent areas.

As with many bottomlands on the margins of urban areas, the bosque has also long functioned as a dump. Early levee construction and armoring techniques also employed the dumping of large amounts of construction debris. This use of the bosque continued until relatively recently, with construction debris from as late as the 1980s present in some areas along the levees. In general, dumping has been one of the most frequently raised concerns of community members and stakeholders alike, and the OSD has worked diligently to curb the dumping within the RGVSP limits.

Land use adjacent to the bosque has also changed a great deal over time. Currently, the primary uses are either residential or public in the form of the Albuquerque Biological Park (Zoo, Botanical Garden, and Aquarium) or one of a number of Bernalillo County and City of Albuquerque Parks. Other land uses within and adjacent to the Proposed Action Area include flood control structures (such as levees and drains), bridges crossing the river, and other restoration projects mentioned above and in Section 4.21. Historically, similarly situated floodplain in the MRG areas would have been a mosaic of wetlands, especially salt grass meadows, pasture lands, irrigated croplands and dumps. With the advent of major flood control measures, the active floodplain has been reduced to a tiny sliver; residential and other urban uses have claimed land that was formerly considered undevelopable right up to the riverside drain. The current mosaic of adjacent land uses tends to be patterned by the bridges and more recent commercial uses. Dumps and major industrial areas have become public parks and open spaces (for example the Albuquerque Country Club Golf Course, Kit Carson Park, the Zoo, and the County Open Space that had been the Serna Trucking site). There are still isolated areas of irrigated farmland, small pastures and other rural uses adjacent to the riverside drain which lies between the bosque and private homes (see Figure 21).

The Proposed Action Area is located in Bernalillo and Sandoval Counties. The area is within the *Facilities of the Middle Rio Grande Floodway Project*. The bosque area within Albuquerque is designated as the Rio Grande Valley State Park through the Park Act of 1983 and is cooperatively managed by the OSD and the MRGCD. These relationships have been long-term and are planned to continue. The federal agencies of USBR and the Corps have also had a long-term involvement in this stretch of the river. All parties have agreed to continue collaborative work to manage, maintain and monitor this site. All applicable permits and licenses would be obtained from the appropriate agency as listed above.

Adjacent to the project area (outside of the levees), farming is still a major land use in various corridors. The Proposed Action would have no effect on current uses of water for agriculture, ranching, residential, or other activities in the area. State of New Mexico designated uses and standards applied to the Rio Grande would not be affected by the Proposed Action.

Farmland that is protected from conversion or other adverse effects under provisions of the Farmland Protection Policy Act (Public Law 97-98) includes lands defined as prime or unique, or that are of statewide or local importance for the production of food, feed, fiber, forage, or oilseed crops, as determined by the appropriate state or unit of local government agency or agencies.

Other adjacent land uses include recreational, commercial and industrial activities.

Increased growth in the Albuquerque Metropolitan Area would be a further burden on the river and the lands along the bosque. Land in the Proposed Action Area is part of the Rio Grande Valley State Park, and as a result, would remain otherwise undeveloped. Residential development adjacent to the Proposed Action Area, and further development of the Albuquerque Area could increase the number of bosque users. Under the No Action Alternative, the lack of restoration and the design of a formal trail system to accommodate these additional users could result in even greater disturbance of the bosque, further accelerating its decline. Based on the current regulatory regime, other problematic land uses such as dumping and wood harvesting should not be a widespread problem. Some of these problems may be addressed by local agencies if the project were not implemented, but not at as large of a scale or as expeditiously.

3.15 Recreational Resources

The Proposed Action Area lies within the RGVSP, Corrales Bosque Preserve, and Pueblo of Sandia. The RGVSP receives heavy use from walkers, joggers, equestrians, and bicyclists along its estimated 24.6 miles of trails, although precise numbers are not available. The Paseo del Bosque is a paved trail which is approximately 15 miles in length from Alameda to south of Rio Bravo. Trails within the RGVSP bosque exist on both sides of the river and are a natural surface (in most cases dirt though in some cases a formalized crusher fine trail has been constructed). At the Rio Grande Nature Center, there are a number of loop trails. Various levels of recreation take place on the paved trail including jogging, bicycling, roller blading and walking. On the natural surface trails jogging and walking take place but mountain biking and horseback riding are also favorite uses. No motorized vehicles, except for maintenance and emergency vehicles, are allowed per City of Albuquerque and Bernalillo County ordinances.

In the Corrales Bosque Preserve, a natural surface trail allows limited access (for those capable of navigating a natural surface trail to enjoy jogging, walking, horseback riding, and bicycling). No motorized vehicles are allowed, except for maintenance and emergency vehicles, per Village ordinance. Within the Sandia Pueblo, a formalized trail system does not exist but varying levels of recreation take place on the levee and inside the bosque.

Another recreational activity that takes place in all locations is fishing. Sandia Pueblo has a formal fishing area called Sandia Lakes. In Corrales, fishing takes place along the drains. Within the RGVSP, there are various fishing locations. Tingley Ponds is the main fishing location, with two large fishing ponds and a children’s fishing pond. Other areas remaining open to anglers include the Rio Bravo Picnic Area fishing pier, which is over the drain at the northeast corner of Rio Bravo and the river. Other fishing takes place on the drain at Paseo del Norte, Bridge Street on the east side of the river and other various locations though these are not formalized.

The remainder of the Proposed Action Area is frequented by hikers, equestrians along informal trails and roads. The current trail network is poorly configured; duplicate trail segments run throughout the Proposed Action Area. The use of informal trails in some places has caused deterioration of vegetation and disrupted wildlife habitat. The Middle Rio Grande Bosque Restoration Supplemental Master Plan was developed in 2003 (MRGCD), and promotes the bosque’s primary land use as open space maintained for wildlife habitat and recreational uses. Project areas have been identified by the MRGCD to decrease the encroachment of invasive species, satisfy the recreational demand, promote educational use, and reduce hazardous fuel loads and risk of wildfire in the bosque. However, many projects have remained incomplete due to the lack of funding sources for this scale of project.

Under the No Action Alternative, the educational and recreational activities currently enjoyed by the citizens of Albuquerque and visitors would remain roughly as they are. As the bosque in the Proposed Action Area becomes increasingly hazardous and unsafe due to increased densities of non-native and dead and down vegetation, however, the quality and time for these activities would be increasingly diminished. The bosque would have to remain closed for longer periods of time because of the fire hazard, and the experience would be further degraded. As noted above, the lack of a clearly defined interpretive trail system could lead to the proliferation of trails and off-trail uses, which would further disturb the Bosque and accelerate its decline. Again, some improvements by local agencies or other initiatives may improve this situation, but not to the level that the preliminary proposed project entails.

3.16 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 Corps, 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.

3.17 Hazardous, Toxic, and Radiological Waste

Multiple locations that currently store hazardous materials, hazardous wastes, and petroleum products and where there have been significant releases of these in the past are identified within a one mile and greater radius from several project areas. A review of the 2007 Environmental Data Report (EDR), dated 9 April 2007, was recently completed along with recent site visits to several of the project areas along the corridor by personnel from the US Army Corps of Engineers (USACE) Albuquerque District Environmental Engineering Section who are trained in identifying the presence of and impacts from hazardous wastes and petroleum products.

Observations by USACE personnel included surficial solid waste in small concentrations typically restricted to the terminus of storm water outfalls. This waste was typically plastic bottles, bags, cups, glass, and other household waste that were washed through the storm water drainage systems and deposited near the outfalls. Other sporadic waste as described above was observed and likely deposited by wind and users of nearby pathways.

A mixture of recreational, residential, commercial, and industrial land uses are located adjacent to the Rio Grande. In a flooding situation, some commercial and industrial properties have a potential to pose an imminent threat to the river from the release of hazardous wastes, hazardous substances, or petroleum products. An Environmental Atlas for the Rio Grande corridor in this flooding situation has been provided in the HTRW Appendix of the Feasibility Study Report.

In the absence of the project, and given the current regulatory regime and policing of the bosque, the current hazardous, toxic and radiological waste is unlikely to change significantly. Illegal dumping would likely continue in the less used and informal access areas. In some places dumping also impedes law enforcement officers and firefighters in their efforts to secure public safety and put out fires in the bosque.

3.18 Environmental Justice

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 (EO12898), *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 Action. Most environmental effects from the Proposed Action, in this instance, would be expected to occur in Bernalillo and Sandoval Counties, New Mexico.

3.19 Invasive Species

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

3.19.1 Invasive Plants

As discussed in Section 3.8, there are a number of invasive tree species that are proposed to be removed and/or reduced in number under the proposed action. These include salt cedar, Russian olive, Siberian Elm, Tree of Heaven, and Russian Mulberry. These species outcompete the native species and can convert riparian habitat to a drier, more upland habitat. Left unchecked, these species can outcompete all native vegetation and take over. This shift would eliminate the native riparian bosque that the goals of this project aim to protect and restore. Under the No Action Alternative, invasive tree species would continue to spread throughout the bosque. Some management of these species is performed by local agencies, but to a limited degree on an annual basis.

3.19.2 Noxious Weeds

Executive Order 13112 directs Federal agencies to prevent the introduction of invasive (exotic) species and provides for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

In addition, the State of New Mexico, under administration of the United States Department of Agriculture, designates and lists certain weed species as being noxious (Nellessen 2000). "Noxious" in this context means plants not native to New Mexico that may 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 infestation 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. In order to prevent this, all equipment would be cleaned with a high-pressure water jet before leaving an area and entering a new area.

Under the No Action Alternative, noxious weeds would continue to spread throughout the bosque and would not be managed in the Proposed Action Area.

4.0 Foreseeable Effects, Environmental Compliance, Commitments and Recommendations of the Proposed Action

Discussion in each of the sections below focuses on Foreseeable Effects of the Proposed Action. Foreseeable Effects of alternatives considered but eliminated from further study would be very similar if not exactly the same. As stated in Section 2.2, alternative analysis included various combinations of nine alternative restoration measures within the five project reaches resulting in hundreds of alternatives that were analyzed. The Proposed Action was the result of the HEAT and ICA that allowed for the greatest increase in habitat units compared to cost, and also met the overall project goals, though alternative types were the same in each reach (as discussed in Table 1) .

4.1 Physiography, Geology and Soils

Soils would obviously be disturbed during construction. As stated above, non-native vegetation would be removed from all work areas. All vegetation would be removed from the banks and bottom of high-flow channels and swales. The bottom of all high-flow channels would be graded. The banks of the swales and high-flow channels would be revegetated with native species but the bottom of the channels would remain open for flows to move through. Vegetation may come in on its own as well.

Prior to construction, all environmental protection measures as expressed by contract clauses, design drawings, or other means would be reviewed with the contractor at a pre-construction conference. Silt fencing would be installed when working near the bank of the river. Local soil disturbance permits would be required from the City of Albuquerque. There would be a fair amount of soil disturbance in order to connect and grade the channels. Replanting the banks with native grasses and other vegetation would negate some of these short-term impacts. The channels, however, needs to remain fairly open to allow flows to move through. Therefore, there would be a temporary short-term adverse effect to soils by the Proposed Action.

4.2 Climate

The Upper Rio Grande Water Operations Model (URGWOM) has investigated this issue extensively and information for the Albuquerque Reach is summarized below. URGWOM is a computational model developed through an interagency effort and is used to simulate processes and operations of facilities in the Rio Grande Basin in New Mexico from the Colorado state-line to El Paso, Texas (flood control operations only below Caballo Dam) and complete accounting calculations for tracking the delivery of water allocated to specific users. URGWOM is not a water supply model, a climate model, a water rights model, a rainfall/runoff model, a hydraulic model, or a groundwater model. URGWOM is used to complete daily timestep rulebased simulations to forecast operations, deliveries, and resulting flows through the end of a calendar year with forecasted inflows computed using a Forecast Model. While this model is continually updated, specific forecast runs can only be done on an annual basis based on the current year's snowmelt. Based on this information and other information available through URGWOM, there is a general assumption that water would be flowing through the Albuquerque Reach under future climate change scenarios but the timing, duration and peak of those flows could more variable than they currently are.

The Rio Grande through this reach is used for conveyance of regulated flows for downstream irrigation and water deliveries to meet compact requirements. Project water features have been designed to operate at the water levels expected during an average water year. These average water year flows have been determined from historical data and are expected to continue into the future if water compact deliveries are to be met. Since the restoration features were not designed for (or dependent upon) extreme events, climate change would not be expected to affect them dramatically so long as water availability is sufficient to meet compact requirements. These features will continue to operate to some level even if the timing, duration and peak of these flows become more variable in the future. Since the maintenance component to this project is key, adaptive management would be utilized as needed based on changes related to climate change and/or other factors. Continued coordination with water management scenarios and their implementation will also be key to successful riparian restoration efforts (Seavy et al., 2009).

4.3 Hydrology, Hydraulics and Geomorphology

FLO-2D modeling was used to support the Proposed Action and is further described in the Feasibility Study Report. The model was used to validate existing conditions as well as analyze Proposed Action alternatives.

A baseline sediment-continuity analysis was also performed to evaluate the potential for aggradation or degradation in response to both individual short-term hydrographs and longer-term flows (50-year project life) with the present channel configuration and reservoir operations.

The hydraulic and sediment-transport results for the existing conditions model were used to perform a channel-stability analysis; results of the analysis indicate that the bed-material transport capacity is relatively consistent from subreach to subreach, although there is a slight net degradational tendency, in the absence of tributary sediment inputs, for the overall study reach for all three of the individual storm hydrographs that were analyzed.

An analysis of the overbank sediment-transport characteristics was conducted to evaluate the long-term sustainability of restoration features. The amount of sediment deposition on the overbank appears to be relatively low during the 100-year post-Cochiti flood-flow snowmelt hydrograph. Given the relatively low amount of deposition during this large event, the overbank features are not expected to be unreasonably affected by sediment deposition over the 50-year life of the project.

For the average-annual hydrograph, the amount of overbank inundation increases in all subreaches and for all five future channel conditions compared to existing conditions. A combined total of 228.7 acres are inundated in Subreaches 1 through 5 in Year 0 conditions for the Proposed Action as compared to 87.9 acres inundated in Subreaches 1 through 5 for the existing condition. The Proposed Action would result in a 160.2% increase in the area of inundation for hydrology scenario 2. The extent and maximum depth of inundation for this scenario are shown in the Hydrology & Hydraulics Technical Section of the Feasibility Study Report.

Therefore, the Proposed Action would have a positive effect on Hydrology, Hydraulics and Geomorphology in the Albuquerque Reach (Proposed Action Area). The Proposed Action would increase connectivity and increase the area of inundation. The project would be sustainable over the project life of 50 years based on the sediment continuity analysis.

4.4 Water Depletions

The Proposed Action consists of approximately 10 water features (e.g. high flow channels and wetlands), the majority of which lie within the designated 600-foot Rio Grande Floodway. All features would be evaluated to determine whether they require depletions offsets. Work on those features that lie outside of the 600-foot corridor and do require offsets would not commence until a source of offset water satisfactory to the Office of the State Engineer has been procured. Depletions offsets are based on open water evaporation rates (NADA, 1983) for the period of inundation for each particular year. Therefore, because any increase in water depletions from the Proposed Action would be offset, there would be no effect on Water Depletions.

4.5 Water Quality

Soil disturbance would result from vegetation clearing, jetty jack removal, and excavation of wetlands, swales and high flow channels. Denuded soils would be susceptible to erosion by wind and water. This erosion could result in introduction of sediment to the Rio Grande. The potential for storm water pollution during construction is minimal for this project. The contractor's work would be in accordance with the National Pollutant Discharge Elimination System permit as described below.

Mechanical equipment such as brush-clearing machines and excavators could potentially leak oil, fuel, or hydraulic fluid, which could reach the Rio Grande and affect surface water quality. Spills of such materials could similarly contaminate surface water in the river or riverside drain. All equipment would be inspected daily to ensure that oil, fuel, hydraulic fluid, or other potential contaminants are not leaking. All petroleum products would be stored outside of the 100-year floodplain and maintained to ensure that leaks or spills are contained and remediated at the storage site.

Section 404 of the Clean Water Act requires analysis under the EPA’s 404 (b)(1) Guidelines if the Corps proposes to discharge fill material into a water or wetlands of the United States. A 404 (b)(1) Evaluation was completed for this project (Appendix E). The 404 (b)(1) analysis has been completed for Nationwide 33 (Temporary Construction, Access, and Dewatering) due to the potential need to dewater at the bank of the river when constructing the high-flow channels, and Nationwide 27 (Stream and Wetland Restoration Activities) for work that would take place in the San Antonio Oxbow to restore wetland function in that habitat. All conditions under Nationwide

Permits 33 and 27 would be adhered to during construction. A water quality certification permit under Section 401 of the CWA would be required. The Corps would coordinate with the New Mexico Environment Department (NMED) regarding activities and schedules to allow the opportunity for monitoring water quality conditions during project implementation.

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 National Pollutant Discharge Elimination System (NPDES) guidance. Some ground disturbance may take place. A Storm Water Pollution Prevention Plan (SWPPP) for the project is required for construction. This would be developed by the contractor who would be required to adhere to this plan and required to file a Notice of Intent (NOI) with the Environmental Protection Agency. Through this NOI the contractor performs all work in accordance with the Nationwide NPDES permit prior to commencement of construction activities. The SWPPP would also include a Spill Control Plan. Compliance with these requirements would ensure that the Preferred Alternative would have no significant effect on the water quality of the Rio Grande. Water quality would be monitored throughout the project. Silt fences (without lead weights) would be installed prior to construction in all areas and other standard BMPs would be implemented. All construction activities would be in compliance to all applicable Federal, state and local regulations.

There may be a short-term adverse effect on water quality during construction along the banks of the river but that portion of construction would take place during low flows of the river. Also, once the water features have been constructed, many of them would provide a benefit to water quality. Those water features where wetland plants are installed would provide improved water quality as the wetland plants take up materials in the water passing through the feature (such as storm water passing through wetlands constructed near these features, or sediment laden water passing through the high-flow channels). Therefore, there would be a minor short-term adverse effect on water quality during construction only and a positive long-term benefit to water quality by the Proposed Action.

4.6 Air Quality and Noise

The Proposed Action is located in New Mexico's Air Quality Control Region No.152, which encompasses all of Bernalillo County and most of Sandoval and Valencia counties. These three counties are "in attainment" (i.e.: do not exceed State and Federal Environmental Protection Agency air quality standards) for all criteria pollutants (NMED, 1997). Air quality in the project area is generally good. The closest Class I area is Bandelier National Monument, approximately 50 miles to the north of the project area. A Class I area is a wilderness area or a National Park. Air quality in the project area is generally good to excellent due to the lack of urban industrial development. Although high winds are common in and around the project area, blowing dust is generally not a problem except during extremely dry years. Airborne particulate and carbon monoxide concentrations from wood burning in the Rio Grande valley are occasionally high during winter months when temperature inversions and wood stove use are both more prevalent. All vehicles involved in construction at the project site would be required to have passed a current New Mexico emissions test and have required emission control equipment (if required).

Since there would be ground disturbance during construction of all features in the Proposed Action, BMPs to minimize air quality disturbance would be employed. These include tracking out of material by covering trucks to avoid fugitive dust violations; maintaining and sweeping public trails to keep them free of debris and dust; and wetting down work areas. Speed limits on levee roads would be limited to 15 mph, which would also minimize dust.
A fugitive dust permit would be obtained from the City of Albuquerque. All work areas would be continually wet down to minimize dust. Any sediment deposited on the paved trail due to construction would be swept as needed. Therefore, short-term impacts to air quality are anticipated during construction but would be abated to the extent possible using BMPs as described above. There would be no long-term adverse effects to air quality by the Proposed Action.

The OSHA (Occupational Safety and Health Administration) noise standard limits noise levels to 90 dBA averaged over an eight-hour day (29 CFR 1910.95), although hearing damage can begin at levels as low as 80 dBA over an eight-hour day. No worker may be exposed to noise in excess of 115 dBA without protection, which would reduce the exposure below 115 dBA (AFSCME, 2004).

Albuquerque's noise control ordinance was placed into effect in June 1975. The Environmental Health Department's Consumer Protection Division personnel are responsible for enforcing the ordinance. Noise control enforcement may involve many sources of excessive noise: radios, stereos, television, live bands, machinery, equipment fans, air conditioners, construction, vehicle repairs, motor vehicles, and general noise. The ordinance stipulates a property-line value in which the noise level emitted must not exceed 50 decibels (dB) or 10 decibels above the ambient level; whichever is greater (Mitzelfelt, 1996). For example, if you are playing a stereo, the sound level traveling from the stereo to the neighboring property lines cannot be more than 10 decibels higher than the general noise level existing before the stereo was turned on. Noise level meters are used to measure the sound level as it is crossing the property line. The meters are similar to radar meters the police use for speed detection; however, instead of detecting an object in motion, it detects air pressure (sound waves) in motion and produces a numbered level called decibels.

Equipment to be used during construction would include pieces generating a fair amount of noise. This noise would be somewhat abated in adjacent neighborhoods due to the buffering by the levee road when work is taking place in the bosque. Travel on the levee roads to and from work locations would also create noise during the project. The project would take place during normal work hours between 7:00am and 5:00pm in order to minimize disturbance. All OSHA and local municipality requirements (as described above) would be adhered to. Therefore, there would be minor, short-term noise impacts by the Proposed Action during construction, which would occur only during normal working hours.

4.7 Aesthetics

The Proposed Action includes removing jetty jacks, reducing fuel loads and thinning of non-native vegetation, creation of water features, and revegetation with native species. In order to accomplish these goals, construction within the bosque would include machinery of varying sizes (as discussed in Section 2 above). This would cause short-term negative affects to aesthetics during construction. Post-construction, some visual effects would be noticed depending on the level of work required. There would be an increase in native plants and therefore, a potential increase in wildlife. Therefore, there would be negative, short-term impacts by the Proposed Action to aesthetics during construction and for a short time after construction, but these impacts would decrease over a short period of time. The Proposed Action would have a long-term positive effect on aesthetics by removing what many may deem as ‘unsightly’ jetty jacks, burned and/or dead material and creating new wetland and other water features. Revegetation with native vegetation species would further increase the aesthetics of the site after a few years of maturation.

4.8 Vegetation Communities

Proposed Riparian Gallery Forest Mosaic

For the Proposed Action, revegetation of areas that OSD has already worked in would be a primary objective. Revegetation of areas proposed to be thinned under this project would also be revegetated in a timely manner. Current discussions among professionals of riparian restoration include a conceptual mosaic for future vegetative conditions. The prescription for bosque landscape alteration centers on re-creating a patchy mosaic of native riparian trees and open spaces along the narrow active floodplain of the Middle Rio Grande (Crawford and Grogan, 2004). Although the present straightened and levee-bordered river would require that the mosaic be somewhat linear, it would otherwise resemble the pattern of scattered cottonwood groves interspersed by open spaces that once characterized the wider historic floodplain (Horgan 1984).

Open areas between the patches also would support grasses and shrubs, and widely spaced individual trees or groves useful for animals moving between the patchy woodlands. This combination of tree reduction (which is already occurring and is being proposed within this project) and increased open space would reduce overall evapotranspiration (ET) in the altered landscape and potentially increase water in its shallow aquifer. The conceptual mosaic is still evolving and would be site specific but an overall breakdown of vegetative communities would include approximately 30% shrub community, approximately 50% tree community (with 25% being tree with grass understory and the other 25% being tree with shrub understory), 16% grassland/herbaceous community, and the other 4% as wet meadow/wetland community. Burned areas being revegetated first would be analyzed by land managers to determine how this mosaic community is establishing and refine that as needed for other locations.

In creating this future conceptual mosaic, revegetation strategies would be implemented. All sites would be tested for depth to groundwater, soil salinity, and soil texture. Existing topography would be coupled with this information to develop revegetation strategies for each project area.

Long-term benefits proposed by the project include reduction in fire potential, potential water savings, potential decreased soil salinity, and increased wildlife habitat value over the long-term. It should be noted that potential water savings can depend significantly on local physical variables.

Fuel loads in the Middle Rio Grande have built up over the last 50 years or more due to the lack of flooding and disconnect between the river and bosque. Flood flows used to carry away debris and allow for quicker processing of vegetative material. Since this does not readily occur, much of the dead material has built up over that period of time and created an extreme fire danger. A reduction in these fuel loads, especially in the ladder fuels (which create a ladder between the floor of the bosque and the cottonwood canopy), can greatly reduce the chance of a catastrophic fire were one to occur. This older material is also extremely dry and flammable. Removal and processing of this material is crucial to preventing future fires.

Saltcedar are fire-adapted species and have long taproots that allow them to intercept deep water tables and interfere with natural aquatic systems. Saltcedar disrupts the structure and stability of native plant communities and degrades native wildlife habitat by out-competing and replacing native plant species, monopolizing limited sources of moisture, and increasing the frequency, intensity and effect of fires and floods. Although it provides some shelter, the foliage and flowers of saltcedar provide little food value for native wildlife species that depend on nutrient-rich native plant resources (Muzika and Swearingen, 1999). Birds prefer to nest in native vegetation that contain their preferred physical structure and food source (Yong and Finch, 2002). Overall, the possible short term ill effects resulting from non-native vegetation removal and the Proposed Action would be strongly mitigated through the replacement of saltcedar with a younger, more diverse native riparian community which would add to biodiversity at the landscape level.

Saltcedar control in mixed saltcedar/native bosque would reduce stress to native species, which are competing with exotic vegetation, and would reduce wildfire hazards (Taylor, 1999). Substrate for native species regeneration within these sites would also be provided as a result of saltcedar control and decreased salinity of the soil. This alternative would maximize the production of indigenous species such as salt grass, willow, and native wet meadow species, to potentially support greater numbers of native bird species and other wildlife.

Individual locations within the Proposed Action may have a varied revegetation strategy in order to aim toward the conceptual mosaic and stay within current water demands. Replacing dead material and non-native vegetation with a mosaic of native vegetation should lead to a system of less water use, decreased fire danger, and increased diversity of native species for use by wildlife. Therefore, the long-term effects of replacing the non-native dominated vegetation system with native dominated species is proposed to outweigh the short-term negative effects, which would be caused by the Proposed Action.

4.9 Floodplains and Wetlands

The majority of wetland communities within the Proposed Action Area would be avoided during implementation. Wet meadow areas would be created during the revegetation phase, which would increase the wetland acreage in the project area. The Oxbow is, however, one location where restoration features are proposed in order to improve the overall function of the wetland. The remaining features to be implemented in the Proposed Action would not affect existing wetland habitat.

Section 404 of the Clean Water Act (CWA) requires analysis under the EPA's 404 (b) (1) Guidelines if the Corps proposes to discharge fill material into water or wetlands of the United States. A 404 (b) (1) Evaluation was completed for this project and is enclosed as Appendix E. The 404 (b)(1) analysis has been completed under Nationwide Permit 33 (Temporary Construction, Access, and Dewatering) because of the potential need to dewater at the bank of the river when constructing the high-flow channels; and under Nationwide Permit 27 (Aquatic Habitat Restoration, Establishment, and Enhancement Activities) for proposed work in the San Antonio Oxbow to restore wetland function. All conditions under Nationwide Permits 33 and 27 would be adhered to during construction. A water quality certification permit under Section 401 of the CWA would also be required. The Corps would coordinate activities and schedule with the New Mexico Environment Department (NMED) to allow water quality monitoring during project implementation. Therefore, the Proposed Action would have a minor adverse impact on the San Antonio Oxbow during construction of features to improve the function, but no effect during implementation of all other features.

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 of critical importance 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." Removal of the non-native vegetation may allow the active floodplain to expand. Since excavation of the bank to reconnect channels and bank terracing are proposed as part of the restoration, there would be an impact to the existing floodplain. These features would be designed, however, so that there is no negative impact to existing flood control levees. Construction of water features and/or willow swales would not take place within 50 feet of the levee. The constructed inlets and outlets of the high flow channels would be formed and protected with vegetation to hold it in place. Therefore, the Proposed Action may affect the floodplain, but these impacts are anticipated to be positive.

4.10 Fish and Wildlife

The proposed work would occur during the winter, which is when Bald Eagles may be in or near the Proposed Action Area. In order to minimize the potential for disturbing Bald Eagles utilizing adjacent habitat, the following guidelines would be employed. If a Bald Eagle is present within 0.25 mile upstream or downstream of the active construction site in the morning before activity starts, or is present following breaks in project activity, the contractor would be required to suspend all activity until the bird leaves of its own volition; or a Corps biologist, in consultation with the USFWS, would determine that the potential for harassment is minimal. However, if a Bald Eagle arrives during construction activities or if an eagle is greater than 0.25 mile away, construction need not be interrupted. Also, cottonwood snags or other large trees present along the riverbanks that may serve as potential roost habitat would be left intact as part of this project. Implementation of these measures would preserve undisturbed Bald Eagle use of roost, foraging and perching sites in the riparian area adjacent to the project sites.

In order to minimize potential effects on nesting birds in the project area, clearing of live vegetation would only occur between August 15 and April 15. Per MBTA, the proposed project would not entail the taking, killing or possession of any migratory birds listed under this Act. Since some raptors begin setting up nests as early as February, monitoring for bird nests would occur before construction to avoid any potentially active nests. The proposed project, is therefore, in compliance with the requirements of the MBTA.

The Proposed Action is approximately 25,000 feet east of the Double Eagle II Airport (which is on the west side of Albuquerque) as well. The Albuquerque International Airport is within the recommended 5 mile approach and departure airspace. The Airport currently implements procedures to reach altitudes well above the bosque canopy to attempt to avoid waterfowl and other birds utilizing the bosque. Therefore, the Proposed Action is within compliance of the Memorandum of Agreement between the Federal Aviation Administration, the U.S. Air Force, the U.S. Army, the U.S. Environmental Protection Agency, the USFWS, and the U.S. Department of Agriculture to *Address Aircraft-Wildlife Strikes* (referenced in Section 3.10).

Other wildlife such as arthropods, mammals, amphibians and reptiles would also be displaced during implementation of the Proposed Action. There is also the potential to affect amphibian species in the bosque due to herbicide use. The New Mexico Department of Game and Fish suggested that risks of toxicity to this fauna could be avoided by eliminating the use of herbicide use during the month of September. Therefore, herbicide use within the project area would only take place between October and April.

Since the ultimate goal is to revegetate with native species, which would create a healthier ecosystem in the long-term for native wildlife, these short-term effects of the project would be outweighed by the long-term benefits to all species. Implementation of the BMPs and timelines mentioned above would also aid in protecting species. Therefore, the Proposed Action would have short-term negative effects on wildlife with long-term positive benefits. The variability of habitat types would also provide different niches for different groups of wildlife (birds, herpetofauna, fish, small mammals and arthropods).

In accordance with the Fish and Wildlife Coordination Act, the Corps has been and will continue to coordinate with the USFWS and seek their advice and recommendations on fish and wildlife resources during all phases of the project. The USFWS submitted a Final Fish and Wildlife Coordination Act Report (CAR) to the Corps on November 10, 2010 (Appendix G). The CAR concluded that the proposed project would not have any permanent adverse impacts on the biological resources in the project area with implementation of recommendations outlined in the report. The CAR's short-term recommendations (to be implemented during construction) are listed below. These recommendations would be incorporated as construction BMPs where possible. Many of the recommendations overlap with specific goals of the Proposed Action. The Corps will coordinate with the USFWS (and other agencies as appropriate) on the more 'long-term' recommendations.

1. Where possible, avoid construction during the migratory bird nesting season of March through August. Where that is not possible, tree stands or other adequately vegetated areas slated for grubbing or clearing should be surveyed for the presence of nesting birds prior to construction. Avoid disturbing nesting areas until nesting is complete.

2. Employ silt curtains (without lead weights), cofferdams, dikes, straw bales or other suitable erosion control measures during construction.

3. Store and dispense fuels, lubricants, hydraulic fluids, and other petrochemicals outside the 100-year floodplain. Inspect construction equipment daily for petrochemical leaks. Contain and remove any petrochemical spills and dispose of these materials at an approved upland site. Park construction equipment outside the 100-year floodplain during periods of inactivity.

4. Ensure equipment operators carry an oil spill kit or spill blanket at all times and are knowledgeable in the use of spill containment equipment. Develop a spill contingency plan prior to initiation of construction. Immediately notify the proper Federal and state authorities in the event of a spill.

5. All work and staging areas should be limited to the minimum amount of area required. 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, and described in the USACE's project description. Provide designated areas for vehicle turn around and maneuvering to protect riparian areas from unnecessary damage.

6. Backfill should be uncontaminated earth or alluvium suitable for re-vegetation with native plant species.

7. Scarify compacted soils or replace topsoil and re-vegetate all disturbed sites with suitable mixture of native grasses, forbs, and woody shrubs.

8. Protect mature cottonwood trees from damage during clearing of non-native species or other construction activities using fencing, or other appropriate materials.

9. Use local genetic stock wherever possible in the native plant species establishment throughout the riparian area.

10. Vegetation treatments will avoid the federally endangered Southwestern willow flycatcher migration and breeding seasons.

11. Immediately prior to construction of each unit and prior to reinitiation of work following an extended period of no action, conduct surveys to assess the possible presence of Federal and State endangered or threatened species, or Tribal species of concern. If protected species are located, coordinate with Federal, State, and Tribal wildlife agencies to prevent adverse impacts to the species.

12. Construction should be accomplished during periods of least resource impact. Work should be scheduled to avoid disturbance to breeding and nesting neotropical migrant land birds and to fish, especially native fishes, during the spawning and hatching periods. To minimize disturbance to wildlife, the duration of project construction should be as brief as possible.

13. Implement recovery measures for the minnow. This should include long-term monitoring throughout the proposed project area.

14. Conduct bald eagle surveys to determine areas of eagle use. Avoid project activity in areas where eagles are known to perch or roost from November to March.

15. Strict control and frequent monitoring of construction activity by the USACE biologist to ensure all contract specifications and agreements are being implemented and achieved.

16. Inspect all equipment daily to ensure there are no leaks or discharges of lubricants, hydraulic fluids or fuels.

4.11 Endangered and Protected Species

Rio Grande Silvery Minnow

Designated critical habitat for the species (68 Federal Register 8087: 8135) encompasses nearly the entire project area. Work would not take place in the main channel but it would take place along the bank and it may result in erosion or other inputs into the river. When work is to occur close to the bank of the river, BMPs would be enforced to prevent erosional inputs into the river. These BMPs would include, but would not be limited to: the use of silt fences adjacent to the riverbank to prevent erosion to the river; fueling of vehicles would not take place inside the levees; and equipment and vehicles would be cleaned prior to entering the bosque.

Additionally, this project is being constructed to provide potential habitat for the RGSM and would create additional suitable nursery habitat through the creation of high-flow channels with scallops which would help with the population. High-flow channels would provide habitat in the form of ephemeral side channels (scallops) for the RGSM and potential refuge during spawning, egg, and/or juvenile stages. This project would be closely monitored to determine the benefits for the RGSM which are proposed to occur as an outcome of the Proposed Action.

Therefore, the Proposed Action may affect but is not likely to adversely modify designated Critical Habitat of the Rio Grande silvery minnow. The Proposed Action may affect and is likely to adversely affect the Rio Grande silvery minnow, though it may also provide positive benefits to the species. The Corps has formally coordinated with USFWS in regard to this species since USFWS was a participant on the E-Team. The Corps submitted a Draft Biological Assessment in reference to the Rio Grande silvery minnow on April 5, 2010 (and amended in November, 2010). A Biological Opinion (BO) was received for the project on April 15, 2011. Both documents are available in Appendix H. USFWS concurred that the Proposed Action may have both adverse and beneficial effects, as well as indirect effects. Therefore, the USFWS issued an incidental take statement as follows: "take in the form of harassment may affect up to 6,988 silvery minnows due to proposed construction, as well as the harassment and mortality of up to 8,471 silvery minnows (juveniles and adults) due to potential stranding in restored features after peak flows recede." Therefore, per the BO, the Corps will perform the following reasonable and prudent measures (RPM) during construction in order to minimize take:

1. Minimize take of silvery minnows due to habitat restoration activities.

2. Manage for the protection of water quality from activities associated with the restoration project.

3. Work collaboratively with the Service on the Middle Rio Grande Endangered Species Collaborative Program.

The following terms and conditions would be implemented during construction, in order to implement the RPM's above:

1. Ensure that all restoration treatment work is conducted during low flow periods, avoiding the silvery minnow spawning period and effects to potentially large numbers of offspring, by working within the timeframes described in this biological opinion (not between April 15 and August 15 of each year).
2. Ensure that conservation measures described in this biological opinion are implemented, including those pertaining to equipment and operations, staging and access, water quality, and others.
3. Ensure that the presence/absence of silvery minnows is visually monitored at construction sites by a permitted biologist, and use adaptive management to modify activities to minimize adverse effects.
4. Implement the project-specific monitoring, including entrapment monitoring, and adaptive management as proposed and report results annually to the Service.
5. As appropriate, report to the Service the results and effectiveness of restoration treatments.
6. Report to the Service findings of injured or dead silvery minnows.
7. Monitor the implementation of RPM 1 and its associated Terms and Conditions.
8. Ensure that conservation measures described in this biological opinion are implemented, including those pertaining to construction timing and sequencing, water quality monitoring, equipment and operations, and staging and access.
9. Ensure that all restoration treatment work is conducted during low flow periods, minimizing water quality impacts, by working within the timeframes described in this biological opinion (not between April 15 and August 15 of each year)

10. Report to the Service any significant spills of fuels, hydraulic fluids, and other hazardous materials.
11. Monitor the implementation of RPM 2 and its associated Terms and Conditions.

Post-construction monitoring, per the protocol provided in the BO, would also be performed for two years after construction.

Southwestern Willow Flycatcher -

Based on the surveys conducted within the Proposed Action Area and other surveys performed in the past within the project areas (by other entities), it is highly unlikely that nesting Southwestern Willow Flycatcher would occupy the project area during the construction period, proposed to begin in 2012 and continue through 2017. It is very possible that migrants would be present in the project area in spring and fall. Surveys at the locations where migrants have been detected would continue each year as they have in the past. If nesting Flycatchers are detected on any locations where work is proposed under this Proposed Action, then consultation with USFWS would be initiated.

Also, creation of willow swales in the Proposed Action would provide potential habitat for the SWFL. Over time, these would create willow stands of the preferred density and stature for SWFL. Restoration proposed in the San Antonio Oxbow would also improve potential habitat where migrants have been detected for the past three years.

Therefore, the Corps has determined that the proposed work may affect but is not likely to adversely affect, the Southwestern Willow Flycatcher. Designated Critical Habitat was determined for SWFL in November 2005 but is not in the project area. Construction of the features described above may beneficially affect the SWFL. The Corps has formally coordinated with USFWS in regard to this species since USFWS was a participant on the E-Team. In the BO (April 15, 2011), the USFWS concurred with the Corps' determination above.

Yellow-Billed Cuckoo –

Habitat potentially suitable for nesting of Yellow-Billed Cuckoo is present in the Proposed Action Area, primarily in the form of dense saltcedar stands, therefore, it is limited. Yellow-Billed Cuckoo has been noted to nest late into October (D. Krueper, personal communication). Surveys for nests in potential habitat would occur through October prior to construction. This habitat would be thinned and revegetated during this project, creating native potentially suitable habitat in the future. Therefore, the Proposed Action may affect but is not likely to adversely affect the Yellow-Billed Cuckoo during implementation and could have a long-term positive effect.

4.12 Cultural Resources

Due to the nature of the Rio Grande, it has generally been thought that if archaeological sites occurred within the Rio Grande Floodway (within the flood control levees), they would have been either washed away or buried by river sediments (Sargeant 1987:36-37); however, that is not the case for more recent historic era properties. For the Corps' recent Bosque Wildfire Project and the Ecosystem Revitalization @ Route 66, Albuquerque, New Mexico, Section 1135 Project, a total of approximately 2,228 acres of Rio Grande bosque, in 50 project area parcels, have been archaeologically surveyed for cultural resources (Marshall 2003; Everhart 2004a; Estes 2005; Walt, Marshall, and Musello 2005; Marshall and Walt 2006). As of September 30, 2008, these Corps surveys have recorded twenty-eight (28) archaeological sites within the Rio Grande Floodway. These sites are primarily remnants of historic earthen structures related to irrigation canals (acequias) and drainage ditches as well as some old, wooden bridge pilings, representing the alignments of historic bridges. Most of the acequia remnants are ditch segments that were abandoned as a result of the 1930s MRGCD construction of the flood control levees. These Laboratory of Anthropology (LA) sites include: LA100484/LA118119; LA118060; LA127144; LA132552; LA138855; LA138856; LA138857; LA138858; LA138859; LA138860; LA139208; LA143458; LA145193; LA145194; LA145195; LA145200; LA145559; LA145560; LA145561; LA146158; LA146160; LA146161; LA146162; LA146163; LA153622; LA153623; LA153624; and LA153625.

One site, an abandoned segment of the historic Alburquerque Acequia Madre (LA143458), probably dates to the 1706 founding of the Villa de Alburquerque (Everhart 2004b). Structural components of other historic acequias may also date to approximately the same period and a few such as the Atrisco and Ranchos de Atrisco acequia remnants (LA138859) may date to as early as the mid-1600s (Marshall 2003; Sánchez 1998). No prehistoric archaeological sites are known to occur in the Rio Grande Floodway project area; however, at least one large prehistoric pueblo, of unknown location, may still exist in the area, potentially within the floodway. American Indian traditional cultural properties are known to occur within the Rio Grande Floodway.

Consulting parties in the Section 106 process for the proposed restoration project include the Corps, Bureau of Reclamation, MRGCD, the City of Albuquerque, and the New Mexico State Historic Preservation Office. 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 and Historic Preservation Division's 2008 Native American Consultations List, American Indian Tribes/Pueblos that have indicated they have concerns within Sandoval and Bernalillo Counties have been contacted regarding the Proposed Action (see Appendix D). These tribes include the Pueblo de Cochiti, the Comanche Indian Tribe, the Hopi Tribe, the Pueblo of Isleta, the Pueblo of Jemez, the Jicarilla Apache Nation, the Pueblo of Laguna, the Navajo Nation, the Pueblo of Ohkay Owingeh, the Pueblo of San Felipe, the Pueblo of San Ildefonso, the Pueblo of Sandia, the Pueblo of Santa Ana, the Pueblo of Santa Clara, the Pueblo of Santo Domingo, the White Mountain Apache Tribe, the Pueblo of Ysleta del Sur, and the Pueblo of Zia. To date, the Corps has received no tribal concerns regarding the Proposed Action. Currently, there are no known tribal concerns and no traditional cultural properties are known to occur within or adjacent to the project areas.

The Proposed Action Area of Potential Effect (APE) covers approximately 668 acres in 16 project area parcels. An archaeological survey of the APE was conducted between September 2 and 8, 2008, by the University of New Mexico's Office of Contract Archeology (OCA). The project's archaeological survey is reported by Robin M. Cordero, Tracy Steffgen, and Patrick Hogan, and entitled *A 667.6 Acre Cultural Resource Survey of the Rio Grande Floodway for the Middle Rio Grande Bosque Restoration Feasibility Project, Bernalillo and Sandoval Counties, New Mexico* (dated January 20, 2009, UNM-OCA Report No. 185-996; NMCRIS No. 111640).

As noted for other Corps' projects and restoration activities located within the Rio Grande Floodway, segments of historic acequias and/or drainage ditches were abandoned when they were cut off by MRGCD construction of the valley's modern irrigation system and the flood control levees and riverside drains in the 1930s. Wide areas near the river were affected by years of flooding prior to the MRGCD work. There was a significant amount of rehabilitation of the MRGCD system that included the levees and riverside drains that was conducted by the Corps and the Bureau of Reclamation in the 1950s and 1960s. Several segments of historic acequia remnants and other structures have been documented during the above noted Corps projects; these all being in a weathered and dilapidated condition, having been subjected to river inundation and flooding. To date, no prehistoric archaeological sites have been discovered within the Rio Grande Floodway. The Corps is aware of two traditional cultural properties that occur within the Rio Grande Floodway. All National Register of Historic Places (NRHP) eligible historic properties recorded within the Rio Grande Floodway during recent Corps' projects have generally been linear, earthen ditch or drain remnants which are relatively easily recognizable. Due to localized areas of dense vegetation, OCA's survey did not cover 26-percent of the project area; however, given the linear nature and large size of previously recorded NRHP eligible properties, as well as the generally disturbed nature of the bosque due to the river's aggradation, degradation, and relatively frequent channel movement, the Corps finds that OCA's identification efforts that covered 74-percent of the APE are sufficient for this project.

The OCA survey documented five (5) structures as historic sites: LA160891, LA160892, LA160893, LA160894, and LA160895. These five earthen structures are reported as abandoned segments of acequias or drainage ditches. There were no artifacts or other features associated with these five sites. No other artifacts or historic properties were observed during the OCA survey. The Proposed Action plans to conduct vegetation removal and riparian restoration activities in the vicinity of the five earthen structures recorded by OCA. OCA recommended that all five sites are not eligible for nomination to the National Register of Historic Properties (NRHP). During review of the OCA survey documentation, the Corps compared the OCA data with recent aerial imagery, the 1922 Reclamation Service (BOR) maps that were prepared from data collected during 1917/1918 field surveys, and Bureau of Reclamation's (BOR) 2001 GIS data on the locations of the Rio Grande channel for the years of 2001, 1992, 1972, 1962, 1949, and 1935.

As noted below, the Corps is of the opinion that LA160891 is a non-eligible historic ditch segment and that OCA's LA160892, LA160893, LA160894, and LA160895, are natural in origin and are, therefore, not archaeological sites. The Corps agrees with OCA's recommendation that LA160891 is not eligible for nomination to the NRHP. From the available information, the Corps is of the opinion that LA160891 is a field ditch that may have been associated with the Corrales Ditch/Sandoval Lateral, and therefore, may date as early as ca. 1850 to as late as the mid-1930s MRGCD construction. The Corps, however, is of the opinion that because it is not a part of a major active acequia or primary lateral, and the salient information was recorded during survey, it is not eligible for nomination to the NRHP.

For OCA's LA160892, LA160893, LA160894, and LA160895 structures, all generally described as earthen, abandoned segments of ditches or drains, none are shown on the 1922 Reclamation Service maps. The Corps has reviewed the available mapping and river channel documentation, and the locations of these four "sites" at one time or another post-1935, were a part of the active river channel. Therefore, they are of a more recent and natural origin and are more likely remnants of naturally occurring river high flow channels/banks. In one case, for LA160895, it may also be related to fire-fighting activities that occurred a few years ago. From the available documentation, the Corps is of the opinion that these four earthen structures are the result of natural river flow or recent activity in the bosque and are therefore not historic properties and not eligible for nomination to the NRHP.

The project's proposed riparian restoration activities would occur in the vicinity of two previously recorded historic archaeological sites: LA118060, an old remnant spur line of the Atchison, Topeka and Santa Fe Railway (previously determined not eligible for nomination to the NRHP), and LA145559, documented as a northeast trending internal drain (previously determined eligible for nomination to the NRHP under criterion d of 36 CFR 60.4). Proposed work near LA118060 would not affect the railroad spur remnant. OCA (2009:29; see Appendix D) indicates that they believe Estes (2005; NMCRIS No. 89833) misidentified LA145559 as an internal drain and that it is actually a natural overflow river channel. Estes's (2005:61-63) description of the LA145559 internal drain presents an unlikely "southwest to northeast" direction (on a river running north-to-south) and unusual dimensions for a drain ditch: "The width of the ditch varies from 17 meters at the southwestern end, and narrows to 3 meters wide near its outlet." The Corps has reviewed the 1922 Reclamation Service maps and the 2001 river channel documentation, and found that LA145559 is located 675 feet north of the internal drain shown on the 1922 Reclamation Service map and that LA145559 was a part of the active river channel in 1935. The Corps therefore agrees with OCA that LA145559 is in fact not an archaeological site.

In summary, based upon the above information and available documentation, the Corps is of the opinion that the LA160891 field ditch is not eligible for nomination to the NRHP, and that LA160892, LA160893, LA160894, LA160895, and LA145559 are in fact not archaeological sites and therefore are not eligible for nomination to the NRHP. The LA118060 railroad spur was previously determined not eligible for nomination to the NRHP and it would not be affected by the project. Therefore, the proposed Middle Rio Grande Bosque Ecosystem Restoration Project would result in "No Historic Properties Effected" because there are no NRHP eligible sites within the APE. On March 9, 2009, the New Mexico Historic Preservation Officer concurred with the Corps determination of "No Historic Properties Effected."

Should previously unknown artifacts or other historic properties be encountered during construction, work would cease in the immediate vicinity of the resource. A determination of significance would be made and further consultation, on measures to avoid, minimize, and/or mitigate potential adverse effects, would take place with the New Mexico State Historic Preservation Office, the Bureau of Reclamation, MRGCD, the City of Albuquerque, and with American Indian Tribes that have cultural concerns in the area.

4.13 Socioeconomic Considerations

The Proposed Action would benefit the socioeconomic environment of the communities (including the City of Albuquerque and Village of Corrales) adjacent to the Proposed Action Area. Potential effects would be associated with construction of the Proposed Action. Construction effects would include beneficial effects associated with localized purchases of material, equipment and supplies and the effects of additional worker salaries and income. In the immediate area, local revenue benefits would largely be limited to a demand for goods and services. Increased recreational and interpretive opportunities may lead to more business for local merchants and other public institutions. The improvements to the Proposed Action Area in tandem with the existing public institutions would help the area become an even greater destination for tourists. Other long-term positive impacts include improved aesthetics, access and recreation.

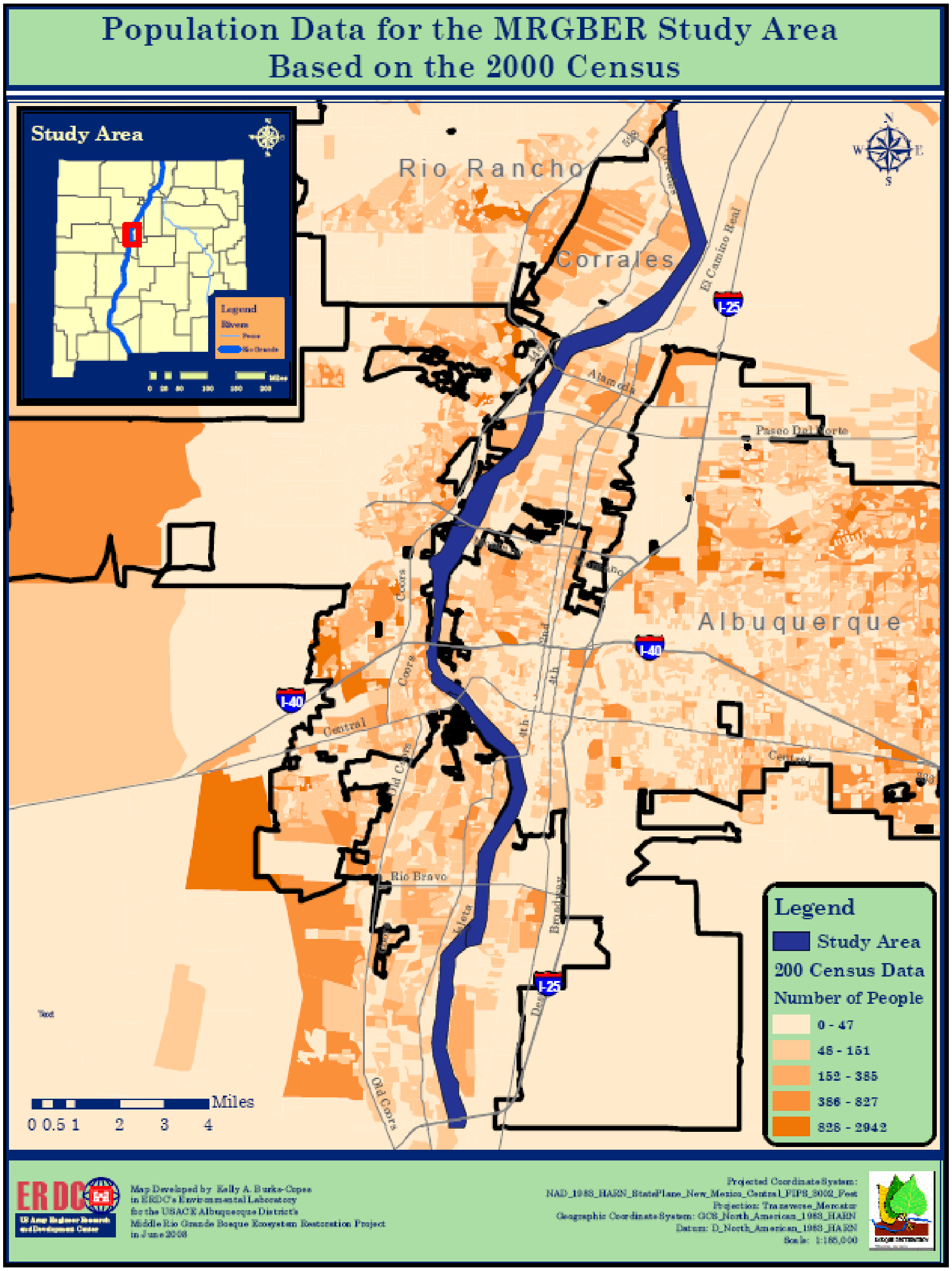


Figure 29. Population data derived from the 2000 Census for Bernalillo and Sandoval Counties

4.14 Land Use

The project areas are within the *Facilities of the Middle Rio Grande Floodway Project* boundaries and would not affect adjacent agricultural land use and would not change current land status. Therefore, the Proposed Action would not affect these land resources.

4.15 Recreation Resources

The education, interpretation, and recreational aspects of the bosque are critical to long-term restoration and sustainability. Additional improvements such as benches, signs and wildlife observation blinds would greatly enhance this resource. Involving the community through educational and recreational features would help to insure that a healthy bosque remains a priority for environmental sustainability. Establishing formal points of access and trails would restore more of the bosque to quality habitat as well as reclaiming and revegetating duplicate trails and trails through core wildlife areas. The essential criteria in this case are to ensure a balance of access and facilities throughout the extent of the Proposed Action Area to avoid wildlife disruption, and to concentrate them near major public access areas. All recreational enhancements would comply with the Bosque Action Plan (1993).

For the Interpretive and Recreational Enhancements feature the following management measures have been generated:

- Stabilized Crusher Fine Trail (see Figure 30 for an example)
- Benches
- Picnic Tables
- Parking Improvements
- Bridge
- Kiosk
- Signage
- Boat launch ramps

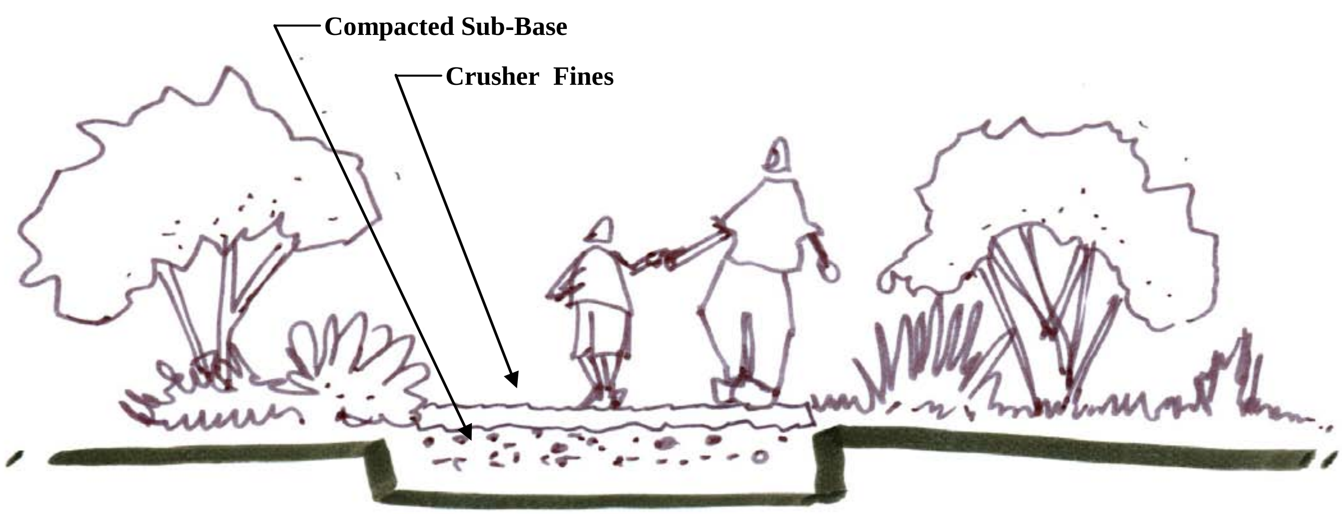


Figure 30. Stabilized Crusher Fine Trail

The current trail network is poorly configured; duplicate trail segments run throughout the Proposed Action Area. The use of informal trails in some places has caused deterioration of vegetation and disrupted wildlife habitat. Additional improvements such as benches, signs and wildlife observation blinds would greatly enhance this resource.

Construction activities would temporarily impede recreational activities in the Proposed Action Area. All work zones would be designated and signed with cautionary information. The paved trail would be kept clean for use by park visitors as much as possible and all machinery and vehicles would yield to park users. Implementation of the Proposed Action would result in a considerable enhancement of the recreation system in the Proposed Action Area. Proposed recreational features area shown in Figures 31-35. The Proposed Action also conforms to and builds upon OSD plans for the recreational system in the RGVSP.

Cumulatively these trails, once built, maintained and policed, have the potential to significantly reduce the human impact on wildlife and vegetation in the bosque, while increasing the functionality of the existing recreation system. These trails would enable the bosque in the Proposed Action Area to connect to the urban fabric of Albuquerque, as well as other recreational areas that can support more intensive recreational uses. The trail system would also integrate significant existing features as well as proposed new amenities and a series of benches throughout the system. In so doing, a unique and improved recreational and interpretive experience would be provided to neighboring residents, the larger community and the many visitors to Albuquerque. Therefore, the Proposed Action would have short-term negative effects on recreational and interpretive resources with long-term positive benefits.

4.16 Indian Trust Assets

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 and Historic Preservation Division's 2008 Native American Consultations List, American Indian Tribes/Pueblos that have indicated they have concerns within Sandoval and Bernalillo Counties have been contacted regarding the Proposed Action (see Section 6.1). To date, the Corps has received no tribal concerns regarding the Proposed Action. No traditional cultural properties are known to occur within or adjacent to the project areas. Some of the work would occur on Pueblo of Sandia land; the Corps is working closely with Sandia Pueblo. While several tribes have reservation lands and water rights within Bernalillo and Sandoval Counties, no specific concerns or ITAs have been brought to the attention of the Corps. The Proposed Action would have no effect to reservation lands or to any water rights.

Figure 31. Recreation Proposed Action, Reach 1

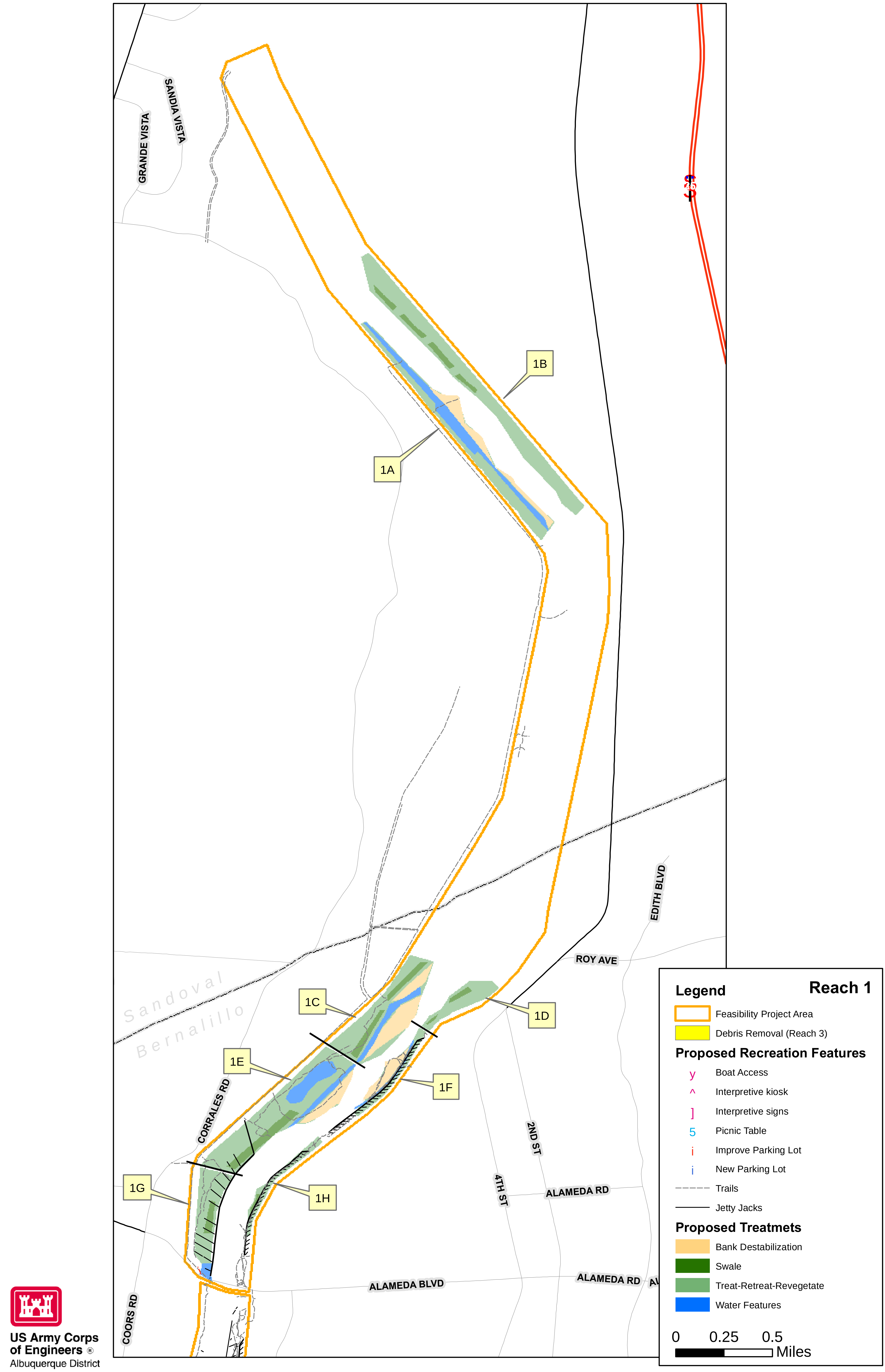
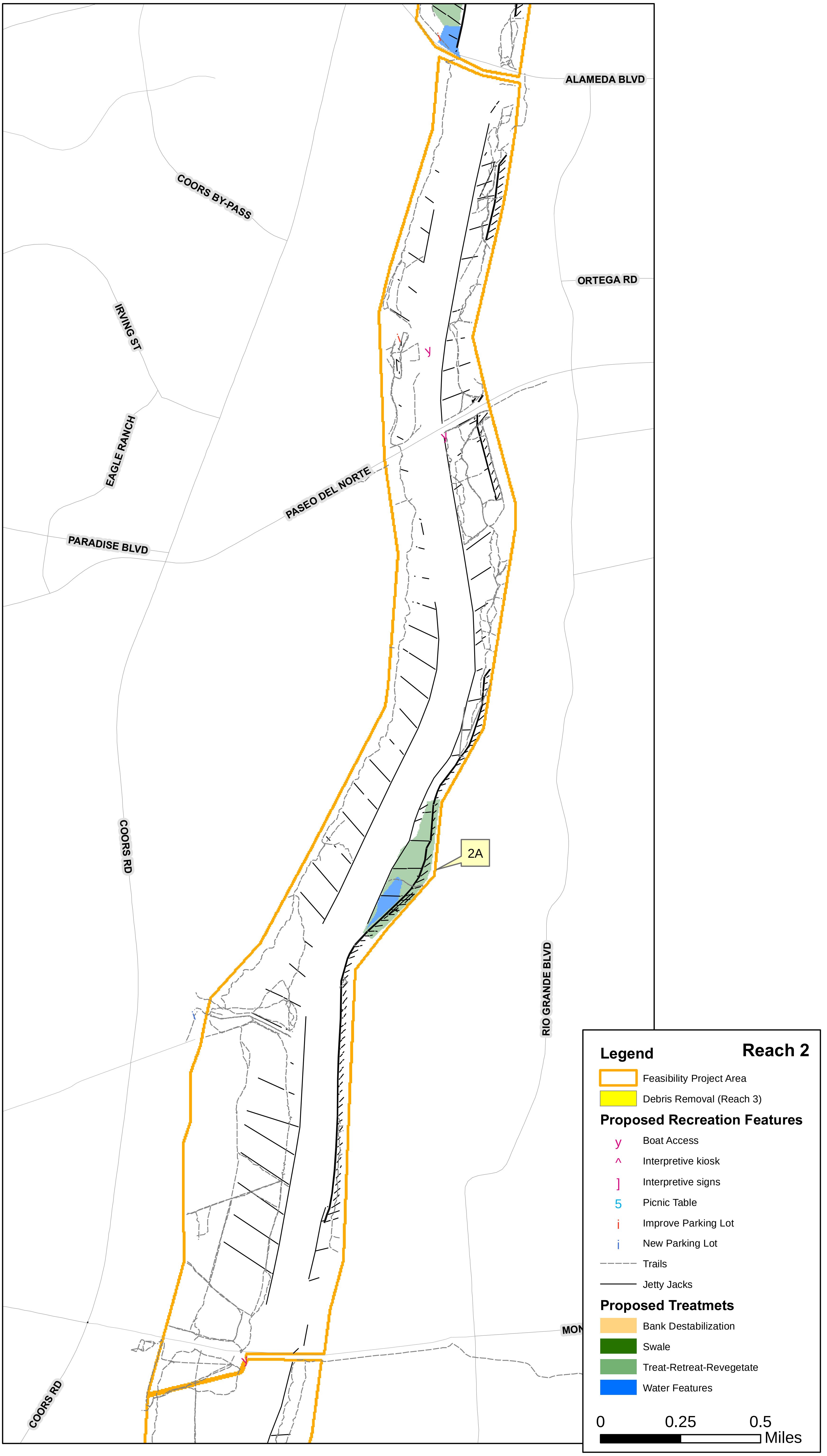


Figure 32. Recreation Proposed Action, Reach 2



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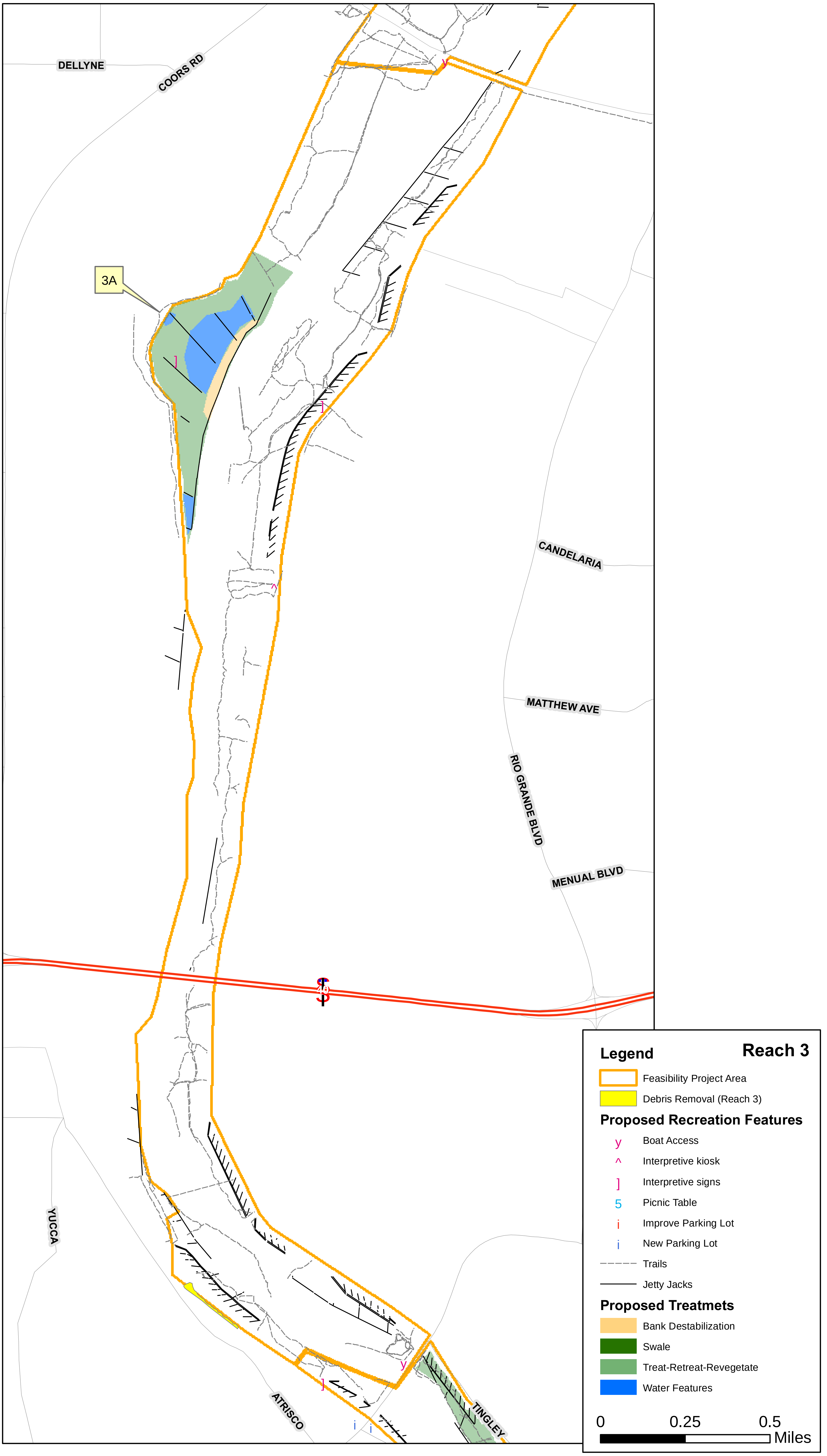
Albuquerque District

Figure 33. Recreation Proposed Action, Reach 3



US Army Corps of Engineers®
Albuquerque District

Figure 34. Recreation Proposed Action, Reach 4

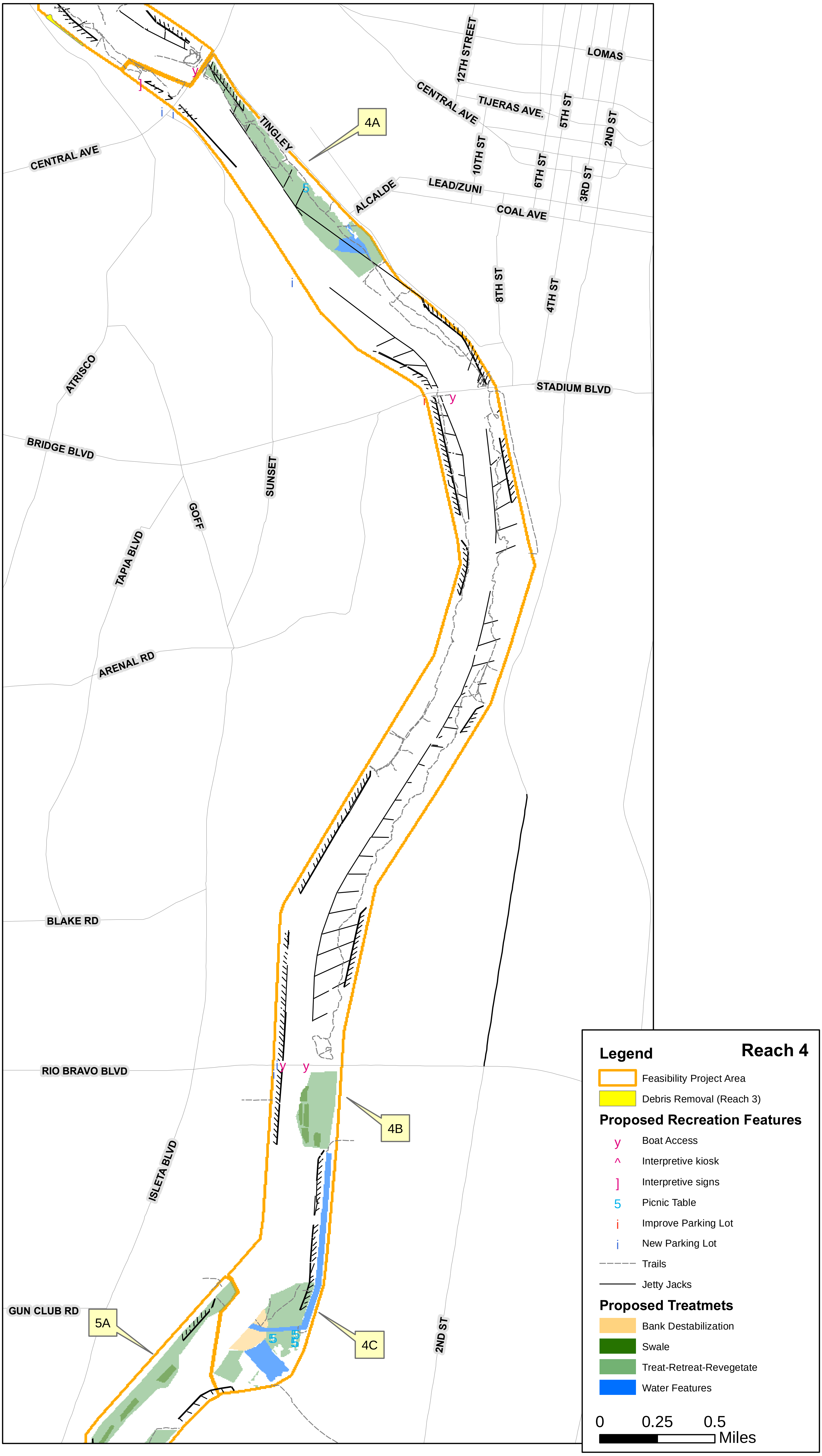


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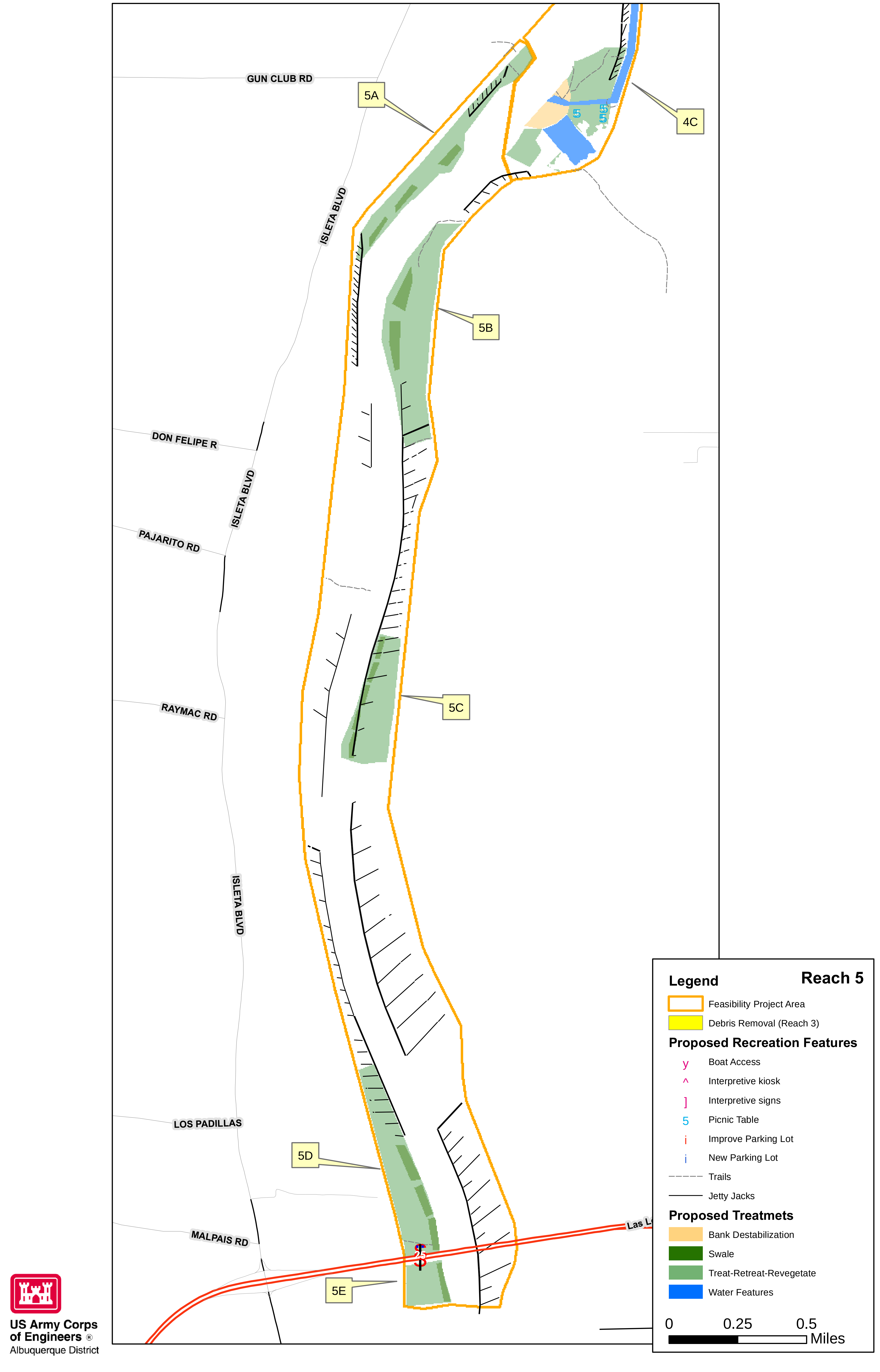
Figure 35. Recreation Proposed Action, Reach 5



4.17 Hazardous, toxic and radioactive waste (HTRW)

Based on field observations by USACE personnel in 2011 and recent internet searches on the U.S. Environmental Protection Agency and New Mexico Environment Depart websites, there are no apparent or anticipated environmental impacts that would adversely affect the planned work at any of the project sites. Field work will mainly be restricted along the Rio Grande within the bounds of the existing levee system. Most identified sites that have had releases of hazardous materials, wastes, and petroleum products are located outside of a one mile radius of a project area or do not directly impact the project areas.

Since all the sites that were identified are located several miles from the actual project sites for this project, there would not be any apparent or expected impact from the project work on any of these identified release or storage sites. Likewise, the sites that do have released contaminants and petroleum products are located several miles from the Proposed Action sites and do not pose a hazard to the work site, workers constructing the Proposed Action features, nor to the public which would be visiting these project sites after construction.

All work planned to construct the proposed features (including but not limited to excavations and vegetation controls) would be conducted in accordance with Federal, State, and local pollution control laws. Requirements would include the contractor's storage and use of fuels, oils and other lubricants, herbicides, pesticides and other potentially used or applied chemicals. A National Pollutant Discharge Elimination System (NPDES) permit for storm water pollution prevention from construction activities would be obtained and implemented. Therefore, there would be no adverse effect to or by HTRW by the Proposed Action.

4.18 Environmental Justice

Due to this project's value as a wildlife habitat, improving the natural environment would increase the benefit the surrounding community and urbanized areas. No displacement, relocation, economic, or any adverse action to minority or low income populations of the community would result from the project. Though some homeless encampments may need to be removed as part of implementation of the Proposed Action, this would allow the area to be safer for public use as well as provide local public assistance to those individuals. The surrounding populations would benefit from this project with improvements to the Proposed Action Area and enhancement of their quality of life through ecosystem restoration and recreational efforts. Reversing ecological degradation and re-creating a healthy natural environment creates more sustainable live, work, and play opportunities for the people of the community.

During the scoping process for the project, a number of public meetings were held and input was solicited from the public. Input was provided during meetings and/or after via mail or e-mail. This input from the public was used to develop alternatives, especially those providing public access and use of the bosque.

Table 9 shows the demographics of the project area population in relation to county and state-wide data. When comparing the demographics of the immediate surrounding tract populations with the state and county wide data, it is evident that the statistics remain similar including the majority of the population being Hispanic/Latino at 57.8%, with poverty levels remaining below 10%.

Table 9. Demographics within the Proposed Action Area

Middle Rio Grande Flood Plain Environmental Justice		Race				Below Poverty Level			Age		
	Total Population	White	Hispanic & Latino	American Indian & Alaskan Native	Other	0-17	18-64	65+	0-17 years	18-64 years	65 and older
New Mexico	1,819,046	44.7%	42.1%	8.9%	2.6%	7.0%	9.9%	1.5%	27.9%	60.4%	11.7%
Bernalillo County	556,678	48.3%	42.0%	3.5%	4.2%	4.6%	8.0%	1.0%	25.3%	63.3%	11.5%
Sandoval County	66,152	39.6%	55.0%	2.5%	1.4%	6.9%	8.7%	1.1%	29.9%	59.7%	10.3%
Proposed Action Area	61,816	35.6%	57.8%	8.2%	1.2%	6.6%	8.6%	1.6%	28.7%	59.3%	11.3%

The proposed project would create some economic opportunities through ecotourism, education and recreational sites, as well as promoting programs for resource conservation and protection. Executive Order 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…" The project would not disrupt or displace any residential or commercial structures. The work has been reviewed for compliance with this order and it has been determined that the Proposed Action would not adversely affect the health or environment of minority or low-income populations. Under the definition of Executive Order 12898, there would be no adverse environmental justice impacts under the proposed action. From north to south, the Proposed Action Area borders high to low income neighborhoods. The Proposed Action benefits all income brackets by increasing ecosystem restoration, access and recreational amenities along the whole project area.

4.19 Invasive Species

4.19.1 Invasive Plants

Though the goal is not to totally eradicate all of the invasive tree species, the proposed action does include selectively thinning these species to allow native species to be planted and given a chance to outcompete the non-native vegetation. Non-native trees will most likely always be present, but the proposed action goal would be to reduce them to a manageable level (for example, 10-15% of the tree population). Therefore, the Proposed Action would have a beneficial effect by removing non-native vegetation and planting native vegetation.

4.19.2 Noxious Weeds

A detailed mapping of Class A and B noxious weeds within the Proposed Action Area was performed in 2006 as part of the Bosque Wildfire Project (Parametrix, 2007) (Figure 36). OSD has continued to update mapping of weeds within the Albuquerque Reach. Weeds within the Proposed Action Area would be treated (if a proven method for treatment exists) or avoided (if no treatment method exists) in order to prevent the spread. Any new patches of weeds found during construction of the Proposed Action would be noted and treated/avoided as pertinent. This information would also be provided to the land manager and the State Weed database for monitoring and follow-up.

Salt cedar is a Class C weed that also occurs within the Proposed Action Area. It is anticipated that due to efforts to treat resprouts of non-natives and replanting of native species, that this 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 saltcedar and Russian olive. Also, in addition to the BMPs discussed above, the contractor would be required to wash all equipment being used before entering the project area. Therefore, it has been determined by the Corps that the Proposed Action 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.

SECTOR NUMBER	PROPERTY NAME	ACRES
1	Alameda NE	36
2	Alameda SW	38
3	Paseo NW	26
4	Alameda SE	54
5	Paseo SW	44
6	SIPI	52
7	Paseo SE	49
8	Los Ranchos	34
9	La Orilla	65
10	Taylor N	63
11	Taylor S	64
12	Montaño NW	67
13	Montaño NE	51
14	Montaño SW	60
15	Graham S	54
16	Montaño SE	53
17	Oxbow	66
18	Nature Center N	57
19	Nature Center S	49
20	I-40 NW	55
21	I-40 NE	64
22	I-40 SW	63
23	Central NW	55
24	I-40 SE	63
25	Central NE	45
26	Central SW	76
27	Central SE	47
28	Tingley	45
29	Bridge NE	49
30	Bridge SW	65
31	Bridge SE	35
32	South Second	83
33	Rio Bravo NW	66
34	Schwartzmann	60
35	Rio Bravo NE	67
36	Rio Bravo SW	58
37	South Harrison	55
38	Rio Bravo SE	57
39	South Diversion North	51
40	South Diversion S	44
41	Durand	48
42	Pajarito	57
43	Shirk	41
44	Umbrage Farms	59
45	Padilla's	53
46	Price's	77
47	State Land N	62
48	State Land S	56
49	I-25 W	72
50	I-25 E	54

Figure 36. Map of Noxious Weeds in Albuquerque, Fall 2006 (Parametrix, 2007).

4.20 Herbicide Application and the Environmental Fate of Chemicals

Herbicide application would be used after manual and/or mechanical treatment of non-native vegetation. The preferred herbicides to use are Garlon®3A (for treatment of resprouts) and Garlon® 4 (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, unless certified by the Environmental Protection Agency (EPA) for aquatic use. In areas within or adjacent to water, only aquatic approved herbicide would be used (Renovate 3® (triclopyr) is the preferred herbicide). Herbicides not certified for aquatic use cannot be used within 50 feet of the bank of the river. 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 EPA (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 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 (Parker, 1996). 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).

These herbicides would be used as described above. 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 in accordance with all manufacturer's 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.

4.21 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 Proposed Action Area, when combined with the actions in the Proposed Action, could contribute to cumulative effects and may vary with the resource being considered. Environmental impacts associated with the bosque in Albuquerque have been evaluated relative to the Proposed Action.

Other projects in the region

Construction of Cochiti Dam in the 1960s has resulted in the ongoing degradation of the Rio Grande channel and its riparian zone both upstream and downstream of the structure. It is anticipated that the adverse environmental impacts attributed to its placement and traditional operation would continue in the future as long as it is operated for existing purposes and in the present manner. Its impacts to the immediate and surrounding landscape and local terrestrial ecosystem have stabilized since its construction.

Currently, the Corps, USBR, and the NMISC are signatories of the Memorandum of Agreement to conduct the Upper Rio Grande Water Operations Review (URGWOR) and prepare a Programmatic Water Operations Environmental Impact Statement. They are also all partners in the MRGESCP and constructing projects as described above. The URGWOR study is being prepared by the parties in accordance with NEPA and would present alternatives for analyzing water operations at Federally-operated facilities in the Upper Rio Grande Basin and would evaluate the environmental, economic, and social effects of these alternatives. It is not anticipated that the Proposed Action would add cumulatively to the environmental effects of any of the water operations alternatives that may be considered and/or adopted by the water operations review.

The MRGESCP is a multi-agency organization that has funded a number of habitat restoration projects in the Proposed Action Area. The Corps, City of Albuquerque Open Space Division, USBR and NMISC have all constructed projects within the Proposed Action Area under the MRGESCP (see Figure 37). These projects have been planned and constructed in coordination with each other and the development of the Middle Rio Grande Bosque Restoration Project. They have been planned so that they complement one another and do not overlap. The culmination of these projects would provide additional habitat for all species, and especially the Rio Grande silvery minnow and Southwestern Willow Flycatcher. Since they have been constructed during different times and not in overlapping geographic areas, it is anticipated there would be no cumulative negative impact considered in these projects, but potentially a cumulative positive benefit. These projects are described in further detail below:

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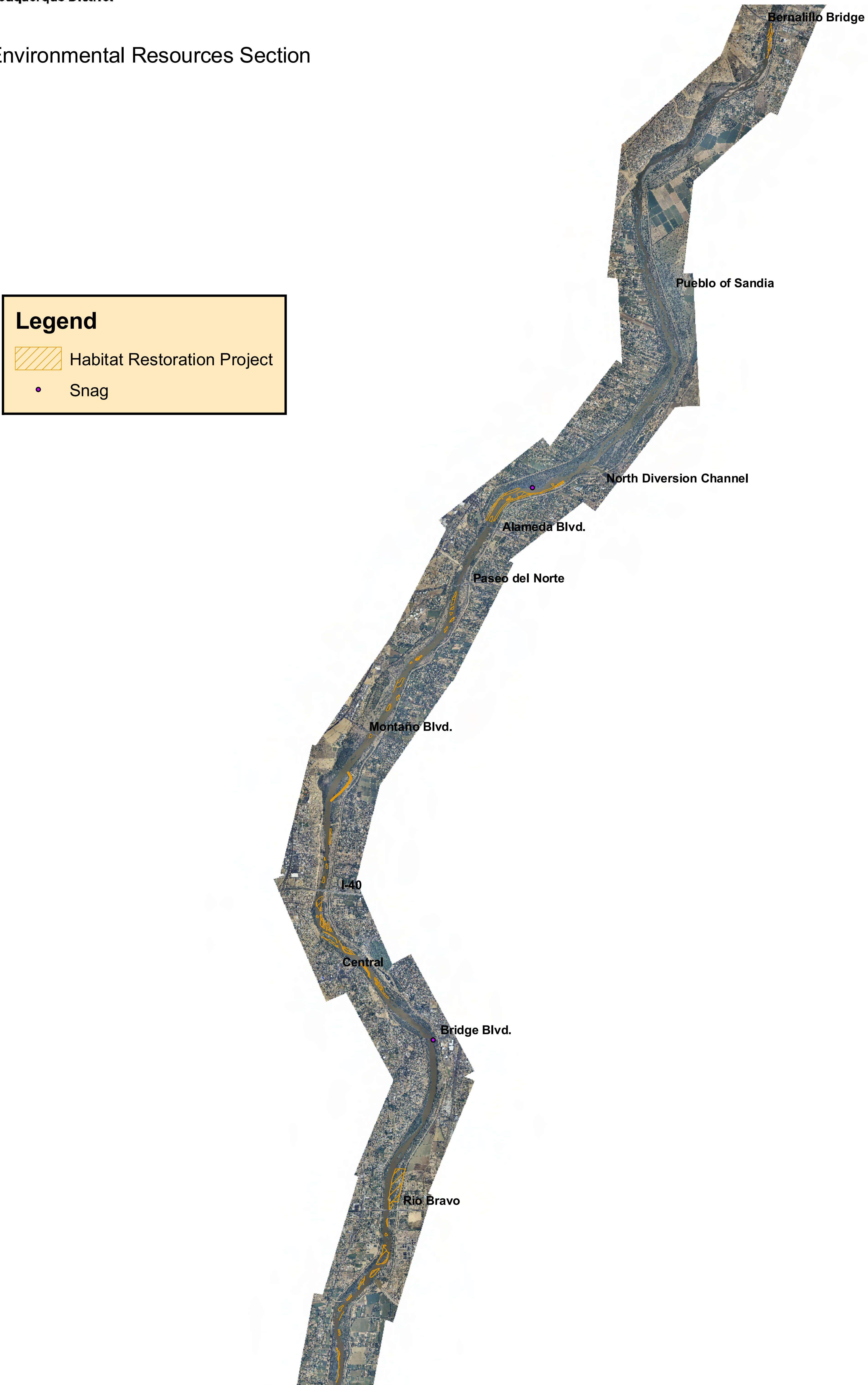
Figure 37. MRGESCP Projects in the Proposed Action Area

Environmental Resources Section



- Habitat Restoration Plan for the Middle Rio Grande – The Middle Rio Grande Endangered Species Collaborative Program (Program) is a partnership involving 20+ current signatories organized to protect and improve the status of endangered species along the Middle Rio Grande (MRG) of New Mexico while simultaneously protecting existing and future regional water uses. Two species of particular concern to the Program are the Rio Grande silvery minnow (RGSM) and the Southwestern Willow Flycatcher (SWFL). The Habitat Restoration Plan for the Middle Rio Grande provides a framework plan to implement and integrate actions needed to address both water and endangered species management issues in the Middle Rio Grande. The Habitat Restoration Plan was developed for the Habitat Restoration Workgroup in order to aid in the development of reach-specific habitat restoration plans (Tetra Tech, 2004).
- A number of restoration projects have been or are being implemented by the Program within the Albuquerque Reach including:
- Middle Rio Grande Riverine Habitat Restoration Project – ISC. In this project, the ISC is restoring aquatic habitat for the benefit of the RGSM in the river in the Albuquerque Reach by manipulating islands, bars and banks to mobilize sediments. Phase I of this project constructed potential RGSM habitat by destabilizing islands and bank lines and was completed in 2004-2005. Phase II of this project will continue island and bank line terracing in the Albuquerque Reach in 2008-2009. This project is documented in the "Middle Rio Grande Riverine Habitat Restoration Project Environmental Assessment, March 2005" (ISC and BOR, 2005).
- Rio Grande Nature Center Habitat Restoration Project - This project was constructed by the Corps to provide habitat that would potentially benefit the RGSM and the SWFL. Project construction was completed in 2007 by reconnecting an historic remnant side channel that runs through the Rio Grande Nature Center State Park to the mainstem of the river. The side channel flows when the river is flowing 1500-2000 cfs and higher. Embayments were also constructed off of the side of the channel to provide nursery habitat for the RGSM (Environmental Assessment, December 2006).
- City of Albuquerque Habitat Restoration Project - The project constructed various habitat restoration/rehabilitation techniques to restore aquatic and riparian habitat for the benefit of RGSM and SWFL within the Albuquerque Reach of the Middle Rio Grande. Construction was completed in 2006. (Final Environmental Assessment, February 2007)

The City of Albuquerque has constructed a diversion dam in the Rio Grande south of Alameda to divert San Juan/Chama water into the City's water supply system. The City has also constructed water intakes and a crossing in the Rio Grande at Campbell Road. These works are in the river and are proposed not to affect river flows except at minimal levels when the Dam is raised which would only be at low flows (500 cfs or less) (USBR, 2004).

The Corps is involved in another 1135 Ecosystem Restoration projects within the RGVSP between I-40 and Bridge Boulevard, called the Ecosystem Restoration @ RT66 Project. The construction of this project is meant to be a demonstration for the Proposed Action and began construction in January 2009 and would continue through April 2010. Construction of the Bio-Park Project south of Central Avenue was completed in the fall of 2006. The Proposed Action would not conflict with these plans and took them into consideration during plan formulation. These projects would benefit one another.

The Albuquerque BioPark project is a Corps 1135 Ecosystem Restoration project that consists of approximately 15 acres of pond reconstruction, 9 acres of wetland restoration, and 48 acres of riparian woodland (bosque) restoration in the bosque south of Central Ave. on the east side of the river in Albuquerque. The bosque was restored by enhancing hydrology and native vegetation. Non-native saltcedar and Russian olive were removed through brush cutting, root plowing and localized herbicide application. Project construction was completed in October 2006 (Detailed Project Report and Environmental Assessment for Albuquerque Biological Park Wetland Restoration Project, Albuquerque, New Mexico, January 2004a).

Under the Bosque Wildfire project, activities of selective thinning of areas with high fuel loads and/or non-native plant species populations; removal of jetty jacks and removal of debris; improvement of emergency access in the form of drain crossings, levee road improvement, and construction of turnarounds; and revegetation of burned areas began in 2004 in and around the Albuquerque area, including the Proposed Action Area. Approximately 8,000 (out of 30,000) jetty jacks have been removed under this effort. Revegetation in some of these areas has also begun in coordination with the Proposed Action. The project also includes maintenance of weather stations and a live web site that provides potential fire conditions in the bosque. Again, these actions were planned and coordinated to provide an overall beneficial effect to the system. This project is documented in the "Environmental Assessment for the Bosque Wildfire Project, Bernalillo and Sandoval Counties, New Mexico, September 2004" (USACE, 2004b).

Through the Bosque Wildfire Project and the proposed action, the Corps has worked with the Village of Corrales and the Corrales Bosque Preserve. The Corrales Bosque Advisory Commission recently completed the Corrales Bosque Preserve Habitat Management Plan (April 2009). The Proposed Action is in compliance with this document and would help implement some of its goals.

Additional non-Federal efforts include fire hazard management by OSD. The Ciudad Soil and Water Conservation District (SWCD) has also completed some thinning at locations near the Rio Grande Nature Center, the west side of the river south of Montaño Bridge and near the National Hispanic Cultural Center.

A Biological Opinion also exists for the Middle Rio Grande and contains reasonable and prudent alternatives to avoid the likelihood of jeopardizing the continued existence of listed species (USFWS. 2003. Biological and Conference Opinions on the Effects of Actions Associated with the Programmatic Biological Assessment of Bureau of Reclamations, Water and River Maintenance Operations, Army Corps of Engineers; Flood Control Operation and Related Non-Federal Actions on the Middle Rio Grande, New Mexico).

Geomorphology and Hydrology

As described above, the Proposed Action would likely have long-term positive effects on the geomorphology and hydrology as they relate to the environment of the Proposed Action Area.

There would be no effect to either during construction of the Proposed Action. 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, there are other projects planned for this area which would work in harmony with the Proposed Action to enhance ecosystem health and function in the Albuquerque reach. Therefore, the cumulative effects on the geomorphology and hydrology of the Proposed Action Area would not negatively impact the Proposed Action Area.

Water Quality
For the Proposed Action to have cumulative effects on water quality in the Rio Grande, a threshold in concentration of some pollutant, due to the effects of the Proposed Action, would have to be exceeded. In this scenario, the additive effect of a pollutant due to actions taken in the Proposed Action combined with existing water quality conditions would have to exceed a toxicity level or water quality standard. As described in Section 4.4, the additive effect of sediment impacts in the Rio Grande from the Proposed Action is likely to be immeasurable. The Proposed Action would not have any additive, long-term impacts to existing chronic effects the potentially lead to adverse water quality impacts on the Rio Grande. There could be some minor, localized, long-term beneficial effects to shallow groundwater and surface water in the Rio Grande from removal of pollutants by project features such as wetlands and over-bank channels. BMPs that would be included in the SWPPP and Environmental Protection Plan for construction would be implemented to reduce cumulative effects. In summary, cumulative adverse effects on water quality as a result of the Proposed Action would not occur.

Air Quality and Noise
There would be minor cumulative effects to air quality and noise levels during the project construction periods. However, the additive effects on noise and air quality would not extend beyond the period of equipment operation. During the period of construction, effects on air quality or noise wouldn't be likely to exceed any critical environmental thresholds due to the Proposed Action. There would be no long-term effect on air quality and noise due to implementation of the Proposed Action.

Ecological Resources
The Proposed Action would have beneficial effects on restoration of native riparian vegetation and wet habitat in the Proposed Action Area. Therefore, there would be no adverse cumulative effects from implementing the Proposed Action. Non-native vegetation removal in the Proposed Action Area would consist largely of maintaining past vegetation-clearing efforts and would not cause substantial alteration of habitat structure. Planting of native species would set forest and woodland stands on a trajectory of improving 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 Proposed Action.

Because the majority of the Proposed Action Area is within a State park and is located in the middle of a major metropolitan area, recreational use and demand is high and widespread throughout the bosque. Increased recreation use in the Proposed Action Area would be likely to occur with implementation of the Proposed Action, albeit in a more limited area. Much of the Proposed Action Area currently is subject to disturbance from recreational uses. Implementation of the Proposed Action could cumulatively add to ongoing adverse impacts to wildlife habitat from recreation uses. However, these additive impacts are not likely to exceed a threshold in habitat suitability throughout the Proposed Action Area for any species of wildlife.

While revegetation eventually avoids a significant adverse effect of the Proposed Action, there would remain a short-term adverse effect on wildlife populations until planted shrub communities mature. It is estimated that it would take up to 5-10 years for planted shrubs to be achieve stature and densities required for high use by wildlife.

In summary, it is proposed that this project would have a long-term positive impact on the environment resulting from the potential cumulative effects of other Federal and non-Federal agencies. There would, however, be short term effects during construction as described in Section 4 above.

Recreation and Interpretive Resources
A number of new recreational and interpretive features have been proposed for the Proposed Action Area, which would increase access and opportunities throughout the Proposed Action Area. They would also 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 Proposed Action Area would be temporarily limited during the construction process, the Proposed Action would only have a positive additive, long-term impact on the recreational and interpretive value of the Rio Grande bosque. In summary, cumulative adverse effects on recreation and interpretive resources as a result of the Proposed Action would become strongly positive once the project is completed.

Aesthetics
Although aesthetics would be temporarily impacted during the construction process (increased amount of bare earth areas and staging areas), the Proposed Action would have a net positive additive and long-term impact on the aesthetic value of the Rio Grande bosque in the Proposed Action Area. In summary, cumulative effects are likely to improve overall aesthetics.

5.0 Conclusion

The Proposed Action would restore 916 acres of the Middle Rio Grande bosque by enhancing hydrologic function (by constructing wet features such as high-flow channels, willow swales, and wetlands) and restoring native vegetation and habitat by removing jetty jacks, exotic species/fuel reduction, and riparian gallery forest restoration. All applicable laws and regulations noted in Section 1.4 were considered during analysis of potential effects. A summary of the effects discussed in Section 4 are shown in Table 10 below.

3.1 Summary of Effects

Table 10. Summary of Effects

Existing Environment	Foreseeable Effects
Physiography, Geology, Soils	Short-term adverse effect on soils; Positive effect on soil moisture
Hydrology, Hydraulics and Geomorphology	No negative effects on river H&H, potential positive effects
Water Quality	Short-term adverse effect; Beneficial effect by wet features
Air Quality and Noise	Short-term adverse effects
Aesthetics	Short-term negative effects with long-term positive effects by jetty jack removal and natural landscape features
Vegetation Communities	Short-term negative effects with long-term positive effects
Floodplains and wetlands	Long-term positive effect Minor adverse effect during construction
Fish and Wildlife	Short-term negative effects with long-term positive effects
	May affect but not likely to adversely affect: Southwestern Willow Flycatcher, Yellow-Billed cuckoo, Rio Grande silvery minnow critical habitat; may affect and is likely to adversely affect Rio Grande silvery minnow; Potential positive benefits to RGSM and SWFL by high flow channel, bank terracing and swale construction
Cultural Resources	No adverse effect to Historic Properties
Hazardous, Toxic and Radioactive Waste	No adverse effect
Socioeconomic Considerations	Short-term positive effects with increase in construction jobs; Long-term positive effects on improved aesthetics, access and recreation.
Land Use and Recreational Resources	No adverse effect
Indian Trust Assets	No adverse effect
Environmental Justice	No adverse effect

Noxious Weeds	Positive short and long term effects

The summary of effects above includes some short-term adverse effects during construction and long-term benefits.

6.0 Preparation, Consultation, and Coordination

6.1 Notification/Public Review

As mentioned in Section 1.4, public review of the Draft Environmental Assessment occurred on April 5 through May 5, 2010. Comments received are available in Appendix I. Below is the Notice of Availability that was released to the public in the local newspaper, neighborhood coordination newsletters and via e-mail to Middle Rio Grande stakeholders. Letters of notification were also mailed to the distribution list in Section 6.3.

Notice of Availability
Draft Environmental Assessment for the
Middle Rio Grande Bosque Restoration Project, Bernalillo and Sandoval Counties,
New Mexico

The U.S. Army Corps of Engineers (Corps), Albuquerque District, has completed the **Draft Environmental Assessment for the Middle Rio Grande Bosque Restoration Project, Bernalillo and Sandoval Counties, New Mexico (DEA)**. The Proposed Action would restore 916 acres of the Middle Rio Grande bosque through (1) by improving hydrologic function by constructing high-flow channels, willow swales, and wetlands, and (2) restoring native vegetation and habitat by removing jetty jacks, thinning exotic species, and revegetation with native species. Improvements of existing facilities for educational, interpretive and low-impact recreational uses also are proposed. Project construction would be phased over 3-5 years and is proposed to begin in August 2011 and continue through April 2016, though no work would occur between May 1 and August 30, annually.

The DEA is electronically available for viewing and copying at the Albuquerque District website (under "FONSI/ Environmental Assessments") at:

http://www.spa.usace.army.mil

or a hard copy will be sent upon written request to the following address:

U.S. Army Corps of Engineers
Albuquerque District
Environmental Resources Section
Attn: CESPA-PM-LE (Mrs. Ondrea Hummel)
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Paper copies of this document are also available for review at:

Albuquerque Main Library
501 Copper NW
Albuquerque, NM 87102

Los Griegos Library
1000 Griegos NW
Albuquerque, NM 87107

Alamosa/Robert L. Murphy Library
6900 Gonzales SW
Albuquerque, NM 87121

Taylor Ranch Library
5700 Bogart NW
Albuquerque, NM 87120

Corrales Community Library
84 West La Entrada
Corrales, NM 87048

The public review period is from April 5, 2010 to May 5, 2010. Written comments should be sent to the above address and will be accepted until 4:00 PM, May 5, 2010. Alternatively, comments may be sent electronically to **ondrea.c.hummel@usace.army.mil**.

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6.2 Preparers

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Alicia AustinJohnson – Project Manager
Julie Alcon – Supervisory Ecologist (QC)
John Schelberg- Archaeologist (QC)
William DeRagon - Biologist (QC)

6.3 DEA Distribution List

Agencies and other entities contacted formally or informally in preparation of this DEA and/or that will be notified of the public review of the document include:

U.S. Bureau of Reclamation
U.S. Fish and Wildlife Service
City of Albuquerque – Planning Department, BioPark, Open Space Division, Public Works
Middle Rio Grande Conservancy District
U.S. Environmental Protection Agency
U.S.D.A Natural Resource Conservation Service
U.S Department of Transportation
New Mexico Department of Transportation
New Mexico Department of Game and Fish
New Mexico Environment Department
New Mexico Interstate Stream Commission
Bernalillo County
Sandoval County
Albuquerque Metropolitan Arroyo Flood Control Authority
Adjacent Neighborhood Association
Interested Pueblos and Tribes:
Cochiti Pueblo
Comanche Indian Tribe

Hopi Tribe
Isleta Pueblo
Jemez Pueblo
Jicarilla Apache Nation
Laguna Pueblo
Navajo Nation
Ohkay Owingeh Pueblo
San Felipe Pueblo
San Ildefonso Pueblo
Sandia Pueblo
Santa Ana Pueblo
Santa Clara Pueblo
Santo Domingo Pueblo
White Mountain Apache Tribe
Ysleta del Sur Pueblo
Zia Pueblo

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