# Middle Rio Grande Flood Protection

# Bernalillo to Belen, New Mexico

# Mountain View, Isleta, and Belen Units

Appendix E

Environmental Resources

December 2019

**FINAL**

US Army Corps
of Engineers ®
Albuquerque District

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CONVERSION FACTORS

| | From | Multiplier | To |
|---|---|---|---|
| Distance: | inches (in) | 25.4 | millimeters (mm) |
| | feet (ft) | 0.3048 | meters (m) |
| | miles (mi) | 1.6093 | kilometers (km) |
| Area: | acres (ac) | 0.0407 | hectares (ha) |
| | square miles ($mi^2$) | 2.590 | square kilometers ($km^2$) |
| Volume: | cubic yards (CY) | 0.7646 | cubic meters ($m^2$) |
| | acre-feet (ac-ft) | 1,233.5 | cubic meters ($m^2$) |
| | acre-feet (ac-ft) | 325,851 | gallons (gal) |
| Discharge: | cubic feet/second (cfs) | 0.0283 | cubic meters/second (cms) |
| Mass (weight) : | tons [short] | 0.9072 | metric tons [long] |
| Velocity: | feet/second (fps) | 0.3048 | meters/second (cms) |
| Salinity: | µSiemens/cm<br>or µmhos/cm | 0.32379 | parts/million NaCl<br>or mg/liter NaCl |
| Temperature: | ° Fahrenheit (°F) | (°F-32)/1.8 | ° Celsius (°C) |

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# LIST OF ACRONYMS AND TERMS

| | |
|---|---|
| 1992 SEIS | *Final Supplemental Environmental Impact Statement, Rio Grande Floodway, San Acacia to Bosque del Apache Unit, Socorro County, NM,* July 1992. |
| AEP | annual exceedance probability |
| AFB | alternative formulation briefing |
| AMAFCA | Albuquerque Metropolitan Arroyo Flood Control Authority |
| ASA(CW) | Assistant Secretary of the Army (Civil Works) |
| AT&SF | Atchison, Topeka and Santa Fe |
| BDANWR | Bosque del Apache National Wildlife Refuge |
| BIA | U.S. Bureau of Indian Affairs |
| BERH | Board of Engineers for Rivers and Harbors |
| BLM | U.S. Bureau of Land Management |
| BMP | best management practice |
| BNSF | Burlington Northern Santa Fe |
| cfs | cubic feet per second |
| CNP | conditional non-exceedance probability |
| CO | carbon monoxide |
| Compact | Rio Grande Compact |
| Corps | U.S. Army Corps of Engineers |
| EAD | expected annual damage |
| ENSO | El Niño-Southern Oscillation |
| EQ | environmental quality |
| ESA | Endangered Species Act |
| ESI | environmental site investigation |
| FCA | Flood Control Act |
| FDM | feature design memorandum |
| FEMA | Federal Emergency Management Agency |
| FIA | Flood Insurance Administration |
| FIRMS | flood insurance rate maps |
| GDM | general design memorandum |
| HTRW | Hazardous, Toxic and Radioactive Waste |
| LERRD | land, easements, rights-of-way, relocation, and disposal areas |
| LFCC | Low Flow Conveyance Channel |
| LPP | locally preferred plan |
| GRR | general reevaluation report |
| MOA | memoranda of agreement |
| MRGCD | Middle Rio Grande Conservancy District |
| NAAQS | National Ambient Air Quality Standards |
| NED | National Economic Development |
| NEPA | National Environmental Policy Act |
| NER | National Ecosystem Restoration |
| NFIP | National Flood Insurance Program |
| NMDGF | New Mexico Department of Game and Fish |
| NMED | New Mexico Environmental Department |
| NMCRIS | New Mexico Cultural Resources Inventory System |

| | |
|---|---|
| NMHPD | New Mexico Historic Preservation Department |
| NMSHPO | New Mexico State Historic Preservation Officer |
| NMISC | New Mexico Interstate Stream Commission |
| $NO_x$ | nitrogen oxides |
| NPDES | National Pollution Discharge Elimination System |
| NRCS | U.S. Natural Resource Conservation Service |
| NWR | National Wildlife Refuge |
| $O_3$ | ozone |
| OHWM | ordinary high water mark (relative to Section 404 of the Clean Water Act) |
| OMRR&R | operation, maintenance, repair, replacement, and rehabilitation |
| OSE | other social effects |
| Pb | lead |
| PDO | Pacific Decadal Oscillation |
| PSDP | New Mexico Environmental Improvement Division's Prevention of Significant Deterioration Program |
| PL | public law |
| $PM_{10}$ | total suspended particulates smaller than 10 microns |
| PSTB | Petroleum Storage Tank Bureau |
| P&S | plans and specifications |
| Reclamation | U.S. Bureau of Reclamation |
| RED | regional economic development |
| RBA | risk-based analysis |
| RGF | Rio Grande Floodway |
| RGSM | Rio Grande silvery minnow |
| ROD | record of decision |
| RM | river mile |
| SADD | San Acacia Diversion Dam |
| sq. mi. | square miles |
| SEIS | Supplemental Environmental Impact Statement |
| SHPO | State Historic Preservation Officer |
| $SO_2$ | sulfur dioxide |
| SPF | standard project flood |
| SPT | standard penetration test |
| SWPPP | Storm Water Pollution Prevention Plan |
| SWWF | Southwestern Willow Flycatcher |
| TCP | traditional cultural properties |
| TSP | total suspended particulate matter |
| USACE | See Corps |
| USBR | See Reclamation |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Service |
| UST | underground petroleum storage tanks |
| USWRC | U.S. Water Resources Council |
| WRDA | Water Resources Development Act |

# 1 - EXISTING CONDITIONS*

The flood risk management plan authorized for the Mountain View, Isleta, and Belen Units study area was formulated under the consideration of conditions existing at the time of analysis and projected conditions expected to exist in the future (Appendix I). This section updates that information to account for current conditions in the proposed study area.

To define the potential benefits and degree of improvement possible with various alternative solutions to flood risk management problems, a complete understanding of the existing condition of the study area is required. Definition of this existing condition allows the comparison of the value of various alternatives to one another, as well as to the existing degraded condition. Definition of baseline conditions must also be done to determine what the likely future condition is in the absence of measures done to solve observed problems. This condition is called the future "without-project" condition. Future without-project conditions are based on the study of trends and recent behaviors in the study area. To this end, information on existing (presented under Chapter 2) and future without-project conditions (presented under Chapter 3) was collected, analyzed, and quantified. Forecasting these conditions is vitally important to the evaluation and comparison of alternative plans and the identification of impacts (both beneficial and adverse) attributable to proposed Federal actions. A forecast of conditions that will exist for a 50-yer period of analysis without a Federal project was used as the baseline.

## **1.1** PHYSICAL ENVIRONMENT*

The Middle Rio Grande (MRG) in New Mexico is divided into four reaches, Cochiti, Angostura, Isleta, and San Acacia named for the dam at the upstream end of each reach (Archdeacon et al. Cook. 2015). The study area begins in the Angostura Reach at the South Diversion Channel, with the Belen Units extending downstream in the Isleta Reach.

### 1.1.1 Hydrology and Hydraulics

Appendix H provides a detailed discussion of river geomorphology, sedimentation, hydraulic models, and flood frequency from snowmelt and monsoonal events. The Rio Grande watershed upstream of Albuquerque is comprised of 17,440 square miles (Appendix H). Of the total watershed upstream of Albuquerque, Cochiti, Jemez, and Galisteo Dams regulate 16,535 square miles. Downstream of these structures, the remaining 900 square miles are unregulated and contribute directly to flooding in the Rio Grande floodway in Albuquerque.

The major Upper Rio Grande tributaries in Colorado and New Mexico are, from north to south, the Conejos River (watershed area: 821 $mi^2$), Rio Chama (watershed area: 3,150 $mi^2$), Galisteo Creek (watershed area: 670 $mi^2$), Jemez River (watershed area: 1,038 $mi^2$), Rio Puerco (watershed area: 6,057 $mi^2$), and Rio Salado (watershed area: 1,394 $mi^2$). The Rio Grande watershed upstream of El Paso, Texas, also contains five closed basins: San Luis in Colorado (watershed area: 2,884 $mi^2$), the Llano de Albuquerque (watershed area: 147 $mi^2$), North Plains (watershed area: 1,373 $mi^2$), San Agustin Plains (watershed area: 1,990 $mi^2$), and Jornada del Muerto (watershed area: 3,316 $mi^2$) in New Mexico.

The "Middle Rio Grande Flow Frequency Study" by the USACE Hydrologic Engineering Center (HEC), June 2006, studied flood frequencies for the Rio Grande at the Central Avenue Bridge, where the Albuquerque gage is located. The HEC Middle Rio Grande flow frequency is a combined frequency based on regulated flood flows from the reservoirs upstream of Albuquerque, predominantly snowmelt floods, and flood flows from unregulated local areas downstream of the reservoirs, primarily from rainfall runoff. The Albuquerque levee was designed prior to Cochiti Dam being constructed. The design flow for the Albuquerque levee was 42,000 cfs. The present day probability of a flow of 42,000 cfs is significantly different than it was before the dams were put into operation. The probability of a flood flow of 42,000 cfs was determined by extrapolating it from the combined frequency curve. It is 0.000168, and the return period is 5,950 years.

### 1.1.2 Water Resources

Section 401 of the Clean Water Act requires that a Water Quality Certification Permit be obtained for anticipated discharges associated with construction activities or other disturbance within waterways in the study area. Water quality certification is the responsibility of the New Mexico Environment Department, Surface Water Quality Bureau.

Section 404 of the Clean Water Act provides for the protection of "waters of the United States" from impacts associated with irresponsible or unregulated discharges of dredged or fill material in aquatic habitats, including wetlands as defined under Section 404(b)(1). For the proposed action three activities relating to proposed work below the ordinary high water mark (OHWM) are: 1) earthen levee construction; and 2) placement of rip rap along the riverward slope and toe of the levee; 3) partial fill within the levee footprint of two freshwater ponds.

Although the Rio Grande has a well-defined channel throughout the proposed action area, flows in portions of the area frequently exceed the bank elevation and inundate the overbank area adjacent to the channel. For the purposes of evaluation, the OHWM relative to Section 404 was estimated to be the water surface elevation of the 50%-exceedance discharge based on mean-daily-discharge values at the USGS stream flow gage at for the period 1974 through 2002. This discharge was determined to be 5,660 cfs by Parametrix (2008).

There are freshwater ponds, as defined in Section 404(b)(1) of the Clean Water Act, that have been identified within the study area for levee construction alternatives. The proposed levee alignment and construction footprint impinges on the two ponds (wetland classification PUBFh/x). The affected pond and wetland habitat within the construction footprint of the levee will be addressed in the mitigation plan.

### 1.1.3 Floodplains

Pursuant to the National Flood Insurance Act of 1968(42 U.S.C. 4001 et seq.) as amended, and the Flood Disaster Protection Act of 1973 (P.L. 93-234, 87 Stat. 975), Executive Order 11988 requires that each federal agency take actions to reduce the risk of flood loss, minimize the impact of floods on human safety, health and welfare, and preserve the beneficial values which floodplains serve by evaluating the potential effects of actions within a floodplain and to avoid floodplains unless the agency determines that there is no practicable alternative. The flood frequency and floodplain determination was modeled by USACE (2014) for the project (Appendix H).

## **1.2** ENVIRONMENTAL RESOURCES*

The Rio Grande is one of the top ten endangered rivers in the world (Wong *et al.* 2007) because of water over-extraction. Regulation of water in the Rio Grande has changed the mosaic of vegetation types once present in the valley: wetlands have been greatly reduced, and the cottonwood trees are dying out. From 1935 to 1989, surface area covered by wet meadows, marshes, and ponds declined by 73% along the Middle Rio Grande floodplain.

The Rio Grande floodway in New Mexico has been managed by USBR in cooperation with the MRGCD starting in the 1930's. The existing setback spoil bank alignment defines the Rio Grande floodway through the study area. The majority of the riparian forest (bosque) managed by these two agencies is downstream of Isleta Pueblo which includes aggrading and incised sub-reaches of the river. Approximately 10% of the Rio Grande in New Mexico is managed by other federal and state agencies (besides USBR and MRGCD).

The current hydrologic regime favors establishment of these non-native species over native cottonwood and willow species. Much of the loss of cottonwood gallery forests and other riparian habitat within the floodway has been due to decreased stream flows and longer drought (Friggens et al. 2013). The bosque understory in many areas is now dominated by non-native shrubs (Russian olive, salt cedar, tree of heaven) and Siberian Elm saplings, and the open forest character has been lost.

### 1.2.1 Riparian Forest Community

The cottonwood forests that border the Rio Grande in central New Mexico are remnants of a unique and diminishing habitat known locally as the bosque, a Spanish word for forest. These riparian forests provide habitat for a wide variety of plants and animals. At least 80% of vertebrate wildlife occurring in New Mexico use riparian areas at some stage of their lives and 50% are permanent residents (NMDGF 2004). Riparian areas support a greater diversity of breeding birds than all other habitats in the state combined. In addition, the Middle Rio Grande is a critical travel corridor for migrating birds connecting Central and South America to North America along the Rio Grande Flyway.

Although once widespread throughout floodplains in New Mexico, many cottonwood forests have been cleared for farming, flood risk management projects, and urban development. Non-native plants and animals have spread throughout the valley, often displacing the population of native species. The only remaining extensive tracts of Rio Grande cottonwoods are found along the Rio Grande in central New Mexico, from approximately Española south to the Belen area. The floodway established by setback spoil banks protected the bosque from further clearing.

The creation of the cottonwood communities depends on lateral stream movement, and sand bars formed by the meandering river provide the conditions necessary for cottonwood establishment (Crawford *et al.,* 1993). Cottonwoods grow well only when roots can reach moisture provided by underground water and where seeds can germinate in bare, moist soil. Therefore, cottonwoods are limited to areas with a permanent water supply. A group of cottonwood seedlings that germinate on a newly-scoured sand bar produces plants that reach maturity at approximately the same time. New seedlings cannot grow in a forest with a closed canopy that prevents adequate sunlight from reaching the forest floor. However, as the river meanders, sections of the mature forest die, thus providing space to establish a new stand of cottonwoods. The result is a variety of patches, or mosaics, ranging from newly established seedlings to old, mature stands of huge trees to open areas with few trees.

Historically, these forest patches were interspersed with wetland areas, transitional zones between terrestrial and aquatic systems where the water table is at or near the surface or where land is covered by water at least part of the year.

Despite the extensive changes to channel geomorphology due to channelization activities, unlawful gravel mining, and the creation of the spoil bank levee system, the Middle Rio Grande valley supports one of the highest value riparian ecosystems remaining in the Southwest (Crawford, *et al.*, 1993), providing green infrastructure for managing flood flows (The Nature Conservancy, 2014). Plant communities currently occupy approximately 12,700 acres bordering the Rio Grande (see Table 1-1).

Table 1-2 summarizes results from GIS spatial analysis for the affected vegetation and habitat in the proposed study area which includes sections of the Angostura and Isleta Reaches.

Riparian woodlands in the Isleta Reach have a canopy of Rio Grande cottonwood and, less extensively, Goodding's willow (Parametrix, 2008). These bosque habitats comprise about 3,885 acres (31%) of the riparian vegetation in the study area. An understory of native shrub species (primarily coyote willow and seep-willow) occurs in only a small percentage of woodland stands. The majority (approximately 3,290 acres) of bosque has an understory dominated by salt cedar - an exotic shrub that has extensively colonized the Rio Grande floodway since its introduction in region in the early 1900s - and, secondarily, by Russian olive, another non-native shrub.

Riparian shrublands are the most abundant plant community in this reach, occupying over 7,700 acres (61% of all vegetated area). Again, exotic shrub species, primarily salt cedar, dominate this plant community type (Parametrix, 2008). The structure of shrub stands can vary widely depending on age and species composition. Young stands or those in relatively dry areas may be short (less than 5 feet in height) and sparsely distributed. The majority of shrub stands in the study area consist of moderately dense to very dense stands of 5- to 15-foot-tall salt cedar. Native shrub species (coyote willow, seep-willow, and screwbean mesquite) occupy only about 1,600 acres (13% of all vegetation types).

Salt cedar is a prominent colonizer of exposed, bare soil sites in the riparian zone (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, 1993). 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 study area where there is sufficient light (Crawford, *et al.*, 1996).

**Table 1-1 Vegetation and Open Water Types within the Floodway of the entire Isleta Reach from Isleta Diversion Dam to the San Acacia Diversion Dam.**

| Plant Community or Open Water Type | Acres | Percent of Vegetated Area |
|---|---|---|
| Riparian Woodland | | |
| Native understory | 599 | 4.7 |
| Mixed understory | 1,656 | 13.1 |
| Exotic understory | 1,630 | 12.9 |
| *Woodland Subtotal* | *3,885* | *30.7* |
| Riparian Shrubland | | |
| Native | 1,581 | 12.5 |
| Mixed native and exotic | 236 | 1.9 |
| Exotic | 5,887 | 46.5 |
| *Shrubland Subtotal* | *7,704* | *60.8* |
| Emergent wetland | 459 | 3.6 |
| Dry grassland and open areas | 625 | 4.9 |
| **Subtotal - All Vegetation** | **12,672** | **100.0** |
| Pond and small channel | 138 | |
| Rio Grande channel | 1,343 | |
| **TOTAL** | **14,153** | |

Source: Parametrix, 2008

### 1.2.2 Wetland Plant Community

Executive Order 11990, Protection of Wetlands, requires each federal agency to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the federal agency's responsibilities.

Wetlands in the Middle Rio Grande Valley included wet meadows, marshes, sloughs, ponds, and small lakes. In combination, these wetland areas constituted a significant component of the floodplain ecosystem, greatly affecting the vegetation and animals present. Wetlands were formed in part by the meandering nature of the river and partly by the high water table in the valley; in some areas, the water table existed at the ground surface, supporting water-loving plants. The resulting mosaic of vegetation types, consisting of patches of cottonwood forest of different ages mixed with various wetland communities and open areas of low terrestrial vegetation, supported a large diversity of organisms. As a consequence, the Middle Rio Grande valley had an extremely rich assortment of plant and animal life.

Small areas of emergent wetlands are scattered throughout the floodway. These consist of marshes dominated by broad-leaved cattail and hardstem bulrush along the riverbank or in poorly drained depressions within the overbank area. Wet meadows consisting primarily of saltgrass also occur. Together, these comprise only 459 acres in the floodway of the study area (3.6% of all vegetation types). The majority of wetlands (255 of 459 acres) within the Isleta Reach are downstream of the study area. The wetlands (204.3 acres) in the study area are in the floodway are mostly outside of the levee construction zone, including the vegetation management zone.

**Table 1-2 Summary of baseline habitat and affected vegetation in the proposed study area (USBR 2012; Hink and Ohmart 1984).**

| Riparian Floodplain Vegetation | | | Subset of suitable avian habitat[a] | |
|---|---|---|---|---|
| Native vegetation (27.6%) | Existing | Affected (2.3%) | Cuckoo | Flycatcher |
| C/CW1 (cottonwood/coyote willow) | 61.3 | 12.0 | 12.0 | 3.8 |
| C/CW2 | 242.7 | 48.8 | | |
| C/CW3 | 76.9 | 3.7 | 3.7 | 1.2 |
| C/CW4 | 639.0 | 14.6 | | |
| C/CW5 (shrub) | 197.3 | 9.0 | | 4.3 |
| C/CW6 (meadow) | 29.7 | | | |
| Tree willow-C/CW3/5 | 103.7 | 2.6 | 1.8 | 0.8 |
| Marsh (6) | 204.3 | | | |
| Native vegetation subtotal | 1555.0 | 68.9 | 17.4 | 10.1 |
| | | | Subset of moderately suitable habitat[a] | |
| Mixed gallery forest / shrubs (1-5 ) (68.8%) | Existing | Affected (2.8%) | Cuckoo | Flycatcher |
| C/CW with Russian olive | 2316.0 | 61.2 | 60.3 | 19.0 |
| C/CW with salt cedar | 934.1 | 42.8 | 42.8 | 2.7 |
| Mixed invasive forest | 341.6 | 15.5 | 11.3 | 9.8 |
| Russian olive dominated forest | 96.7 | 6.5 | 1.0 | 2.9 |
| Salt cedar dominated forest | 186.4 | 6.1 | | |
| Mixed gallery forest subtotal | 3874.8 | 167.3 | 115.3 | 34.4 |
| Other classifications | Existing | Affected | | |
| Open area (herbaceous vegetation or bare) | 159.1 | 28.8 | | |
| Roads / canals | 44.2 | 0.8 | | |
| Other subtotal | 203.3 | 29.6 | 0.0 | 0.0 |
| Total Area | 5633.1 | -265.8 | 132.8 | 44.5 |
| Vegetation management zone | | +87.5 | | |
| Net active floodway area loss | | -178.3 | | |

a. *Flycatcher gallery forest habitat is considered suitable for cuckoos.*

Impacts to wetlands in study area are minimized through impact avoidance to the extent possible, and proposed excavation where appropriate to maintain the same wetland area at the affected location. The two wetland ponds identified adjacent to the levee will require mitigation (see mitigation plan). Several additional sites have been identified as possible or former wetlands that require field verification. Mitigation will focus on maintaining acreage continuous with the affected wetlands.

Changes to channel geometry have reduced overbank flooding and floodplain connectivity, limiting regeneration of riparian habitat. The long-term impacts of channel incision on wetland and riparian habitat are two-fold: a gradual reduction in the number of wetland and riparian plant species results in shrinking areas of these habitat types while at the same time, the lower ground water and surface water elevations relative to floodplain terraces reduce the probability of regeneration of these habitats.

## **1.3** FISH AND WILDLIFE

Approximately 400 species of vertebrates occur within the floodway (riparian, wetland, aquatic habitat) in Bernalillo and Valencia Counties (Table 1-3; BISON-M 2017). Studies by Hink and Ohmart (1984) and Thompson *et al.*, (1994) have characterized wildlife use of the various plant associations that make up the riparian plant community in the proposed study area. These characterizations conclude that the riparian community, as a whole, supports a rich assemblage of vertebrate species, particularly birds. The highest numbers of vertebrate wildlife were found in marshes; cottonwood stands with a dense understory of Russian olive or coyote willow; and Russian olive shrub stands. Open areas, early growth stands, salt cedar, and river bars support lower densities and numbers of vertebrate species.

Of about 20 reptile and amphibian species found in bosque habitat, only a few are widespread and common. These species include eastern fence lizard, New Mexico whiptail, and Woodhouse's toad. 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 in the bosque are representative of drier upland habitats. A distinct assemblage of species associated with denser vegetation cover in wetter habitats includes tiger salamander, western chorus frog, bullfrog, northern leopard frog, Great Plains skink, New Mexico garter snake, western painted turtle, and spiny softshell turtle. Western rattlesnakes have also been noted in the riparian zone.

The most common breeding bird species in Rio Grande riparian areas include the Mourning Dove, Black-chinned Hummingbird, Gambel's Quail, Northern Flicker, Ash-throated Flycatcher, European Starling, Bewick's Wren, American Robin, Northern Oriole, Black-headed Grosbeak, Lesser Goldfinch, Spotted Towhee, Blue Grosbeak, Yellow-billed Cuckoo, Greater Roadrunner, Lazuli Bunting, Indigo Bunting, Summer Tanager, Yellow-breasted Chat, Brown-headed Cowbird and Wild Turkey. Common breeding raptors include Cooper's Hawk, Swainson's Hawk, Western Screech-Owl, and Great-horned Owl (Crawford *et al*., 1996).

Generally, the abundance of breeding birds increases with the complexity and density of vegetation structure, which is thought to be related to the increased food, cover, or nest substrate it provides (Crawford, *et al*., 1996). Along the Rio Grande, the highest breeding densities typically have been found in marshes, cottonwood stands with a well developed shrub understory, and in tall shrub stands (Hink and Ohmart; 1984; Hoffman 1990; Thompson *et al.*, 1994; Stahlecker and Cox, 1997). Within this woodland type, avian abundance is approximately four times greater along the riverward and landward edges of the bosque than in the interior of the stand (Hink and Ohmart, 1984). Bosque stands with a sparse understory generally support fewer breeding birds. Stands of intermediate age or structure vary widely in breeding bird use among the studies conducted (Farley, *et al*., 1994), but in light of the general lack of natural cottonwood and willow regeneration along the Rio Grande, are important for their potential to develop into mature stands.

Salt cedar stands (with or without a cottonwood canopy) have relatively low breeding bird use. Species commonly breeding in salt cedar include Mockingbird, Lark Sparrow, Western Meadowlark, Black Throated Sparrow, Blue-Grey Gnatcatcher, and Crissal Thrasher. Some birds, such as the House Wren, Virginia's Warbler, MacGillivray's Warbler, and Lincoln's Sparrow, are associated with salt cedar during migration and winter months (Crawford, *et al*., 1996).

The Rio Grande is a major migratory corridor for songbirds (Yong and Finch, 2002), waterfowl, and shorebirds. At various times of the year, riparian areas support the highest bird densities and species numbers in the Middle Rio Grande. Both the river channel and the drains adjacent to the bosque provide habitat for species such as Mallards, Wood Ducks, Great Blue Herons, Snowy Egrets, Green Herons, Belted Kingfishers, and Black Phoebes. Agricultural fields and grassy areas with little woody vegetation are important food sources for sparrows and other songbirds during migration and winter.

Common small mammals in the study area are white-footed mouse, western harvest mouse, house mouse, tawny-bellied cotton rat, and rock squirrel. Small mammals were found to be more abundant in more moist and densely vegetated habitats and those with dense coyote willow than at drier sites. Hink and Ohmart (1984) described assemblages of small mammals associated with different habitat types. Crawford's desert shrew and white-footed mouse were associated with moist forest and woodland habitats. Well-vegetated, grassy habitats and emergent wetlands were occupied by western harvest mouse, plains harvest mouse, house mouse, and tawny-bellied cotton rat. Also occurring on the study area is the New Mexican jumping mouse, which is a state endangered and Federal candidate species. As a Federal candidate species, it receives no legal protection under the Endangered Species Act. The deer mouse is associated mainly with dry cottonwood forest habitat. Open salt cedar habitat had four small mammal species typically found in dry upland habitats: silky pocket mouse, Ord's kangaroo rat, Merriam's kangaroo rat, and northern grasshopper mouse. Large mammals likely to occur in the study area include beaver, raccoon, and muskrat in aquatic and wetland habitats; and long-tailed weasel, striped skunk, rock squirrel, Botta's pocket gopher, coyote, and common gray fox in riparian woodlands. Mountain lion are known to occasionally frequent the river corridor near San Marcial and mule deer and elk range through the study area.

The native ichthyofauna of the Rio Grande in New Mexico has historically consisted of at least 19 and perhaps as many as 27 native fish species (Sublette, *et al.*, 1990; Platania 1993a). Through several studies and examination of catalogue collections, there has been documentation of extirpation of at least six species of native fishes from the basin. Regulated water storage and delivery, changes in channel morphology, and introduction of non-native fish have greatly influenced the existing aquatic community in the proposed study area.

Fish sampling by Platania (1993b; Dudley and Platania, 2016) from 1987 to 2015 in the Rio Grande, from San Acacia Diversion Dam downstream to Elephant Butte Reservoir, confirmed the following 14 species: gizzard shad, common carp, red shiner, Rio Grande silvery minnow, fathead minnow, flathead chub, longnose dace, river carpsucker, white sucker, smallmouth buffalo, black bullhead, channel catfish, western mosquitofish, and white crappie. Red shiners and the Rio Grande silvery minnows were the most abundant fish captured. Other fish that were common included flathead chub, river carpsucker, channel catfish, and western mosquitofish.

The reach of the Rio Grande along the proposed study area is designated as a warmwater ecosystem. There are extended periods of low flow, with extremes in habitat characteristics, such as depth, velocity, and cross-sectional area, and water quality parameters, such as temperature, dissolved oxygen, and suspended sediment, which require existing communities to have wide environmental tolerances (Crawford, *et al.*, 1993). The river channel is used by a variety of wildlife, primarily birds, when streamflow is present. Wintering waterfowl use the river as loafing habitat, while herons and egrets forage in shallow pools. Winter Sandhill Crane flocks typically use sand bars for night roosting. Sand bars, river, and dry channel are characteristically low in species diversity and density (Hink and Ohmart, 1984); however, animals such as raccoons, coyotes, lizards, Killdeer, Water Pipits, Spotted Sandpipers, Juncos, and Mountain Bluebirds are common users. As with aquatic life, wildlife use of the channel is limited by the altered flow regime caused by diversion of water from the river channel (Crawford, *et al.*, 1993).

**Table 1-3 Wildlife species in Bernalillo and Valencia Counties (BISON-M 2017).**

| Common Name | Scientific Name | County |
|---|---|---|
| **Birds** | | |
| Acorn Woodpecker | *Melanerpes formicivorus* | Bernalillo, Valencia |
| American Avocet | *Recurvirostra americana* | Bernalillo, Valencia |
| American Bittern | *Botaurus lentiginosus* | Bernalillo, Valencia |
| American Coot | *Fulica americana* | Bernalillo, Valencia |
| American Crow | *Corvus brachyrhynchos* | Bernalillo, Valencia |
| American Dipper | *Cinclus mexicanus* | Bernalillo |
| American Golden Plover | *Pluvialis dominica* | Bernalillo |
| American Goldfinch | *Spinus tristis* | Bernalillo |
| American Kestrel | *Falco sparverius* | Bernalillo, Valencia |
| American Pipit | *Anthus rubescens* | Bernalillo, Valencia |
| American Redstart | *Setophaga ruticilla* | Bernalillo |
| American Robin | *Turdus migratorius* | Bernalillo, Valencia |
| American Three-toed Woodpecker | *Picoides dorsalis* | Bernalillo |
| American Tree Sparrow | *Spizelloides arborea* | Bernalillo, Valencia |
| American Wigeon Duck | *Anas americana* | Bernalillo |
| American Woodcock | *Scolopax minor* | Bernalillo |
| Arctic Peregrine Falcon | *Falco peregrinus tundrius* | Bernalillo, Valencia |
| Ash-throated Flycatcher | *Myiarchus cinerascens* | Bernalillo, Valencia |
| Baird's Sandpiper | *Calidris bairdii* | Bernalillo |
| Bald Eagle | *Haliaeetus leucocephalus* | Bernalillo, Valencia |
| Baltimore Oriole | *Icterus galbula* | Bernalillo, Valencia |
| Band-tailed Pigeon | *Patagioenas fasciata* | Bernalillo |
| Bank Swallow | *Riparia riparia* | Bernalillo, Valencia |
| Barn Owl | *Tyto alba* | Bernalillo |
| Barn Swallow | *Hirundo rustica* | Bernalillo, Valencia |
| Bell's Vireo | *Vireo bellii* | Bernalillo, Valencia |
| Belted Kingfisher | *Megaceryle alcyon* | Bernalillo, Valencia |
| Bewick's Wren | *Thryomanes bewickii* | Bernalillo, Valencia |
| Black Phoebe | *Sayornis nigricans* | Bernalillo, Valencia |
| Black Swift | *Cypseloides niger* | Bernalillo |
| Black Tern | *Chlidonias niger* | Bernalillo |
| Black-and-white Warbler | *Mniotilta varia* | Bernalillo |
| Black-billed Magpie | *Pica hudsonia* | Bernalillo, Valencia |
| Black-capped Chickadee | *Poecile atricapillus* | Bernalillo, Valencia |
| Black-chinned Hummingbird | *Archilochus alexandri* | Bernalillo, Valencia |
| Black-chinned Sparrow | *Spizella atrogularis* | Bernalillo |

| Common Name | Scientific Name | County |
|---|---|---|
| Black-crowned Night-Heron | *Nycticorax nycticorax* | Bernalillo, Valencia |
| Black-headed Grosbeak | *Pheucticus melanocephalus* | Bernalillo, Valencia |
| Black-necked Stilt | *Himantopus mexicanus* | Bernalillo, Valencia |
| Blackpoll Warbler | *Setophaga striata* | Bernalillo |
| Black-tailed Gnatcatcher | *Polioptila melanura* | Bernalillo |
| Black-throated Blue Warbler | *Setophaga caerulescens* | Bernalillo |
| Black-throated Gray Warbler | *Setophaga nigrescens* | Bernalillo, Valencia |
| Black-throated Green Warbler | *Setophaga virens* | Bernalillo, Valencia |
| Blue Grosbeak | *Passerina caerulea* | Bernalillo, Valencia |
| Blue Jay | *Cyanocitta cristata* | Bernalillo, Valencia |
| Blue-gray Gnatcatcher | *Polioptila caerulea* | Bernalillo, Valencia |
| Blue-headed Vireo | *Vireo solitarius* | Bernalillo, Valencia |
| Blue-winged Teal Duck | *Anas discors* | Bernalillo |
| Bohemian Waxwing | *Bombycilla garrulus* | Bernalillo |
| Brewer's Blackbird | *Euphagus cyanocephalus* | Bernalillo |
| Brewer's Sparrow | *Spizella breweri* | Bernalillo, Valencia |
| Broad-tailed Hummingbird | *Selasphorus platycercus* | Bernalillo |
| Broad-winged Hawk | *Buteo platypterus* | Bernalillo |
| Brown Creeper | *Certhia americana* | Bernalillo, Valencia |
| Brown Pelican | *Pelecanus occidentalis* | Bernalillo |
| Brown Thrasher | *Toxostoma rufum* | Bernalillo, Valencia |
| Brown-crested Flycatcher | *Myiarchus tyrannulus* | Bernalillo |
| Brown-headed Cowbird | *Molothrus ater* | Bernalillo, Valencia |
| Bufflehead Duck | *Bucephala albeola* | Bernalillo |
| Bullock's Oriole | *Icterus bullockii* | Bernalillo, Valencia |
| Burrowing Owl | *Athene cunicularia* | Bernalillo, Valencia |
| Bushtit | *Psaltriparus minimus* | Bernalillo, Valencia |
| Cactus Wren | *Campylorhynchus brunneicapillus* | Valencia |
| Calliope Hummingbird | *Selasphorus calliope* | Bernalillo |
| Canada Goose | *Branta canadensis* | Bernalillo, Valencia |
| Canvasback Duck | *Aythya valisineria* | Bernalillo |
| Canyon Towhee | *Melozone fusca* | Bernalillo, Valencia |
| Canyon Wren | *Catherpes mexicanus* | Bernalillo, Valencia |
| Cassin's Finch | *Haemorhous cassinii* | Bernalillo |
| Cassin's Kingbird | *Tyrannus vociferans* | Bernalillo, Valencia |
| Cassin's Vireo | *Vireo cassinii* | Bernalillo, Valencia |
| Cattle Egret | *Bubulcus ibis* | Valencia |
| Cedar Waxwing | *Bombycilla cedrorum* | Bernalillo |
| Chestnut-sided Warbler | *Setophaga pensylvanica* | Bernalillo |
| Chihuahuan Raven | *Corvus cryptoleucus* | Bernalillo, Valencia |
| Chipping Sparrow | *Spizella passerina* | Bernalillo, Valencia |
| Cinnamon Teal Duck | *Anas cyanoptera* | Bernalillo |
| Clark's Grebe | *Aechmophorus clarkii* | Bernalillo |

| Common Name | Scientific Name | County |
|---|---|---|
| Clark's Nutcracker | *Nucifraga columbiana* | Bernalillo |
| Clay-colored Sparrow | *Spizella pallida* | Bernalillo |
| Cliff Swallow | *Petrochelidon pyrrhonota* | Bernalillo, Valencia |
| Common Black Hawk | *Buteogallus anthracinus* | Bernalillo, Valencia |
| Common Gallinule | *Gallinula galeata* | Valencia |
| Common Goldeneye Duck | *Bucephala clangula* | Bernalillo |
| Common Grackle | *Quiscalus quiscula* | Bernalillo, Valencia |
| Common Ground-dove | *Columbina passerina* | Valencia |
| Common Loon | *Gavia immer* | Bernalillo |
| Common Merganser Duck | *Mergus merganser* | Bernalillo |
| Common Nighthawk | *Chordeiles minor* | Bernalillo, Valencia |
| Common Poorwill | *Phalaenoptilus nuttalli* | Bernalillo, Valencia |
| Common Raven | *Corvus corax* | Bernalillo, Valencia |
| Common Yellowthroat | *Geothlypis trichas* | Bernalillo, Valencia |
| Cooper's Hawk | *Accipiter cooperii* | Bernalillo, Valencia |
| Cordilleran Flycatcher | *Empidonax occidentalis* | Bernalillo, Valencia |
| Crissal Thrasher | *Toxostoma crissale* | Bernalillo |
| Curve-billed Thrasher | *Toxostoma curvirostre* | Bernalillo |
| Dark-eyed Junco | *Junco hyemalis* | Bernalillo, Valencia |
| Double-crested Cormorant | *Phalacrocorax auritus* | Bernalillo |
| Downy Woodpecker | *Picoides pubescens* | Bernalillo |
| Dusky Flycatcher | *Empidonax oberholseri* | Bernalillo, Valencia |
| Eared Grebe | *Podiceps nigricollis* | Bernalillo |
| Eastern Bluebird | *Sialia sialis* | Bernalillo, Valencia |
| Eastern Kingbird | *Tyrannus tyrannus* | Bernalillo, Valencia |
| Eastern Phoebe | *Sayornis phoebe* | Bernalillo |
| Eastern Whip-poor-will | *Antrostomus vociferus* | Bernalillo |
| European Starling | *Sturnus vulgaris* | Bernalillo, Valencia |
| Evening Grosbeak | *Coccothraustes vespertinus* | Bernalillo, Valencia |
| Ferruginous Hawk | *Buteo regalis* | Bernalillo, Valencia |
| Flammulated Owl | *Psiloscops flammeolus* | Bernalillo |
| Forster's Tern | *Sterna forsteri* | Bernalillo |
| Fox Sparrow | *Passerella iliaca* | Bernalillo |
| Gadwall Duck | *Anas strepera* | Bernalillo |
| Gambel's Quail | *Callipepla gambelii* | Bernalillo, Valencia |
| Golden Eagle | *Aquila chrysaetos* | Bernalillo, Valencia |
| Golden-crowned Kinglet | *Regulus satrapa* | Bernalillo |
| Golden-crowned Sparrow | *Zonotrichia atricapilla* | Bernalillo |
| Grace's Warbler | *Setophaga graciae* | Bernalillo, Valencia |
| Gray Catbird | *Dumetella carolinensis* | Bernalillo, Valencia |
| Gray Flycatcher | *Empidonax wrightii* | Bernalillo, Valencia |
| Great Blue Heron | *Ardea herodias* | Bernalillo, Valencia |
| Great Horned Owl | *Bubo virginianus* | Bernalillo, Valencia |

| Common Name | Scientific Name | County |
|---|---|---|
| Greater Roadrunner | *Geococcyx californianus* | Bernalillo, Valencia |
| Greater Scaup Duck | *Aythya marila* | Bernalillo |
| Greater White-fronted Goose | *Anser albifrons* | Bernalillo |
| Greater Yellowlegs | *Tringa melanoleuca* | Bernalillo |
| Great-tailed Grackle | *Quiscalus mexicanus* | Bernalillo, Valencia |
| Green Heron | *Butorides virescens* | Bernalillo |
| Green-tailed Towhee | *Pipilo chlorurus* | Bernalillo, Valencia |
| Green-winged Teal Duck | *Anas crecca* | Bernalillo |
| Hairy Woodpecker | *Picoides villosus* | Bernalillo, Valencia |
| Hammond's Flycatcher | *Empidonax hammondii* | Bernalillo |
| Harris's Hawk | *Parabuteo unicinctus* | Bernalillo |
| Harris's Sparrow | *Zonotrichia querula* | Bernalillo, Valencia |
| Hepatic Tanager | *Piranga flava* | Bernalillo, Valencia |
| Hermit Thrush | *Catharus guttatus* | Bernalillo, Valencia |
| Herring Gull | *Larus argentatus* | Bernalillo |
| Hooded Merganser Duck | *Lophodytes cucullatus* | Bernalillo |
| Hooded Oriole | *Icterus cucullatus* | Bernalillo |
| Hooded Warbler | *Setophaga citrina* | Bernalillo |
| House Finch | *Haemorhous mexicanus* | Bernalillo, Valencia |
| House Sparrow | *Passer domesticus* | Bernalillo, Valencia |
| House Wren | *Troglodytes aedon* | Bernalillo, Valencia |
| Indigo Bunting | *Passerina cyanea* | Bernalillo, Valencia |
| Juniper Titmouse | *Baeolophus ridgwayi* | Bernalillo, Valencia |
| Killdeer | *Charadrius vociferus* | Bernalillo, Valencia |
| Ladder-backed Woodpecker | *Picoides scalaris* | Bernalillo |
| Lark Sparrow | *Chondestes grammacus* | Bernalillo, Valencia |
| Lazuli Bunting | *Passerina amoena* | Bernalillo, Valencia |
| Least Bittern | *Ixobrychus exilis exilis* | Bernalillo, Valencia |
| Least Flycatcher | *Empidonax minimus* | Bernalillo |
| Least Sandpiper | *Calidris minutilla* | Bernalillo |
| Least Tern | *Sternula antillarum* | Bernalillo |
| Lesser Goldfinch | *Spinus psaltria* | Bernalillo, Valencia |
| Lesser Scaup Duck | *Aythya affinis* | Bernalillo |
| Lesser Yellowlegs | *Tringa flavipes* | Bernalillo |
| Lewis's Woodpecker | *Melanerpes lewis* | Bernalillo, Valencia |
| Lincoln's Sparrow | *Melospiza lincolnii* | Bernalillo, Valencia |
| Little Blue Heron | *Egretta caerulea* | Valencia |
| Loggerhead Shrike | *Lanius ludovicianus* | Bernalillo, Valencia |
| Long-billed Curlew | *Numenius americanus* | Bernalillo, Valencia |
| Long-eared Owl | *Asio otus* | Bernalillo |
| Lucy's Warbler | *Oreothlypis luciae* | Bernalillo, Valencia |
| Macgillivray's Warbler | *Geothlypis tolmiei* | Bernalillo, Valencia |
| Mallard Duck | *Anas platyrhynchos* | Bernalillo, Valencia |

| Common Name | Scientific Name | County |
|---|---|---|
| Marsh Wren | *Cistothorus palustris* | Bernalillo, Valencia |
| Merlin | *Falco columbarius* | Bernalillo |
| Mexican Jay | *Aphelocoma woolweberi* | Bernalillo |
| Mexican Spotted Owl | *Strix occidentalis lucida* | Bernalillo, Valencia |
| Mexican Whip-poor-will | *Antrostomus arizonae* | Bernalillo |
| Mississippi Kite | *Ictinia mississippiensis* | Bernalillo, Valencia |
| Mountain Bluebird | *Sialia currucoides* | Bernalillo, Valencia |
| Mountain Chickadee | *Poecile gambeli* | Bernalillo, Valencia |
| Mourning Dove | *Zenaida macroura* | Bernalillo, Valencia |
| Mourning Warbler | *Geothlypis philadelphia* | Bernalillo |
| N. Rough-winged Swallow | *Stelgidopteryx serripennis* | Bernalillo, Valencia |
| Nashville Warbler | *Oreothlypis ruficapilla* | Bernalillo |
| Neotropic Cormorant | *Phalacrocorax brasilianus* | Bernalillo, Valencia |
| Northern Cardinal | *Cardinalis cardinalis* | Bernalillo, Valencia |
| Northern Flicker | *Colaptes auratus* | Bernalillo, Valencia |
| Northern Goshawk | *Accipiter gentilis* | Bernalillo, Valencia |
| Northern Harrier | *Circus cyaneus* | Bernalillo, Valencia |
| Northern Mockingbird | *Mimus polyglottos* | Bernalillo, Valencia |
| Northern Parula | *Setophaga americana* | Bernalillo |
| Northern Pintail | *Anas acuta* | Bernalillo |
| Northern Pygmy Owl | *Glaucidium gnoma* | Bernalillo, Valencia |
| Northern Saw-whet Owl | *Aegolius acadicus* | Bernalillo |
| Northern Shoveler Duck | *Anas clypeata* | Bernalillo |
| Northern Shrike | *Lanius excubitor* | Bernalillo, Valencia |
| Northern Waterthrush | *Parkesia noveboracensis* | Bernalillo, Valencia |
| Olive-sided Flycatcher | *Contopus cooperi* | Bernalillo, Valencia |
| Orange-crowned Warbler | *Oreothlypis celata* | Bernalillo, Valencia |
| Orchard Oriole | *Icterus spurius* | Bernalillo, Valencia |
| Osprey | *Pandion haliaetus* | Bernalillo |
| Ovenbird | *Seiurus aurocapilla* | Bernalillo, Valencia |
| Painted Bunting | *Passerina ciris* | Bernalillo, Valencia |
| Painted Redstart | *Myioborus pictus* | Bernalillo, Valencia |
| Palm Warbler | *Setophaga palmarum* | Bernalillo, Valencia |
| Peregrine Falcon | *Falco peregrinus* | Bernalillo, Valencia |
| Phainopepla | *Phainopepla nitens* | Bernalillo |
| Pied-billed Grebe | *Podilymbus podiceps* | Bernalillo |
| Pine Siskin | *Spinus pinus* | Bernalillo |
| Pinyon Jay | *Gymnorhinus cyanocephalus* | Bernalillo, Valencia |
| Plumbeous Vireo | *Vireo plumbeus* | Bernalillo, Valencia |
| Prairie Falcon | *Falco mexicanus* | Bernalillo, Valencia |
| Prothonotary Warbler | *Protonotaria citrea* | Bernalillo, Valencia |
| Purple Martin | *Progne subis* | Valencia |
| Pygmy Nuthatch | *Sitta pygmaea* | Bernalillo, Valencia |

| Common Name | Scientific Name | County |
|---|---|---|
| Pyrrhuloxia | *Cardinalis sinuatus* | Bernalillo |
| Red Crossbill | *Loxia curvirostra* | Bernalillo, Valencia |
| Red-breasted Nuthatch | *Sitta canadensis* | Bernalillo |
| Red-eyed Vireo | *Vireo olivaceus* | Bernalillo |
| Red-faced Warbler | *Cardellina rubrifrons* | Bernalillo |
| Redhead Duck | *Aythya americana* | Bernalillo, Valencia |
| Red-headed Woodpecker | *Melanerpes erythrocephalus* | Bernalillo, Valencia |
| Red-naped Sapsucker | *Sphyrapicus nuchalis* | Bernalillo |
| Red-tailed Hawk | *Buteo jamaicensis* | Bernalillo, Valencia |
| Red-winged Blackbird | *Agelaius phoeniceus* | Bernalillo, Valencia |
| Ring-billed Gull | *Larus delawarensis* | Bernalillo |
| Ring-necked Duck | *Aythya collaris* | Bernalillo |
| Ring-necked Pheasant | *Phasianus colchicus* | Bernalillo, Valencia |
| Rock Pigeon | *Columba livia* | Bernalillo, Valencia |
| Rock Wren | *Salpinctes obsoletus* | Bernalillo, Valencia |
| Rose-breasted Grosbeak | *Pheucticus ludovicianus* | Bernalillo |
| Ross's Goose | *Chen rossii* | Bernalillo |
| Rough-legged Hawk | *Buteo lagopus* | Bernalillo |
| Ruby-crowned Kinglet | *Regulus calendula* | Bernalillo, Valencia |
| Ruddy Duck | *Oxyura jamaicensis* | Bernalillo |
| Rufous Hummingbird | *Selasphorus rufus* | Bernalillo |
| Rufous-crowned Sparrow | *Aimophila ruficeps* | Bernalillo |
| Rusty Blackbird | *Euphagus carolinus* | Bernalillo |
| Sage Thrasher | *Oreoscoptes montanus* | Bernalillo, Valencia |
| Sandhill Crane | *Antigone canadensis* | Bernalillo, Valencia |
| Savannah Sparrow | *Passerculus sandwichensis nevadensis; anthinus* | Bernalillo, Valencia |
| Say's Phoebe | *Sayornis saya* | Bernalillo, Valencia |
| Scaled Quail | *Callipepla squamata* | Bernalillo, Valencia |
| Scissor-tailed Flycatcher | *Tyrannus forficatus* | Bernalillo |
| Scott's Oriole | *Icterus parisorum* | Bernalillo, Valencia |
| Sharp-shinned Hawk | *Accipiter striatus* | Bernalillo, Valencia |
| Short-eared Owl | *Asio flammeus* | Bernalillo |
| Snow Goose | *Chen caerulescens* | Bernalillo |
| Snowy Egret | *Egretta thula* | Bernalillo, Valencia |
| Snowy Plover | *Charadrius nivosus* | Bernalillo, Valencia |
| Solitary Sandpiper | *Tringa solitaria* | Bernalillo |
| Song Sparrow | *Melospiza melodia* | Bernalillo, Valencia |
| Sora | *Porzana carolina* | Bernalillo |
| Southwestern Willow Flycatcher | *Empidonax traillii extimus* | Bernalillo, Valencia |
| Spotted Sandpiper | *Actitis macularius* | Bernalillo, Valencia |
| Spotted Towhee | *Pipilo maculatus* | Bernalillo, Valencia |
| Steller's Jay | *Cyanocitta stelleri* | Bernalillo, Valencia |

| Common Name | Scientific Name | County |
|---|---|---|
| Summer Tanager | *Piranga rubra* | Bernalillo, Valencia |
| Swainson's Hawk | *Buteo swainsoni* | Bernalillo, Valencia |
| Swainson's Thrush | *Catharus ustulatus* | Bernalillo |
| Swamp Sparrow | *Melospiza georgiana* | Bernalillo, Valencia |
| Tennessee Warbler | *Oreothlypis peregrina* | Bernalillo |
| Townsend's Solitaire | *Myadestes townsendi* | Bernalillo, Valencia |
| Townsend's Warbler | *Setophaga townsendi* | Bernalillo |
| Tree Swallow | *Tachycineta bicolor* | Bernalillo, Valencia |
| Turkey Vulture | *Cathartes aura* | Bernalillo, Valencia |
| Verdin | *Auriparus flaviceps* | Bernalillo |
| Vesper Sparrow | *Pooecetes gramineus* | Bernalillo, Valencia |
| Violet-green Swallow | *Tachycineta thalassina* | Bernalillo, Valencia |
| Virginia Rail | *Rallus limicola* | Bernalillo, Valencia |
| Virginia's Warbler | *Oreothlypis virginiae* | Bernalillo, Valencia |
| Warbling Vireo | *Vireo gilvus* | Bernalillo |
| Western Bluebird | *Sialia mexicana* | Bernalillo, Valencia |
| Western Grebe | *Aechmophorus occidentalis* | Bernalillo |
| Western Kingbird | *Tyrannus verticalis* | Bernalillo, Valencia |
| Western Meadowlark | *Sturnella neglecta* | Bernalillo, Valencia |
| Western Sandpiper | *Calidris mauri* | Bernalillo |
| Western Screech-Owl | *Megascops kennicottii* | Bernalillo |
| Western Tanager | *Piranga ludoviciana* | Bernalillo, Valencia |
| Western Wood Pewee | *Contopus sordidulus* | Bernalillo, Valencia |
| White-breasted Nuthatch | *Sitta carolinensis* | Bernalillo, Valencia |
| White-crowned Sparrow | *Zonotrichia leucophrys* | Bernalillo, Valencia |
| White-faced Ibis | *Plegadis chihi* | Bernalillo, Valencia |
| White-throated Sparrow | *Zonotrichia albicollis* | Bernalillo, Valencia |
| White-throated Swift | *Aeronautes saxatalis* | Bernalillo |
| White-winged Dove | *Zenaida asiatica* | Bernalillo |
| Wild Turkey | *Meleagris gallopavo merriami; intermedia; silvestris* | Bernalillo |
| Willet | *Tringa semipalmata* | Bernalillo |
| Williamson's Sapsucker | *Sphyrapicus thyroideus* | Bernalillo |
| Willow Flycatcher | *Empidonax traillii brewsteri; adastus* | Bernalillo |
| Wilson's Phalarope | *Phalaropus tricolor* | Bernalillo |
| Wilson's Snipe | *Gallinago delicata* | Bernalillo, Valencia |
| Wilson's Warbler | *Cardellina pusilla* | Bernalillo, Valencia |
| Winter Wren | *Troglodytes hemialis* | Bernalillo, Valencia |
| Wood Duck | *Aix sponsa* | Bernalillo |
| Woodhouse's Scrub Jay | *Aphelocoma woodhouseii* | Bernalillo, Valencia |
| Worm-eating Warbler | *Helmitheros vermivorum* | Bernalillo |
| Yellow Warbler | *Setophaga petechia* | Bernalillo, Valencia |
| Yellow-bellied Sapsucker | *Sphyrapicus varius* | Bernalillo |

| Common Name | Scientific Name | County |
|---|---|---|
| Yellow-billed Cuckoo (western pop) | *Coccyzus americanus occidentalis* | Bernalillo, Valencia |
| Yellow-breasted Chat | *Icteria virens* | Bernalillo, Valencia |
| Yellow-headed Blackbird | *Xanthocephalus xanthocephalus* | Bernalillo |
| Yellow-rumped Warbler | *Setophaga coronata* | Bernalillo, Valencia |
| Zone-tailed Hawk | *Buteo albonotatus* | Bernalillo |
| ***Mammals*** | | |
| American Badger | *Taxidea taxus* | Bernalillo, Valencia |
| American Beaver | *Castor canadensis* | Bernalillo, Valencia |
| Big Brown Bat | *Eptesicus fuscus* | Bernalillo, Valencia |
| Big Free-tailed Bat | *Nyctinomops macrotis* | Bernalillo, Valencia |
| Black Bear | *Ursus americanus* | Bernalillo, Valencia |
| Black-tailed Jackrabbit | *Lepus californicus* | Bernalillo, Valencia |
| Bobcat | *Lynx rufus* | Bernalillo, Valencia |
| Botta's Pocket Gopher | *Thomomys bottae actuosus;* | Bernalillo, Valencia |
| Brazilian Free-tailed Bat | *Tadarida brasiliensis* | Bernalillo, Valencia |
| Brush Mouse | *Peromyscus boylii* | Bernalillo, Valencia |
| Cactus Mouse | *Peromyscus eremicus anthonyi; eremicus* | Bernalillo, Valencia |
| California Myotis | *Myotis californicus* | Bernalillo |
| Canyon Bat | *Parastrellus hesperus* | Bernalillo, Valencia |
| Cliff Chipmunk | *Tamias dorsalis* | Bernalillo, Valencia |
| Common Gray Fox | *Urocyon cinereoargenteus* | Bernalillo, Valencia |
| Common Hog-nosed Skunk | *Conepatus leuconotus* | Bernalillo, Valencia |
| Common Muskrat | *Ondatra zibethicus pallidus;* | Bernalillo, Valencia |
| Common Porcupine | *Erethizon dorsatum* | Bernalillo, Valencia |
| Common Raccoon | *Procyon lotor* | Bernalillo, Valencia |
| Coyote | *Canis latrans* | Bernalillo, Valencia |
| Crawford's Desert Shrew | *Notiosorex crawfordi* | Bernalillo, Valencia |
| Deer Mouse | *Peromyscus maniculatus* | Bernalillo, Valencia |
| Desert Cottontail Rabbit | *Sylvilagus audubonii* | Bernalillo, Valencia |
| Dusky Shrew | *Sorex monticola* | Bernalillo, Valencia |
| Fringed Myotis | *Myotis thysanodes* | Bernalillo, Valencia |
| Hispid Cotton Rat | *Sigmodon hispidus berlandieri;* | Valencia |
| Hispid Pocket Mouse | *Chaetodipus hispidus* | Bernalillo |
| Hoary Bat | *Lasiurus cinereus* | Bernalillo, Valencia |
| House Mouse | *Mus musculus* | Bernalillo, Valencia |
| Long-legged Myotis | *Myotis volans* | Bernalillo, Valencia |
| Long-tailed Vole | *Microtus longicaudus longicaudus;* | Bernalillo |
| Meadow Jumping Mouse | *Zapus hudsonius luteus* | Bernalillo, Valencia |
| Merriam's Kangaroo Rat | *Dipodomys merriami* | Bernalillo, Valencia |
| Mountain Lion | *Puma concolor* | Bernalillo, Valencia |
| Mule Deer | *Odocoileus hemionus* | Bernalillo, Valencia |
| N. Grasshopper Mouse | *Onychomys leucogaster* | Bernalillo, Valencia |
| Nutria | *Myocastor coypus* | Bernalillo |

| Common Name | Scientific Name | County |
|---|---|---|
| Ord's Kangaroo Rat | *Dipodomys ordii* | Bernalillo, Valencia |
| Pale Townsend's Big-eared Bat | *Corynorhinus townsendii* | Bernalillo |
| Pallid Bat | *Antrozous pallidus* | Bernalillo, Valencia |
| Pecos River Muskrat | *Ondatra zibethicus ripensis* | Valencia |
| Pronghorn | *Antilocapra americana americana* | Bernalillo, Valencia |
| Ringtail | *Bassariscus astutus* | Bernalillo, Valencia |
| Rock Pocket Mouse | *Chaetodipus intermedius intermedius;* | Bernalillo, Valencia |
| Rock Squirrel | *Otospermophilus variegatus grammurus* | Bernalillo, Valencia |
| Silky Pocket Mouse | *Perognathus flavus flavus; hopiensis* | Bernalillo, Valencia |
| Southwestern Myotis | *Myotis auriculus* | Bernalillo |
| Spotted Bat | *Euderma maculatum* | Bernalillo, Valencia |
| Spotted Ground Squirrel | *Xerospermophilus spilosoma* | Bernalillo, Valencia |
| Striped Skunk | *Mephitis mephitis* | Bernalillo, Valencia |
| Tawny-bellied Cotton Rat | *Sigmodon fulviventer minimus* | Bernalillo, Valencia |
| Western Harvest Mouse | *Reithrodontomys megalotis megalotis;* | Bernalillo, Valencia |
| Western Small-footed Myotis | *Myotis ciliolabrum* | Bernalillo, Valencia |
| Western Spotted Skunk | *Spilogale gracilis* | Bernalillo, Valencia |
| White-footed Mouse | *Peromyscus leucopus* | Bernalillo, Valencia |
| White-throated Wood Rat | *Neotoma albigula* | Bernalillo, Valencia |
| White-toothed woodrat | *Neotoma leucodon* | Bernalillo, Valencia |
| | ***Amphibians*** | |
| Boreal Chorus Frog | *Pseudacris maculata* | Bernalillo, Valencia |
| Bullfrog | *Lithobates catesbeianus* | Bernalillo, Valencia |
| Canyon Treefrog | *Hyla arenicolor* | Bernalillo |
| Couch's Spadefoot | *Scaphiopus couchii* | Bernalillo, Valencia |
| Great Plains Toad | *Anaxyrus cognatus* | Bernalillo, Valencia |
| New Mexico Spadefoot | *Spea multiplicata* | Bernalillo, Valencia |
| Northern Leopard Frog | *Lithobates pipiens* | Bernalillo, Valencia |
| Plains Spadefoot | *Spea bombifrons* | Bernalillo, Valencia |
| Red-spotted Toad | *Anaxyrus punctatus* | Bernalillo, Valencia |
| Tiger Salamander | *Ambystoma mavortium nebulosum* | Bernalillo, Valencia |
| Woodhouse's Toad | *Anaxyrus woodhousii* | Bernalillo, Valencia |
| | ***Reptiles*** | |
| Big Bend Slider | *Trachemys gaigeae* | Bernalillo |
| Black-necked Gartersnake | *Thamnophis cyrtopsis* | Bernalillo, Valencia |
| Chihuahuan Nightsnake | *Hypsiglena jani* | Bernalillo, Valencia |
| Chihuahuan Spotted Whiptail | *Aspidoscelis exsanguis* | Bernalillo, Valencia |
| Coachwhip | *Coluber flagellum* | Bernalillo, Valencia |
| Common Checkered Whiptail | *Aspidoscelis tesselata* | Bernalillo, Valencia |
| Common Lesser Earless Lizard | *Holbrookia maculata approximans;* | Bernalillo, Valencia |
| Desert Kingsnake | *Lampropeltis splendida* | Bernalillo, Valencia |
| Desert Striped Whipsnake | *Coluber taeniatus* | Bernalillo, Valencia |
| Eastern Black-tailed Rattlesnake | *Crotalus ornatus* | Bernalillo, Valencia |
| Eastern Collared Lizard | *Crotaphytus collaris* | Bernalillo, Valencia |
| Glossy Snake | *Arizona elegans* | Bernalillo, Valencia |

| Common Name | Scientific Name | County |
|---|---|---|
| Gophersnake | *Pituophis catenifer* | Bernalillo, Valencia |
| Great Plains Rat Snake | *Pantherophis emoryi* | Bernalillo |
| Great Plains Skink | *Plestiodon obsoletus* | Bernalillo, Valencia |
| Hernandez's Short-horned Lizard | *Phrynosoma hernandesi* | Bernalillo, Valencia |
| Lined Snake | *Tropidoclonion lineatum* | Bernalillo |
| Long-nosed Leopard Lizard | *Gambelia wislizenii* | Bernalillo, Valencia |
| Many-lined Skink | *Plestiodon multivirgatus* | Bernalillo |
| Marbled Whiptail | *Aspidoscelis marmorata* | Bernalillo, Valencia |
| Marcy's Checkered Gartersnake | *Thamnophis marcianus* | Bernalillo, Valencia |
| Milk Snake | *Lampropeltis gentilis* | Bernalillo |
| New Mexico Gartersnake | *Thamnophis sirtalis* | Bernalillo, Valencia |
| North American Racer | *Coluber constrictor* | Bernalillo |
| Northern Tree Lizard | *Urosaurus ornatus* | Bernalillo, Valencia |
| Ornate Box Turtle | *Terrapene ornata* | Bernalillo, Valencia |
| Plains Black-headed Snake | *Tantilla nigriceps* | Bernalillo, Valencia |
| Plains Hog-nosed Snake | *Heterodon nasicus* | Bernalillo, Valencia |
| Plateau Striped Whiptail | *Aspidoscelis velox* | Bernalillo, Valencia |
| Prairie Rattlesnake | *Crotalus viridis* | Bernalillo, Valencia |
| Red-eared Slider | *Trachemys scripta* | Bernalillo |
| Ringneck Snake | *Diadophis punctatus* | Bernalillo, Valencia |
| Round-tailed Horned Lizard | *Phrynosoma modestum* | Bernalillo, Valencia |
| Snapping Turtle | *Chelydra serpentina* | Bernalillo, Valencia |
| Spiny Softshell Turtle | *Apalone spinifera* | Bernalillo, Valencia |
| Texas Blind Snake | *Rena dissecta* | Bernalillo, Valencia |
| Texas Long-nosed Snake | *Rhinocheilus lecontei* | Bernalillo, Valencia |
| Twin-spotted Spiny Lizard | *Sceloporus bimaculosus* | Valencia |
| Wandering Gartersnake | *Thamnophis elegans* | Bernalillo, Valencia |
| Western Diamond-backed Rattlesnake | *Crotalus atrox* | Bernalillo, Valencia |
| Western Painted Turtle | *Chrysemys picta* | Bernalillo, Valencia |
| Yellow Mud Turtle | *Kinosternon flavescens* | Bernalillo |
| ***Fish*** | | |
| Black Bullhead | *Ameiurus melas* | Bernalillo, Valencia |
| Bluegill | *Lepomis macrochirus* | Bernalillo, Valencia |
| Brown Trout | *Salmo trutta* | Bernalillo |
| Central Stoneroller | *Campostoma anomalum* | Bernalillo |
| Channel Catfish | *Ictalurus punctatus* | Bernalillo, Valencia |
| Common Carp | *Cyprinus carpio* | Bernalillo, Valencia |
| Fathead Minnow | *Pimephales promelas* | Bernalillo, Valencia |
| Flathead Chub | *Platygobio gracilis* | Bernalillo, Valencia |
| Gizzard Shad | *Dorosoma cepedianum* | Bernalillo, Valencia |
| Grass Carp | *Ctenopharyngodon idella* | Bernalillo |
| Green Sunfish | *Lepomis cyanellus* | Bernalillo, Valencia |
| Largemouth Bass | *Micropterus salmoides* | Bernalillo, Valencia |
| Longnose Dace | *Rhinichthys cataractae* | Bernalillo, Valencia |
| Rainbow Trout | *Oncorhynchus mykiss* | Bernalillo, Valencia |

| Common Name | Scientific Name | County |
|---|---|---|
| Red Shiner | *Cyprinella lutrensis* | Bernalillo, Valencia |
| Rio Grande Chub | *Gila pandora* | Bernalillo |
| Rio Grande Silvery Minnow | *Hybognathus amarus* | Bernalillo, Valencia |
| River Carpsucker | *Carpiodes carpio* | Bernalillo, Valencia |
| Walleye | *Sander vitreus* | Bernalillo |
| Western mosquitofish | *Gambusia affinis* | Bernalillo, Valencia |
| White Crappie | *Pomoxis annularis* | Bernalillo |
| White Sucker | *Catostomus commersoni* | Bernalillo, Valencia |
| Yellow Bullhead | *Ameiurus natalis* | Bernalillo, Valencia |
| Yellow Perch | *Perca flavescens* | Bernalillo |

### 1.3.1 Current Wildlife Habitat Conditions

Numerous resources were compiled for evaluating the current and future conditions in the study area. The Hink and Ohmart (1984) vegetation classification provided the foundation for evaluating habitat. The 2002 vegetation mapping from the Upper Rio Grande Water Operations FEIS (USACE 2007) was updated in 2012 (Siegel et al. 2012) as the primary GIS for the existing habitat conditions (USACE 2017).

### 1.3.2 Determination of Current and Future Conditions

GIS was used to compare the existing vegetation types and how they would change with the levee footprint in the study area (USACE 2017). The existing spoil bank area was removed from the vegetation mapping to establish existing baseline conditions for analysis. The proposed levee construction footprints and the vegetation management zones were used to calculate the areal change for the Hink and Ohmart vegetation types.

### 1.3.3 Fish and Wildlife Coordination Act Report

The Draft Fish and Wildlife Coordination Act report was received from the U.S. Fish and Wildlife Service (USFWS) on February 12, 2015. Comments on the draft report were provided to the USFWS on July 5, 2017, with the final coordination report received on December 4, 2017.

Draft versions of the report were sent to the New Mexico Department of Game and Fish, and the Forestry Division of the New Mexico Energy, Minerals, and Natural Resources Department. The report was also sent to the Pueblos of Isleta, and Valle de Oro National Wildlife Refuge.

# United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113
Telephone 505-346-2525 Fax 505-346-2542
www.fws.gov/southwest/es/newmexico/

December 4, 2017

Consultation No. 02ENNM00-2013-CPA-0059

George H. MacDonell, Chief
Environmental Resource Section
Planning Branch

Planning, Project, and Program Management Division
U.S. Army Corps of Engineers, Albuquerque District
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435
Dear Mr. MacDonell:
This is the U.S. Fish and Wildlife Service (Service) response to your request for review of the U.S. Army Corps of Engineers (USACE) Middle Rio Grande Flood Protection Bernalillo to Belen, New Mexico, Mountain View, Isleta, and Belen Units General Reevaluation Report (Project) (USACE 2013) under the Fish and Wildlife Coordination Act (16 USC 661-667e). Please consider this letter our 2(b) report for this Project.

## Introduction

The purpose of the Project is to 1) reduce the expected annual damages from flooding for both public infrastructure and private property, and 2) reduce the risks to human health and safety in the study area through the period of analysis (USACE 2013: 16). The final array of alternative plans include:

1. Rehabilitation of existing spoil banks in the Mountain View, Isleta, and Belen Units;
2. Flood warning system(s) in the Mountain View, Isleta and Belen Units;
3. Required mitigation measures;
4. Evacuation plans;
5. Flood proofing in the Isleta West and Belen Units; and
6. Raising structures in place in the Isleta West and Belen Units (USACE 2013: 27).

Here we focus on alternatives 1 and 3 as the remaining alternatives are not likely to have substantial impacts to fish and wildlife resources.

The Project Area has been subject to multiple studies over the last 36 years (Service 1978; USACE 1979; USACE 1986; Service 1993, 1996) culminating in the General Reevaluation

Report in 2013 (USACE 2013). You also provided revised supplement information on the affected vegetation and the vegetation management zone (Porter 2015), and the recommended plan (Porter 2016).

## Project Description

This primary impact to fish and wildlife is the expansion of the spoil bank base to make it an engineered levee. About 76 kilometers (km) (47 miles (mi)) of existing spoil banks along the Middle Rio Grande from the South Diversion Channel in Albuquerque to Jarales south of Belen (Figure 1) are proposed to be reconstructed to engineered levee specifications. In addition, to protect the end of the levees from scouring sheet piling may be used (USACE 2013: 20). The Project Area occurs across the Albuquerque and Isleta Reaches of the Rio Grande. The existing spoil bank footprint will be expanded by 9 meters (m) (30 feet (ft)) through increased basal width and adjacent vegetation clearing resulting in additional loss of floodplain and riparian habitat within the levees. The base plan and the recommended plan that would increase levee height between 1.2 and 2.1 m (4 and 7 ft) are evaluated here.

The following is a summary of impacts by unit. Table 1 compares the Base Levee and Recommended Plan options by unit.

Table 1. Length and area of levees to be modified by this Project by unit.

| Levee Location | Levee Length km (mi) | Base Plan ha (acres) | Height Above Base m (ft) | Recommended Plan ha (acres) |
|---|---|---|---|---|
| Mountain View | 6.9 (4.3) | 7.8 (19.3) | 1.2 (4) | 9.4 (23.2) |
| Isleta West | 5.0 (3.1) | 3.8 (9.4) | 1.2 (4) | 4.7 (11.6) |
| Belen East | 28.8 (17.9) | 25.6 (63.2) | 2.1 (7) | 37.8 (93.5) |
| Belen West | 35.6 (22.1) | 29.3 (72.5) | 2.1 (7) | 43.8 (108.3) |
| Total | 76.3 (47.4) | 66.5 (164.4) | | 95.7 (236.6) |

Mountain View (east side of Rio Grande)

Approximately 6.9 km (4.3 mi) of spoil bank will be reconstructed. The Project will affect public access from Valle de Oro National Wildlife Refuge to the Rio Grande. The floodplain area within the levee is part of the Rio Grande Valley State Park.

Isleta West

Improvements are restricted to the west side of the Rio Grande with 5.0 km (3.1 mi) of spoil banks being reconstructed. The actions occur on the Isleta Pueblo and may affect the existing Pueblo Riverine Management Plan (Pueblo of Isleta 2005).

Belen East

About 28.8 km (17.9 mi) of spoil banks will be reconstructed in this unit. The upper portion of this unit is on the Pueblo of Isleta and may have impacts to the existing Pueblo Riverine Management Plan (Pueblo of Isleta 2006). The Whitfield Wildlife Conservation Area abuts the Project area east of Belen (Whitfield Wildlife Conservation Area 2015).

Belen West

About 35.6 km (22.1 mi) of spoil banks will be reconstructed in this unit. No existing conservation areas were identified adjacent to the Project Area.

## Sensitive Species and Habitat

This section of the Middle Rio Grande has a diverse biotic community and some of the best riparian habitat on the Rio Grande (Hink and Ohmart 1984; Finch et al. 1999; Cartron et al. 2008). The Middle Rio Grande harbors the largest cottonwood forest (Bosque) along the Rio Grande (Crawford et al. 1993; Scurlock 1998). In the last 30 years the Bosque has become aged (Mount et al. 1996) and more dominated by invasive species (Horner 2006). The Bosque provides a riparian corridor that helps maintain regional biodiversity (Naiman et al. 1993).

Federally listed species in the Project Area include the Rio Grande silvery minnow (*Hybognathus amarus*) (silvery minnow), southwestern willow flycatcher (*Empidonax traillii extimus*) (flycatcher), New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) (jumping mouse), and yellow-billed cuckoo (*Coccyzus americanus*) (cuckoo), and their designated and proposed critical habitat.

Within the Mountain View Unit silvery minnow designated critical habitat occurs in the area bounded by existing levees. No work is proposed in the active channel so no direct effects to aquatic wildlife are expected. Yellow-billed cuckoo have been observed in this area and the riparian zone is proposed as critical habitat.

In the Isleta West Unit historically used jumping mouse habitat occurs along the proposed levee alignment. We recommend special measures be taken to maintain or enhance habitat suitable for the jumping mouse in partnership with the Pueblo. Flycatchers are reported to nest within 1 km (0.6 mi) of the levee alignment (Smith and Johnson 2008). No cuckoos have been reported from this unit though the riparian zone is proposed as critical habitat.

In the Belen West and East Units flycatchers are not common but have nested consistently over time (Moore and Ahlers 2012). The levees are adjacent to or within flycatcher designated critical habitat. There is a considerable amount of suitable flycatcher habitat in this unit (Parametrix 2008). Silvery minnow designated critical habitat includes those areas bounded by existing spoil banks. Yellow-billed cuckoo have been observed in this area and the riparian zone is proposed as critical habitat. The proposed actions will need consultation under section 7 of the Endangered Species Act of 1973 as amended (16 USC 1531 et seq.).

Birds

Birds are one of the most diverse groups of wildlife in the Project Area with over 280 species known from the Middle Rio Grande (Hink and Ohmart 1984; Thompson et al. 1994; Hawks Aloft 2010). The riparian corridor of the Rio Grande is a major migratory route for neotropical birds (Yong et al. 1995; Leal et al. 1996; Yong and Finch 1997; Finch and Yong 2000). About 61 percent of the birds known from the area are neotropical migrants. Loss of riparian habitat in the region is believed to be related to the decline in some bird species (DeSante and George 1994; Askins 2002). The effects of floodplain dysfunction may be first evident in loss of bird species richness and abundance.

## Discussion

With and without the Project

Conversion of the existing spoil banks to engineered levees will more permanently cut off a large area of the floodplain that was periodically flooded in conjunction with reducing the risk of flood damage. The reduced risk of flooding should allow water managers to overbank the Rio Grande with lower risk of property damage. Overbanking the river more often is needed to help restore the remaining floodplain habitat within the levees (Ellis et al. 1996) and restore silvery minnow populations.

Maintaining riparian habitat is a conservation priority throughout the west (Knopf et al. 1988; Krueper 2000) and especially in the Middle Rio Grande (Crawford et al. 1993). While the extent of riparian habitat necessary to maintain a diverse and functional Bosque is unknown, the isolation of riparian habitat outside the levees could lead to functional failure of this ecosystem component. Better flood protection does not eliminate the risk of flooding but will encourage further development in the floodable area outside the levees making maintenance and enhancement of the remaining riparian habitat within the levees essential to a functioning floodplain (American Rivers 2012). We believe this includes the levee itself, which cannot be developed but could support, if designed and maintained properly, an important vegetation component to the floodplain. While current USACE specification call for a low to minimal vegetation component (USACE 2014) recent studies have shown the levees can support a diverse structural plant community without compromising levee safety (Kabir and Bean 2011; Corcoran 2012). We believe that in this reach of the Rio Grande it is essential to do the utmost to maintain the greatest areal extent and diversity of riparian habitat to insure the long-term persistence of the biological diversity that occurs here. This includes enhanced management effort on levee vegetation.

Levees should be planted with vegetation that maintains stability and provides higher quality habitat for wildlife. This typically would be forbs, shrubs, and small trees that provide the structural diversity important for wildlife diversity (Szaro 1980; Hink and Ohmart 1984; Thompson et al. 1995). Bird richness and abundance is directly related to the number and size of trees (Thompson et al. 1995) and succession to a heterogeneous mix of plant species (Farley et al. 1994). A heterogeneous plant community also increases the trophic base for wildlife in the floodplain (Ellis et al. 1996). In general increased habitat heterogeneity results in increased animal diversity (Tews et al. 2004). Allowing woody scrubs and small trees to develop on the levees would provide environmental benefits and enhance structural integrity (Shield and Gary 1992). This vegetation community should be maintained through performance measures in the operations and maintenance plan.

The TSP option proposes to move the levee footprint closer to the river in many areas. This will further reduce the active floodplain that is already highly compromised and may not be able to maintain existing endangered species populations.

Without the project additional funds would not be available for habitat restoration associated with the project. Existing habitat quality is low in many places adjacent to the spoil banks as there is an active program to eliminate encroaching trees. Existing spoil banks do pose a flood risk but also limit further urban development and help maintain riparian communities within the floodplains.

Mitigation for loss habitat

The Reevaluation Report originally estimated 42.5 ha (105 acres) of riparian woodlands would be lost with a further 60.7 ha (150 acres) of habitat damaged (USACE 2013: 20). Compensation for the loss included 81 ha (200 acres) of riparian woodland protected and restored; the woodlands would be intensively managed; and all denuded areas would be restored to grassland conditions (USACE 2013: 21). Riparian woodlands would represent the highest habitat value in the Project Area. Based on data on affected vegetation within the proposed levee footprint provide by USACE (Porter 2014, 2016) we estimate the following habitat loss for the NED and TSP alternatives in Table 2.

Table 2. Habitat loss by vegetation type for the Base Plan and Recommended Plan alternatives.

| | Base | | Recommended | | Percent |
|---|---|---|---|---|---|
| Habitat Type | ha | acres | ha | acres | Change |
| Native | 27.4 | 67.8 | 58.4 | 144.4 | 113 |
| With Exotics | 64.1 | 158.5 | 79.1 | 195.5 | 23 |
| River Channel | 0.0 | 0 | 1.3 | 3.3 | 330 |
| Disturbed | 6.6 | 16.3 | 8.1 | 19.9 | 22 |
| TOTAL | 98.2 | 242.6 | 146.9 | 363.1 | 50 |

The TSP alternative has a substantial increase in native vegetation loss and includes some river channel. Overall there is a 50 percent increase in habitat loss in the TSP alternative.

The ongoing formal consultation (Consultation number 02ENNM00-2014-F-0302) is further evaluating impacts to flycatcher, cuckoo, and silvery minnow that may require additional habitat compensation. Before the mitigation needs of the project are finalized these habitat impacts should be also be incorporated.

## Recommendations

The recommendations of Hink and Ohmart (1984) are still relevant and sound today and are incorporated in our recommendations (Appendix A). Recommendation are grouped into three categories; impact avoidance, mitigation and restoration, and monitoring.

Impact Avoidance

Further reductions in the active floodplain should be avoided as the floodplain is already highly compromised in its functionality. We recommend the levee improvement be done in the current alignment and if a change in alignment is needed that the levee be moved further away from the river. This would maintain or improve the functionality of the floodplain for fish and wildlife and reduce the mitigation cost.

Construction should be accomplished during periods of least resource impact. Work should be scheduled to avoid disturbance to breeding and nesting birds especially Neotropical migrants (March through September) and to fish, especially native fishes, during the spawning and hatching periods. To minimize disturbance to wildlife, the duration of disturbance activities should be as brief as possible.

When it is not possible to avoid the bird breeding and nesting season, vegetation identified for ground disturbance should be surveyed for the presence of nesting birds prior to construction. Avoid disturbing nesting areas until birds have fledged. Areas occupied by flycatcher and cuckoo should be avoided from April 15 to September 1.

Backfill should be uncontaminated earth or alluvium suitable for revegetation with native plant species.

Protect mature cottonwood trees adjacent to the construction footprint from damage during clearing of nonnative species or other construction activities using fencing, or other appropriate materials.

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.

There has been substantial restoration planned and completed in the Project Area (Crawford et al. 1993; Robert 2005; Parametrix 2008; SWCA 2008, 2010). Project construction activities should avoid impacts to proposed and existing restoration areas.

## Mitigation and Restoration

We recommend a habitat equivalency analysis be used to determine the adequacy of the mitigation (Ray 2008). If restoration of existing conservation areas is used for mitigation only the habitat lift should be counted toward offsetting the impacts and should not supplant other efforts. Compensatory measures should be completed before the impacts of the action occur or should account for temporal loss of resources.

The total mitigation requirements should include habitat losses calculated in the biological opinion.

Mitigation should be consistent with and contribute to the overall success of existing multiagency restoration plans (Crawford et al. 1993; Parametrix 2008).

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

Due to the lack of groundwater access and the compacted nature of the soil, levees pose a challenge to developing a diverse plant community. We recommend working with the Natural Resources Conservation Service Los Lunas Plant Materials Center to select and test suitable native plants for maintaining a diverse vegetative assemblage. Active management of the plant community will be necessary and operations and maintenance plans should include agreements to maintain an appropriate plant community in terms of ground coverage and composition.

In the Mountain View Unit we recommend working with the Refuge personnel to replace existing levee crossings and develop an addition crossing including bridging the drainage canal to improve public access to the floodplain. If the levee construction will affect the bridge crossing at the South Diversion Channel either maintain or replace the bridge to maintain connectivity along the floodplain. Work with stakeholders to evaluate the use of the top of levee to provide a foot and bicycle pathway where feasible.

We recommend other impediments to floodplain function, such as jetty jacks, be removed.

Support and encourage the maintenance of riparian habitat and agricultural lands outside the levees on the historical floodplain.

## Monitoring

Develop an Adaptive Management Plan to monitor and evaluate success of Project mitigation, especially water quality, revegetation, and habitat enhancement to determine if the mitigation actions are sufficient enough to avoid, minimize, or compensate for adverse impacts.

Continue support and participation in annual bird monitoring especially for flycatchers and cuckoos in the proposed Project Area.

Monitor operations and maintenance activities to ensure the levee plant communities are maintained.

We appreciate the opportunity to provide these recommendations and look forward to working with you on the mitigation implementation. If you have any questions please contact George Dennis, 505761-4754, george dennis@fws.gov of my staff.

Sincerely,

o ).>d.)J\.

Susan S. Millsap
Field Supervisor

cc:

Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico (electronic copy)

Director, New Mexico Energy, Minerals, and Natural Resources Department, Forestry Division, Santa Fe, New Mexico (electronic copy)

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Governor, Isleta Pueblo, Isleta, New Mexico.

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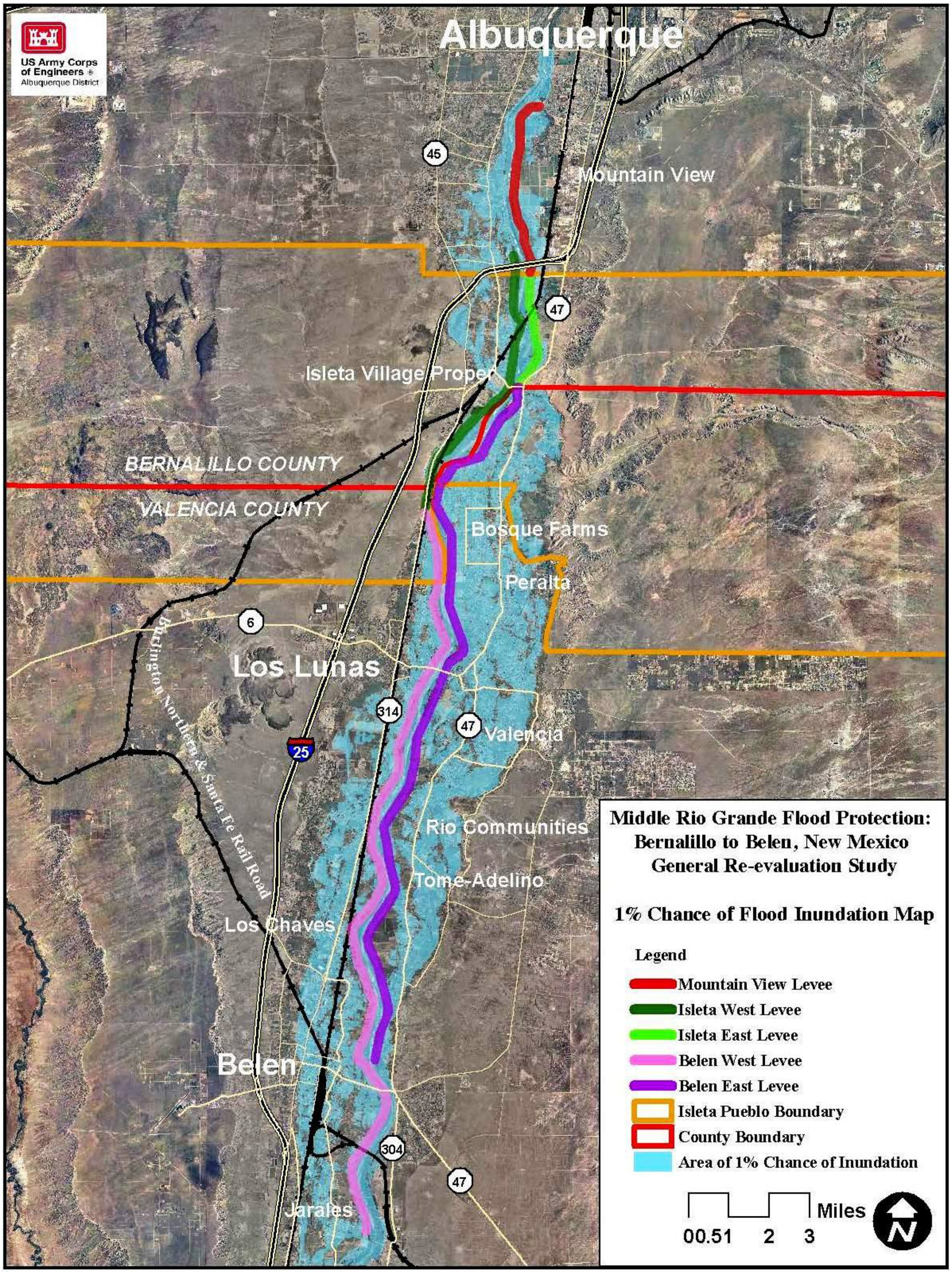


Figure 1. The Middle Rio Grande Flood Protection, Bernalillo to Belen, Project area (from USACE 2013).

The project shall incorporate the following recommendations from the Fish and Wildlife Coordination Act report.

- We recommend the levee improvement be done in the current alignment and if a change in alignment is needed that the levee be moved further away from the river.
- Work (vegetation removal and grubbing) should be scheduled (September 1 to April 15) to avoid disturbance to breeding and nesting birds especially
- Avoid disturbing nesting areas until birds have fledged. Areas occupied by flycatcher and cuckoo should be avoided from April 15 to September 1.
- Backfill should be uncontaminated earth or alluvium suitable for revegetation with native plant species.
- Protect mature cottonwood trees adjacent to the construction footprint from damage during clearing of nonnative species or other construction activities using fencing, or other appropriate materials.
- 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.
- Project construction activities should avoid impacts to proposed and existing restoration areas.
- The total mitigation requirements should include habitat losses calculated in the biological opinion.
- Mitigation should be consistent with and contribute to the overall success of existing multiagency restoration plans.
- Scarify compacted soils or replace topsoil and revegetate all disturbed sites with suitable mixture of native grasses, forbs, and woody shrubs.
- We recommend working with the Natural Resources Conservation Service Los Lunas Plant Materials Center to select and test suitable native plants for maintaining a diverse vegetative assemblage.
- In the Mountain View Unit we recommend working with the Refuge personnel to replace existing levee crossings and develop an addition crossing including bridging the drainage canal to improve public access to the floodplain. Work with stakeholders to evaluate the use of the top of levee to provide a foot and bicycle pathway where feasible.
- We recommend other impediments to floodplain function, such as jetty jacks, be removed.
- Develop an Adaptive Management Plan to monitor and evaluate success of Project mitigation, especially water quality, revegetation, and habitat enhancement to determine if the mitigation actions are sufficient enough to avoid, minimize, or compensate for adverse impacts.
- Continue support and participation in annual bird monitoring especially for flycatchers and cuckoos in the proposed Project Area.
- Monitor operations and maintenance activities to ensure the levee plant communities are maintained.

# 2 - FUTURE WITHOUT PROJECT CONDITIONS

## **2.1** PHYSICAL ENVIRONMENT*

The future without the project would not result in any changes to the physical resources in the Middle Rio Grande study area. The physiography, geology, soils, and climate would remain the same without the project. The no-action alternative would have no adverse impacts on the wetlands, water quality, and erosion. The no-action alternative would continue to periodic impacts on vegetation within and outside the floodway.

### 2.1.1 Water Resources

In general water quality within the study area would remain the same or possibly decline slightly. Population growth in the upper and Middle Rio Grande valley is expected to continue at a moderate rate in the areas of Albuquerque and Santa Fe. Population growth and changes in land use within the study are not expected to change dramatically in the future. Demand on limited water resources within the Rio Grande Basin would increase and potentially impact water quality through slight increases in salinity and other pollutants from use and reuse of water for municipal supply and irrigation.

Water and sediment quality are likely to be negatively impacted without construction of a superior flood risk management project in the study area. The spoil banks are considered to have a high probability of failing during high frequency flood events. The consequences of a spoil bank failure are exacerbated by the perched channel condition in some of the proposed study areas. A spoil bank breach would result in all or a large portion of floodwaters flowing from the river channel into the lower elevations of the former floodplain. Due to the perched channel condition, floodwaters would not flow back into the river channel but rather drain through irrigation channels. The limited capacity of these channels would ensure a prolonged inundation of the floodplain landward of the spoil bank.

Waters of the United States and wetlands, as defined in the Clean Water Act, 33 U.S.C. 1251 et seq. would continue to be potentially impacted by the activities of Federal, State, local and private entities. The actual activities and extent of impact are not predictable.

### 2.1.2 Floodplains

Without the project, the spoil bank would periodically fail at approximately 7000 cfs discharge (Central Ave gage) on either or both sides of the river. Breached or damaged spoil banks would be quickly repaired or rebuilt along the existing alignment. Damages to ecological resources from both the 10% unregulated and 1.0%-chance regulated flood events (10,300 cfs at Central) are expected to occur both within the current floodway and across pueblo and private property on the historical floodplain outside the spoil banks. The estimated inundated area for both flood frequencies totals approximately 13,495 acres (Appendix H).

Without the project there would still be impacts to riparian and aquatic communities within the floodway. The 1%-chance flood event would likely scour the substrate, and remove or damage vegetation within the floodway. Riparian plant species are adapted to the dynamics of sand-bed river systems.

The without-project effects of the 10%-chance events are nominal; therefore, the extent of adverse effects would be similarly small. The magnitude of the 10%-chance flood event is within the range of unregulated snowmelt and thunderstorm flows recorded in the Middle Rio Grande over the past 100 years, and is well within the flow regime to which native riparian species (cottonwood, willow) have adapted. The 1%-chance event are qualitatively likely to include the physical destruction of vegetation from high flow velocities, soil erosion, and/or sediment deposition; the temporary displacement of non-aquatic animals; and the death (primarily through drowning) of animals that cannot escape floodwaters. Although inundation, scouring and sediment accretion are natural processes of sand-bed rivers such as the Rio Grande, the recovery of plant and animal communities following the 1%-chance flood would be slow.

## **2.2** ENVIRONMENTAL RESOURCES*

Without the project, there would be no changes to the biological resources in the Middle Rio Grande, New Mexico study area. The no action alternative would have “No Impact” on any federal or state-listed T&E species that may occur within the proposed study area. The riparian and wetland vegetation and wildlife communities would persist without the project.

### 2.2.1 Riparian Forest Community

During the last two centuries, human induced hydrological, geomorphological, and ecological changes have heavily influenced the composition and extent of floodplain riparian vegetation along the Middle Rio Grande (Bullard and Wells, 1992; Dick-Peddie, 1993). In the future without-project scenario, the current status of the riparian ecosystem would continue to degrade due factors unrelated to the proposed project, including aggradation and degradation patterns, flow regulation, irrigation withdrawals, channel dredging, exotic shrub invasion, fire, and drought and climate change.

By 2080, the mean annual temperature in the Southwest is projected to increase approximately 4 to 6°F under conservative climate scenarios and as much as 7 to 10°F in higher emissions scenarios (USGCRP, 2009). Recent analysis suggesting the higher warming scenario is more likely, with temperature increases of 4 to 7°F by 2050 (Barnett and Pierce, 2009). While effects have not been quantified at his time, the condition of riparian vegetation within the study area may degrade due to lower streamflow volumes and increased evaporation rates associated with warmer temperatures.

Affected plant communities outside the baseline floodway area include: rural and suburban yards; agricultural fields and edges; upland Chihuahuan desert scrub; and wetland and riparian communities. These plant communities may be subjected to substrate scouring or extensive sediment deposition. Additional stress may result from extended inundation, depending on the tolerance of plant species within each community. Periodic floodplain flooding outside the existing floodway has the potential for providing allochthonous material land outside the spoil bank alignment, and also return a range of undesirable materials back into the Rio Grande. Following a spoil bank breach, floodwaters would likely return potential contaminants (sewage, petroleum products) to the river, with adverse impacts to habitat and organisms.

Without the project, there would be no change to the existing spoil bank footprint throughout the study area. There would be no vegetation removal or clearing-and-grubbing activities for the staging and access areas, levees side-slopes, and the vegetation-free zone that would disturb habitat for nesting migratory birds or other wildlife. Limiting the peak flow to the current safe channel capacity will reduce the opportunities for natural processes to scour habitat within the floodway to create a mosaic of riparian habitat succession.

### 2.2.2 Wetland Plant Community

The two perennial freshwater pond (PUBFh) located within the proposed levee footprint would not be affected by the no-action alternative. In the future without-project scenario, the current status of the aquatic ecosystem is likely to continue to degrade, including continued fragmentation of remaining habitat, aggradation of the floodplain coupled with increasing depths to groundwater, and narrowing of the river channel from the effects of water regulation and the restriction of historical river avulsion patterns due to constrains on the channel, resulting in the loss of warmwater aquatic habitat and wetlands.

## **2.3** FISH AND WILDLIFE

The hydrological, geomorphological, and ecological changes along the Middle Rio Grande will continue to affect the riparian vegetation. The future without-project scenario would continue degradation of the riparian ecosystem, reducing the habitat suitability for birds (Thompson et al. 1994) and other terrestrial species (Hink and Ohmart 1984). Without scouring flow from increased safe channel capacity, riparian habitat management will be increasingly dependent on periodic habitat restoration projects.

## 2.4 SOCIOECONOMIC ENVIRONMENT*

### 2.4.1 Demography

The City of Albuquerque in Bernalillo County is the largest population center in the study area. Of the 676,685 people that live within Bernalillo County, 545,852 live in Albuquerque based on the 2010 U. S. Census. The principle industries in the study area are education and research, health care, entertainment, accommodations, and food services, and retail (Table 2-1). Household income and racial statistics are provided in Table 2-2.

**Table 2-1 Employment by industry for the two counties, state and country.**

| INDUSTRY | Bernalillo County | Valencia County | New Mexico | United States |
|---|---|---|---|---|
| Civilian employed population 16 years and over | 244,760 | 10,196 | 602,632 | 121,079,879 |
| Agriculture, forestry, fishing and hunting, and mining | NA | NA | 3.66% | 0.76% |
| Construction | 6.55% | 7.52% | 6.34% | 4.71% |
| Manufacturing | 5.00% | NA | 4.39% | 9.44% |
| Wholesale trade | 4.63% | NA | 3.55% | 4.93% |
| Retail trade | 14.67% | 23.16% | 15.88% | 12.70% |
| Transportation and warehousing, and utilities | 2.59% | NA | 2.96% | 4.17% |
| Information | 2.61% | NA | 1.92% | 2.78% |
| Finance and insurance, and real estate and rental and leasing | 6.12% | 3.34% | 5.48% | 6.69% |
| Professional, scientific, and management, and administrative and waste management services | 16.38% | 4.75% | 13.98% | 9.79% |
| Educational services, and health care and social assistance | 21.41% | 18.98% | 20.70% | 18.52% |
| Arts, entertainment, and recreation, and accommodation and food services | 14.99% | 20.38% | 15.99% | 12.36% |
| Other services, except public administration | 4.36% | 4.24% | 4.36% | 4.42% |

**Table 2-2 Comparison of population, ethnicity and income in study area by county, state and country (July 1, 2015).**

| POPULATION | Bernalillo County | Valencia County | New Mexico | United States |
|---|---|---|---|---|
| Population estimate | 676,685 | 75,737 | 2,085,109 | 321,418,820 |
| Total population - 16 years and over | 521,040 | 58,807 | 1,600,398 | 243,275,505 |
| Total households | 266,000 | 27,500 | 791,395 | 116,716,292 |
| **ETHNICITY** | | | | |
| White alone or in combination | 84.6% | 89.3% | 82.5% | 77.1% |
| Hispanic or Latino alone or in combination | 49.2% | 59.9% | 48.0% | 17.6% |
| Black or African American alone or in combination | 3.4% | 1.7% | 2.6% | 13.3% |
| American Indian and Alaska Native alone or in combination | 6.0% | 5.7% | 10.5% | 1.2% |
| Asian alone or in combination | 2.8% | 0.9% | 1.7% | 5.6% |
| Two or More Races | 3.0% | 2.2% | 2.5% | 2.6% |
| **HOUSEHOLD INCOME** | | | | |
| Median household income (in 2015 dollars), 2011-2015 | $47,725 | $41,703 | $44,963 | $53,889 |
| Per capita income in past 12 months (in 2015 dollars), 2011-2015 | $26,765 | $19,412 | $24,012 | $28,930 |
| Persons in poverty, percent | 19.0% | 19.8% | 20.4% | 13.5% |

# 3 - FUTURE WITH PROJECT CONDITIONS*

## 3.1 PHYSICAL ENVIRONMENT*

The future with project would not result in any changes to the physical resources in the Middle Rio Grande study area. The physiography, geology, soils, and climate would remain the same with the project. The following discussion describes effects of replacing the spoil bank levee with an engineered levee for the Mountain View, Isleta, and Belen Units.

### 3.1.1 Water Resources

The flooding problems along the Middle Rio Grande between Bernalillo and Belen, New Mexico are documented in a 1979 feasibility report, Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico, Interim Feasibility Report, which was authorized for construction by Section 401 of the Water Resources Development Act of 1986 (Public Law 99-662), in accordance with the recommendation of the Chief of Engineers, dated 23 June 1981.

USACE projects proposing the discharge of dredged or fill material into waters of the United States are developed in accordance with guidelines promulgated by the Administrator of the Environmental Protection Agency in conjunction with the Secretary of the Army under the authority of Section 404(b)(1) of the Clean Water Act. A Section 404(b)(1) evaluation shall be completed to fulfill the requirements of the Clean Water Act. Section 401 Water Quality Certification would be obtained from the New Mexico Environment Department and the Pueblo of Isleta (see Appendix B), and conditions of the permit would be incorporated into pertinent construction contract specifications.

For alternatives brought forward for analysis of effects, construction activities associated with any of the earthen levee construction activities would not significantly affect water or sediment quality in the Rio Grande because the majority of the construction activity would not involve direct contact with water in the Rio Grande. Further, construction specifications, such as those listed below, would be designed to protect surface water quality. Disturbance of native habitat adjacent to the study area would be avoided except where removal of vegetation within the levee footprint and vegetation management zone is required. Fouling or polluting of water would not be permitted. Wash waters and wastes would be processed, filtered, or otherwise treated prior to evaporation or removal from the area.

Activities associated with project features other than the earthen levee would take place in or near the Rio Grande, and, therefore, would present opportunities for water quality degradation if precautions are not taken. The following impacts are anticipated as a result of these activities.

Construction activities in or immediately adjacent the Rio Grande channel would be scheduled during low-flow conditions and no impoundment of water would occur. No significant surface water, ground water, or sediment quality impacts would likely result from any of these construction activities.

All work in areas below the OHWM would be performed only during the annual low-flow period. Placement of all fill material would be onto non-inundated substrates. For all levee alternatives, all waste spoil material would be disposed at sites above the OHWM. Two freshwater ponds with peripheral wetlands, as defined in Section 404(b)(1) of the Clean Water Act, have been identified within the proposed study area. The mitigation plan will address measures for the loss of pond habitat under Section 404(b)(1). Considering the relatively minor net effects described above, none of the levee construction alternatives would adversely affect water quality and waters of the United States.

Finally, the 1972 amendments to the Clean Water Act prohibit the discharge of any pollutant to waters of the United States from a point source unless the discharge is authorized by a National Pollution Discharge Elimination System (NPDES) permit. Storm water runoff from construction activities, including clearing, grading, and excavating, disturbing more than one acre of total land area, require preparation of a Storm Water Pollution Prevention Plan (SWPPP) in accordance with the EPA Construction General Permit. Six major phases of the NPDES/SWPPP process are: (1) site evaluation and design development; (2) assessment; (3) control selection and plan design; (4) certification and notification; (5) construction / implementation; and (6) final stabilization/ termination. Best management practices would be developed in the SWPPP and implemented to eliminate/reduce pollutants to include the following: good housekeeping; performing preventive maintenance; maintaining visual inspections; prevention and response to spills; sediment and erosion control; managing runoff; training personnel, keeping records, and reporting; and any other activity-specific and site-specific storm water best management practices that apply.

The following are construction specifications, best management practices, and stipulations typically associated with Section 404 permits and Section 401 water quality certifications that would be complied with during construction of any of the levee alternatives to protect water resources from degradation:

1. Stream flow would be maintained at all times during construction so fish can migrate through the study area during and after construction.
2. Silt curtains, cofferdams, dikes, wattles, straw bales and other suitable erosion control measures would be employed to prevent sediment-laden runoff or contaminants from entering the watercourse.
3. Work would be performed below the elevation of the ordinary high water mark only during low-flow periods. Flowing water must be temporarily diverted around the work area, but remain within the existing channel to minimize erosion and turbidity and to provide for aquatic life movement. Diversion structures must be non-erodible, such as sand bags, water bladders, concrete barriers, or channel lined with geotextile or plastic sheeting. Dirt cofferdams are not acceptable diversion structures.
4. All asphalt, concrete, drilling fluids and muds, and other construction materials will be properly handled and contained to prevent releases to surface water. Poured concrete will be will be fully contained in mortar-tight forms and/or will be placed behind non-erodible cofferdams to prevent discharge contact with surface or groundwater. Wastewater from concrete batching, vehicle washdown, and aggregate processing would be contained, and treated or removed for off-site disposal. Dumping of any waste material in or near watercourses is prohibited.
5. Fuel, oil, lubricants, hydraulic fluids and other petrochemicals would be stored outside the floodway and at least 100 feet from surface water (including ditches and drains). The fuel storage facility must have a secondary containment system capable of containing twice the volume of the product. Appropriate spill clean-up materials such as booms and absorbent pads must be available on-site at all times during construction.

6. Fueling of wheeled construction vehicles would not be permitted in the construction area. Only tracked vehicles may be fueled within the construction area via a fuel tender with a maximum fuel capacity of 500 gallons, thereby minimizing the consequences of any accidental spill. Refueling of all vehicles and equipment must be performed at least 100 feet from surface water.
7. All heavy equipment used in the study area must be pressure washed and/or steam cleaned before the start of the project, and again before they leave the study area. All heavy equipment will be inspected daily for leaks. A written log of inspections and maintenance must be completed and maintained throughout the project period. Leaking equipment must not be used in or near surface water. Any petroleum or chemical spills would be contained and removed, including any contaminated soil.
8. Only uncontaminated earth or crushed rock would be used for backfills, and for the temporary river crossing.
9. Water quality would be monitored during bankline and in-channel construction to ensure compliance with State water quality standards for turbidity, pH, temperature, and dissolved solids.
10. Excavated trenches must be backfilled and compacted to match the bulk density and elevation of the adjacent undisturbed soil.
11. All disturbed areas that are not otherwise physically protected from erosion will be reseeded or planted with native vegetation.
12. A copy of the water quality certification must be kept at the project site during all phases of construction. All contractors involved in the project must be provided a copy of the certification and made aware of the conditions prior to starting construction.

### 3.1.2 Floodplains

Currently, the more probable 10%-chance unregulated flood event would be approximately 10,300 cfs at Albuquerque, with a 1%-chance unregulated flood event of 18,900 cfs (Appendix H). Appendix H describes the changes in flood frequency and floodplain area with project.

The existing spoil bank has been estimated to fail at a 7000 cfs regulated discharge at the Central Ave gage in Albuquerque, NM. Currently, spoil bank failure would periodically result in inundation throughout the historical floodplain on both sides of the river. Breached or damaged spoil banks would be quickly repaired or rebuilt along the existing alignment. Flow conditions within the floodway up to the breaching or failure discharge would be the same with or without the proposed action. The principal effect of the proposed action is that higher discharges that would be contained within the floodway. The following discussion focuses on the differential extents of inundation are first described, followed by changes in water depth and velocity are discussed specific to the minnow and flycatcher.

The magnitude of the 10% chance event is within the range of unregulated snowmelt and thunderstorm flows recorded in the Middle Rio Grande over the past 100 years, and is well within the flow regime to which native riparian species (cottonwood, willow) have adapted. Retaining flood flows within the floodway would be expected to increase scouring and sediment accretion. These dynamic processes have the potential to increase the loss of older riparian habitat patches while supporting the regeneration of new riparian habitat patches. The net result would be a continually changing mosaic of suitable riparian habitat for the flycatcher.

Although periodic floodplain inundation outside of the existing floodway has the potential for providing allochthonous material to the Rio Grande, historic and existing land outside the spoil bank alignment also present potential threats to water quality. Following a spoil bank breach, floodwaters would likely be of low quality and could result in the introduction of potential contaminants (sewage, petroleum products) to the river, and, therefore, may not be considered beneficial to aquatic habitat and organisms.

#### *3.1.2.1 1%-Chance-Event Floodplain*

With the proposed action, all flow for the 1%-chance event is estimated to inundate approximately 7,247 acres of the floodway between the spoil banks. Flooding and potential ecological damages would be eliminated from approximately 13,495 acres of the land outside the floodway on both sides of the spoil bank alignment.

Within the floodway, however, potentially adverse impacts to riparian and aquatic communities would still occur following levee construction. Currently, the 1%-chance flood event has the potential to scour the substrate and remove, or otherwise damage, vegetation within the Rio Grande floodway. This process is inherent in sand-bed river systems of the Southwestern U.S., and one to which riparian plant species are adapted.

Because of the rarity of the 1%-chance event, quantitative data on ecological impacts are not available for the Southwestern United States. Potential impacts likely include the physical destruction of vegetation from high flow velocities, soil erosion, and/or sediment deposition; the temporary displacement of non-aquatic animals; and the death (primarily through drowning) of animals that cannot escape floodwaters. Qualitatively, we believe that ecological effects within the floodway following construction of any of the levee alternatives would be as extensive and similar to the without-project condition. Although inundation, scouring and sediment accretion are natural processes of sand-bed rivers such as the Rio Grande, the recovery of plant and animal communities following the 1%-chance flood would be slow.

#### *3.1.2.2 10% Chance-Event Floodplain*

Currently, the more probable 10%-chance unregulated flood event (approximately 10,300 cfs at Albuquerque) is also expected to result in spoil bank failure and extensive inundation—between 469 up to 13,495 acres of the valley may be inundated depending on the side of the river and extent of a levee breach (Appendix H). Because spring runoff floods would be regulated by upstream reservoirs, this event would most likely result from rainstorm activity, and, therefore, would be of short duration. Therefore, resultant ecological damage from scouring, deposition, and inundation would be significantly less than for the 1%-chance event.

After construction of a new levee, the 10%-chance event would be contained to the floodway (7,247 acres). The with- versus without-project differential in depths and velocities of the 10%-chance events are nominal; therefore, the extent of adverse effects would be similarly small. The magnitude of the 10%-chance flood event is within the range of unregulated snowmelt and thunderstorm flows recorded in the Middle Rio Grande over the past 100 years, and is well within the flow regime to which native riparian species (cottonwood, willow) have adapted.

## 3.2 ENVIRONMENTAL RESOURCES*

### 3.2.1 Riparian Forest Community

The basal extent of the proposed levee was superimposed on geo-referenced aerial photography from 2002 and on riparian vegetation coverage mapped in 2012 (Siegle et al. 2013). Detailed levee information was imported into ArcGIS for spatial analysis of effects on existing vegetation and changes in floodway area. Generally, the proposed levee construction footprint would extend beyond the riverward toe of the existing spoil bank throughout the study area, removing approximately 265.8 acres of vegetation in the floodway (Figure 3-1; Table 3-1).

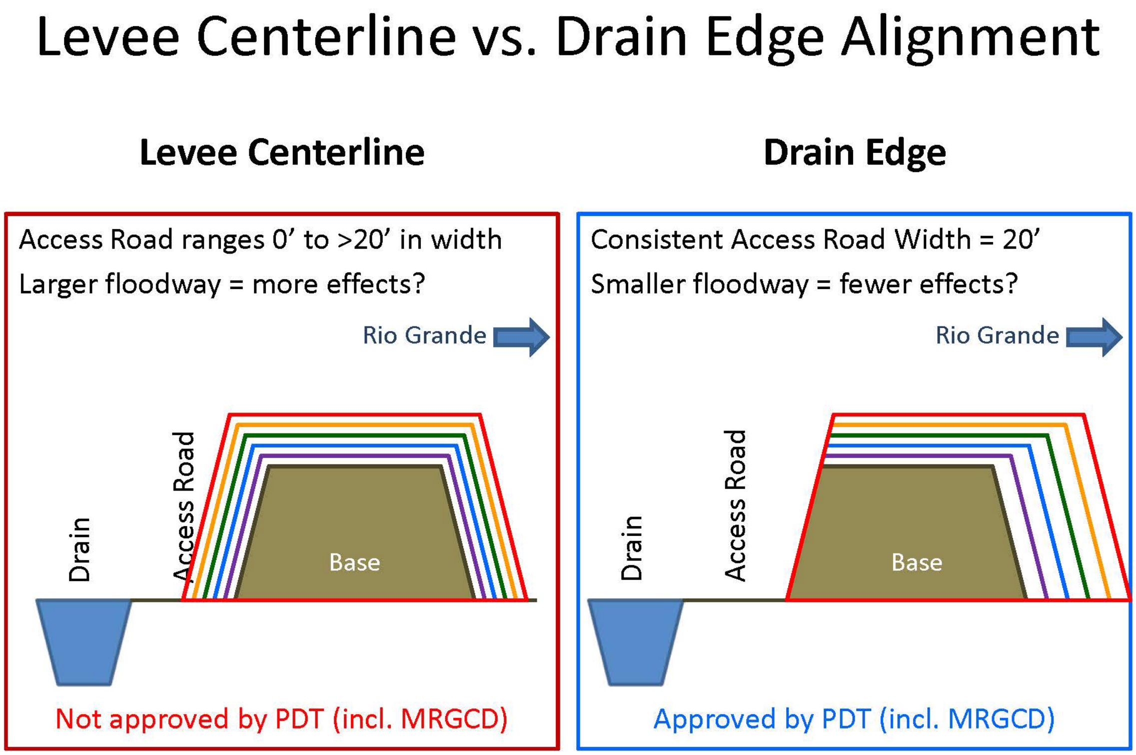


**Figure 3-1 Placement of the levee footprint relative to irrigation infrastructure.**

**Table 3-1 Affected vegetation (acres) for the 1% water surface and Recommended Plan levee area.**

| Levee Location (height above 1% ACE water surface) | Levee length (mi) | Base (acres) | Recommended Plan (acres) |
|---|---|---|---|
| Mountain View (1% ws +4) | 4.35 | 19.31 | 23.36 |
| Isleta West (1% ws +4) | 3.18 | 9.37 | 12.48 |
| Belen East (1% ws +5) | 18.1 | 63.18 | 96.90 |
| Belen West (1% ws +5) | 22.1 | 72.55 | 133.06 |
| Approximate total | 47.8 | 164.41 | 265.8 |

The loss of floodway area is approximately 178.3 acres (construction footprint minus the 87.5 acre vegetation-free zone). Vegetation removal and clearing-and-grubbing activities for all proposed construction would only occur between September 1 and April 15 to avoid disturbance of nesting migratory birds (flycatchers and cuckoos). If needed, vegetation removal outside of that period would only be performed after a survey by a biologist confirms that disturbance to nesting migratory bird species would be avoided.

The proposed levee construction footprint totals 265.8 acres, including the 87.5 acre Vegetation-free Zone. USACE (2016a) summarizes the area of extent and vegetation types (Hink and Ohmart 1984; USBR 2011b) affected by the proposed earthen levee.

### 3.2.2 Wetland Plant Community

Executive Order 11990, Protection of Wetlands, requires each federal agency to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the federal agency's responsibilities. Wetlands are defined as areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Given the design considerations and construction best management practices discussed above, construction of any of the levee alternatives would conform to Executive Order 11990. The U.S. Fish and Wildlife Service's (USFWS 2016b) National Wetland Inventory data, National Hydrological Data, and publicly available aerial imagery show two perennial ponds (PUBFh/x) would be affected by construction of the proposed levee. Placement of fill would likely occur, requiring mitigation of the wetland pond habitat.

Two freshwater ponds with peripheral wetlands, as defined in Section 404(b)(1) of the Clean Water Act, have been identified within the proposed study area. The two perennial freshwater pond (PUBFh) are located within the proposed levee footprint. Both of the ponds (PUBFh) would be partially filled adjacent to the levee to support wet meadow or sedges for the vegetation management zone.

### 3.2.3 Vegetation-free Zone

USACE requires that no vegetation other than grasses be allowed to grow on the levee or within 15 feet of either toe of the levee (USACE Technical Letter 1110-2-571). This prevents root penetration into the levee that can compromise its structural integrity and allows for unobstructed visual inspections on a periodic basis. Vegetation removal in preparation of construction would include the removal of above-ground stems, root crowns, and roots greater than 0.5-inch in diameter. Removal methods include clearing and grubbing, scraping, or root-plowing and raking. Following construction, a 15-foot-wide zone (approximately 87.5 acres) along the riverward toe of the levee would be permanently maintained to be devoid of all vegetation except grass.

During construction, existing vegetation would be removed adjacent to the riverward toe of the proposed levee to create the Vegetation-free Zone. This would only be necessary where the new levee toe is within 15 feet westward of the existing spoil bank toe, or where the new levee footprint extends riverward (eastward) of the existing toe. No vegetation removal would be required where the new levee width is sufficiently narrower than that of the existing spoil bank.

#### *3.2.3.1 Summary of affected vegetation*

Following construction, the USACE operation and maintenance manual would require the local sponsor to maintain the Vegetation-free Zone (the levee itself and the 15-foot-wide strip adjacent to each toe) to preclude the establishment of all vegetation except grass. The Vegetation-free Zone would be periodically mowed, when dry. If required, spot-application of approved herbicides would be used to prevent colonization by invasive weed species.

#### *3.2.3.2 Mitigative Vegetation Establishment*

All areas disturbed by construction activities would be re-vegetated following construction. These areas include staging and access areas, levees side-slopes, the Vegetation-free Zone, and additional locations within the floodway.

USACE would mitigate approximately 265.8 acres with appropriate levels of native shrubs and trees (up to 30% tree canopy cover) on or in close proximity to each phase of levee construction. The mitigation plan measures include removal of invasive plants species, planting variable densities of shrubs and trees, terrace lowering and willow swales, and other riparian ecosystem measures. USACE is coordinating with MRGCD, USBR, the Pueblo of Isleta, and Valle de Oro National Wildlife Refuge on possible locations for mitigating riparian and wetland habitat.

## **3.3** FISH AND WILDLIFE

Several plant community studies within the floodway of the Middle Rio Grande valley have documented their use and relative value to wildlife. These studies (Hoffman, 1990; Thompson *et al.*, 1994; HAI 2010) used the Hink and Ohmart, (1984) riparian vegetation classification system to document the utilization of various floristic/structural communities for birds and, to a lesser extent, small mammals. These relationships form the basis for determining the relative impacts of project alternatives on wildlife given the extents and types of affected plant communities. The footprints of project features for the proposed levee processed using GIS with the updated vegetation classification from USBR (2011b). The results determined that 265.8 acres of riparian habitat (Table 1-2) would affected by the proposed levee construction footprint. The mitigation plan proposes vegetation management to improve habitat value for birds and other species.

# 4 - SECTION 404 (B) (1) EVALUATION

**Section 404 (b)(1) Guidelines**
**Evaluation for the Recommended**
**Plan**

This evaluation is an appendix to the *General Reevaluation Report / Supplemental Environmental Impact Statement II, Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico: Mountain View, Isleta and Belen Units* - (U.S. Army Corps of Engineers, Albuquerque District, 2017). A complete description of the entire project and its effects is included in the GRR/SEIS-II.

I. Project Description

a. Location: Adjacent to the channel of the Rio Grande, Socorro County, New Mexico. The total study area extends approximately 20 river miles from Albuquerque's South Diversion Channel on the east bank and the I-25 Bridge on the west bank to the vicinity of the State Highway 346 Bridge in Valencia County.

b. General Description: The proposed project would remove approximately 47.8 miles of spoil bank adjacent to the Rio Grande floodway and replace it with an engineered levee capable of containing at least the 1%-chance flood event (approx. 18,900 cfs at Albuquerque).
Two activities relating to proposed work below the Ordinary High water Mark OHWM) are described in detail in this evaluation: 1) earthen levee construction; and 2) placement of riprap along the riverward slope and toe of the levee.

c. Authority and Purpose: The project's single purpose is flood risk management. Construction of the Bernalillo to Belen Project was authorized by Congress in 1948. In 1979, USACE completed a feasibility report and environmental impact statement addressing the construction of selected units of the Middle Rio Grande Flood Protection, Bernalillo to Belen project. An appendix in the 1979 EIS included an evaluation of effects and a Finding of Compliance relative to Section 404(b)(1) of the Clean Water Act; therefore, meeting the requirements for an exemption under §404(r) of the Act.
This current re-evaluation revises the Section 404(b)(1) guidelines evaluation for the project. Because the project's design has substantively changed, an exemption under §404(r) of the Act is not being sought for the proposed construction.

d. Determination of Ordinary High Water: Throughout the study area, the Rio Grande occupies a physically well-defined channel; however, flows regularly reach a magnitude to inundate portions of the overbank area adjacent to the channel in the southern portion of the study area.
Therefore, for the purposes of this evaluation, the Ordinary High Water Mark (OHWM) was defined as the extent of the 50%-exceedance discharge (colloquially termed the "2-year" discharge). The 50%-exceedance discharge is described in Parametrix [2008]), and was based on daily mean discharge values at the Bosque Farms streamflow gage for the period 1974 through 2002. The 50%-exceedance flows were determined to be 6,000 cfs at Bosque Farms.

The Parametrix (2008) investigation also modeled and mapped these flows using the FLO2-D two-dimensional hydraulic model. The mapped extent of inundation for the attenuated 6,000-cfs discharge at Bosque Farms served as the basis for determining the OHWM throughout the project reach.

e. Description of Activities and Fill Material

(1) Earthen Levee Construction
The existing spoil bank will be removed (approximately one mile at a time) with bulldozers, scrapers, or excavators and the excavated material would be used for construction of a new levee. Material for the proposed levee will be stockpiled and mixed within the footprint of the levee alignment. (All waste spoil will be deposited in upland locations.) Soil material consists of poorly sorted sand and gravel.

The spoil bank and the proposed levee are set back from the Rio Grande channel bank by 150 to 1,800 feet, except at two locations. The existing spoil bank is adjacent to the channel bank at RM 171.1 for 600 feet, and RM 147.7 for 425 feet. Sediment control measures shall be implemented during levee construction. The 50%-chance discharge frequently inundates the vegetated overbank area at the toe of the spoil bank or proposed levee. The mapped area of the 6000 cfs discharge (2005) identified where the existing spoil bank / future levee footprint that would be below the water surface of the OHWM (Table B-1).

Throughout its entire length, the existing spoil bank is fairly uniform in height and base width. The proposed new levee would increase in both height and width from north to south. Therefore, the base of the new levee would extend riverward of the toe of the existing spoil bank, the area of the active floodway would be reduced. Within the overbank segments identified as being below the OHWM, the proposed levee would fill 28.65 acres (Table B-1).

**Table 4-1. Locations, length, and affected area below OHWM for earthen levee construction.**

| Levee Unit | Length (feet) | (miles) | New levee is larger than existing spoil bank: loss of 6,000-cfs flow area (acres) filled) |
|---|---|---|---|
| Mountain View | 0 | 0.0 | 0.00 |
| Isleta West | 3,375 | 0.64 | 1.30 |
| Belen East | 31,870 | 6.04 | 13.70 |
| Belen West | 23,750 | 4.50 | 13.65 |
| **Total** | 58,995 | 11.18 | 28.65 |

All of the affected area below the OHWM is located on the overbank terrace of the floodway, and is currently occupied by the spoil bank or dense riparian shrubs (primarily salt cedar). Soils within the affected area are mapped as Riverwash, Mixed alluvial, Torrifluvents, and Vinton-Brazito soils (NRCS 2017), non-hydric soil types. No activities associated with earthen levee construction would occur within, nor would it affect, the clearly defined active Rio Grande channel. All earthwork would be performed when the substrate is dry (not inundated).

Two wetland ponds as defined in Section 404(b)(1)of the Clean Water Act occurs within the affected area of the proposed project. There is a 0.65 acre wetland pond (PUBFh) with cattails abutting the levee immediately upstream of the railroad crossing. Value Engineering identified that realigning the levee toward the river and redesigning the irrigation wasteway will eliminate effects on the wetland and streamline construction. Alternatively the wetland may be partially filled to support wet meadow or sedges for the Vegetation Management Zone. Mitigation.

There is a 1.9 acre wetland pond (PUBFh) surrounded by a berm and abutting the levee upstream of Belen on the west side of the river. USACE proposes adjusting the perimeter of the riverside berm to maintain the pond area.

There are two freshwater forested wetlands (PSS1) is adjacent to the proposed levee footprint, one near RM 163 (1.33 acres), and the second between RM 167-168 (37.4 acres). The perimeter of the RM 167-168 is outside the proposed levee footprint and the vegetation management zone. The potential overlap with the levee footprint will be re-evaluated during the design phase.

The RM 163 wetland would be partially filled adjacent to the levee to support wet meadow or sedges for the vegetation management zone. USACE proposes adjusting the perimeter of the wetland away from the levee to maintain the same surface area and wetland vegetation.

(2) Riprap Erosion Protection for Earthen Levee:
The riverward slope of selected segments of the proposed levee would be blanketed with riprap to protect it from erosion and scouring during large flood events. Riprap will consist of basalt obtained from a local source, and would vary in diameter and thickness depending on the location along the alignment. The three levee segments where rock would be placed below the OHWM are listed in Table B-2. At all three locations, the proposed levee is set back from the active channel. Riprap would be placed in a blanket on the riverward slope of the new levee, and the lower portions would be buried in the terraced overbank during dry conditions. The depth to which riprap will be buried varies from 7 to 12 feet. In all, riprap would be placed along 4.7 miles of the area below the OHWM, entailing 21.9 acre-feet of rock and 5.6 acres. Because riprap would be buried by earthen material, this activity does not result in a decrease in the area flooded by 6,000 cfs (*i.e.*, the area below the OHWM).

After removal of the spoil bank, the below-ground portions of riprap would be installed immediately adjacent to the location of the riverside toe of the new levee. At any given time, a 500-foot linear trench would be excavated to the appropriate depth (ranging from 7 to 12 feet). Wells would be installed immediately riverward of the trench at approximately 50-foot intervals. Pumps would lower the water elevation within the trench to accommodate the placement of rock within. After the placement of rock, pumps would be removed and the trench refilled to the ground surface. This operation would be repeated sequentially in 500- foot-long segments.

**Table 4-2. Locations, length, and affected area below OHWM for riprap placement.**

| Station | USBR river miles | Distance (feet) | Distance (miles) | Volume of rock below OHWM (cu yds) | Volume of rock below OHWM (acre-feet) | Area of rock below OHWM (acres) |
|---|---|---|---|---|---|---|
| Mountain View | 177.0-172.6 | | | | | |
| 82+00 to 100+00 | | 1800 | 0.34 | 2600 | 1.61 | 0.41 |
| Isleta West R1 | 172.6-171.2 | | | | | |
| 40+00 to 56+00 | | 1600 | 0.30 | 1155.6 | 0.72 | 0.18 |
| 68+00 to 80+68 | | 1268 | 0.24 | 1761.1 | 1.09 | 0.28 |
| Isleta West R2 | 171.2-169.5 | | | | | |
| 78+00 to 83+00 | | 500 | 0.09 | 416.7 | 0.26 | 0.07 |
| Belen East | 169.5-149.5 | | | | | |
| 10+00 to 16+00 | | 600 | 0.11 | 500.00 | 0.31 | 0.08 |
| 200+00 to 211+00 | | 1100 | 0.21 | 2016.7 | 1.25 | 0.32 |
| 346+00 to 354+00 | | 800 | 0.15 | 1333.3 | 0.83 | 0.21 |
| 662+00 to 676+00 | | 1400 | 0.27 | 2333.3 | 1.45 | 0.37 |
| 720+00 to 741+00 | | 2100 | 0.40 | 2916.7 | 1.81 | 0.46 |
| 766+00 to 830+00 | | 6400 | 1.21 | 9244.4 | 5.73 | 1.47 |
| Belen West | 165.4 - 142.5 | | | | | |
| 7+00 to 18+00 | | 1100 | 0.21 | 1833.3 | 1.14 | 0.29 |
| 40+00 to 54+00 | | 1400 | 0.27 | 2333.3 | 1.45 | 0.37 |
| 464+00 to 476+00 | | 1200 | 0.23 | 2133.3 | 1.32 | 0.34 |
| 476+00 to 486+00 | | 1000 | 0.19 | 1388.9 | 0.86 | 0.22 |
| 494+00 to 505+00 | | 1100 | 0.21 | 1405.6 | 0.87 | 0.22 |
| 964+00 to 976+00 | | 1200 | 0.23 | 2000.0 | 1.24 | 0.32 |
| **Total** | | **24,568** | **4.7** | **35372.2** | **21.9** | **5.6** |

Each 500-foot-long segment would require approximately 7 days to install below-ground portions of riprap. Pumps would be operated as needed to maintain proper working conditions. In areas with relatively shallow water in the trench, pumps would not need to be operated during the non-working, overnight period.

Pumped water would be discharged into or through the riparian zone towards the Rio Grande channel. Solid or perforated pipes would discharge pumped water onto the ground surface or into small natural drainage channels leading to the river. Geotextile material would be (manually) placed along the flowpath or under perforated pipes to minimize surface erosion. If groundwater is sufficiently low in dissolved oxygen, pumped water would be aerated prior to its discharge into the mainstem flow of the Rio Grande.

Except for minor evaporation losses, all water pumped from trenches would return to the surface water or groundwater system through immediate or slightly delayed infiltration. From previous experiences of dewatering activities during construction, it is expected that normal water levels in and adjacent to the trench would resume within 12 hours following the cessation of pumping.

Project construction may begin as early as FY 2020 depending on funding, and continue in phases for up to 20 years to complete all associated construction. All proposed work below the OHWM, as described above, would occur between September 1 and April 15 when flows are relatively low in the Rio Grande.

(3) Best Management Practices:

The following best management practices would be employed during construction to prevent or minimize the potential for erosion or degradation of water quality:

a. Stream flow would be maintained at all times during construction and the streambed contoured so that fish can migrate through the study area during and after construction.
b. Silt curtains, cofferdams, dikes, wattles, straw bales and other suitable erosion control measures would be employed to prevent sediment-laden runoff or contaminants from entering the watercourse.
c. Work would be performed below the elevation of the ordinary high water mark only during low-flow periods. Flowing water must be temporarily diverted around the work area, but remain within the existing channel to minimize erosion and turbidity and to provide for aquatic life movement. Diversion structures must be non-erodible, such as sand bags, water bladders, concrete barriers, or channel lined with geotextile or plastic sheeting. Dirt cofferdams are not acceptable diversion structures.
d. All asphalt, concrete, drilling fluids and muds, and other construction materials will be properly handled and contained to prevent releases to surface water. Poured concrete will be will be fully contained in mortar-tight forms and/or will be placed behind non-erodible cofferdams to prevent discharge contact with surface or groundwater. Wastewater from concrete batching, vehicle washdown, and aggregate processing would be contained, and treated or removed for off-site disposal. Dumping of any waste material in or near watercourses is prohibited.
e. Fuel, oil, lubricants, hydraulic fluids and other petrochemicals would be stored outside of the floodway and at least 100 feet from surface water (including ditches and drains). The fuel storage facility must have a secondary containment system capable of containing twice the volume of the product. Appropriate spill clean-up materials such as booms and absorbent pads must be available on-site at all times during construction.
f. Fueling of wheeled construction vehicles would not be permitted in the construction area or near the MRGCD irrigation infrastructure. Only tracked vehicles may be fueled within the construction area via a fuel tender with a maximum fuel capacity of 500 gallons, thereby minimizing the consequences of any accidental spill. Refueling of all vehicles and equipment must be performed at least 100 feet from surface water.
g. All heavy equipment used in the study area must be pressure washed and/or steam cleaned before the start of the project and inspected daily for leaks. A written log of inspections and maintenance must be

completed and maintained throughout the project period. Leaking equipment must not be used in or near surface water. Any petroleum or chemical spills would be contained and removed, including any contaminated soil.

h. Only uncontaminated earth or crushed rock would be used for backfills, and for the temporary river crossing.
i. Water quality would be monitored during bankline and in-channel construction to ensure compliance with State water quality standards for turbidity, pH, temperature, and dissolved solids.
j. Excavated trenches must be backfilled and compacted to match the bulk density and elevation of the adjacent undisturbed soil.
k. All disturbed areas that are not otherwise physically protected from erosion will be reseeded or planted with native vegetation.
l. A copy of the water quality certification must be kept at the project site during all phases of construction. All contractors involved in the project must be provided a copy of the certification and made aware of the conditions prior to starting construction.
m. All construction contractors will be required to prepare and submit, for the Corps' approval, a Storm Water Pollution Prevention Plan (SWPPP) pursuant to the National Pollution Discharge Elimination System (NPDES) prior to the start of construction activity. The SWPPP will incorporate the Best Management Practices listed above, as well as any other practices which would avoid or minimize stormwater runoff due to construction activities, including clearing, grading, and excavating.

(4) Public Review:

The Draft GRR/SEIS-II, includes the draft Section 404(b)(1) Guidelines Evaluation. The Draft GRR/SEIS-II, will be circulated for public review and published in the Federal Register.

The Section 404(b)(1) Guidelines Evaluation will be circulated for public review.

II. Factual Determination (Section 231.11)

a. Physical Substrate Determinations

(1) Substrate Elevation and Slope: Channel slope would not be affected.

(2) Sediment Type: Sediment gradations would not change.

(3) Dredged/Fill Material Movement: Not applicable.

(4) Physical Effects on Benthos (burial, changes in sediment type, etc.): Not applicable.

(5) Actions Taken to Minimize Impacts (Subpart H): Work would be performed during the annual low-flow period. See section I.e.(8) above for best management practices to be employed.

b. Water Circulation, Fluctuation and Salinity Determinations

(1) Water
   (a) Salinity: No effect.
   (b) Water Chemistry (Ph, etc.): No effect.
   (c) Clarity: No effect.
   (d) Color: No effect.
   (e) Odor: No effect.
   (f) Taste: No effect.
   (g) Dissolved Gas Levels: No effect.
   (h) Nutrients: No effect.
   (i) Eutrophication: No effect.

(2) Current Patterns and Circulation
   (a) Current Patterns and Flow: Following construction, current flow patterns would only be altered for flood events exceeding 11,800 cfs at San Acacia—the minimum probable failure point of the existing spoil bank. Current patterns of flows below this magnitude would not change. Flood events greater than 11,800 cfs would be confined to the floodway rather than inundating the developed floodplain west of the spoil bank/levee alignment
   (b) Velocity: Velocities in the floodway would only be altered for flood events exceeding 11,800 cfs at San Acacia—the minimum probable failure point of the existing spoil bank. Velocities of flows below this magnitude would not change.
   (c) Stratification: No effect.
   (d) Hydrologic Regime: No effect.

(3) Normal Water Level Fluctuations: No effect.

(4) Salinity Gradients: No effect.

c. <u>Suspended Particulate/Turbidity Determinations</u>

(1) Expected changes in suspended particulates and turbidity levels in vicinity of disposal site: Soil material where excavation would occur is primarily coarse sand with some gravel and only a small percentage of suspendable fine particles. The initial reflooding of the new levee and the excavated eastern bank would only slightly increase turbidity downstream. This temporarily elevated turbidity would be similar to, or less than, levels occurring annually in the Rio Grande during the spring runoff period.

(2) Effects (degree and duration on Chemical and Physical properties of the water column)
   (a) Light Penetration: No effect.
   (b) Dissolved Oxygen: No effect.
   (c) Toxic Metals and Organics: No effect.
   (d) Pathogens: No effect.

(e) Aesthetics: No effect.

(f) Others as Appropriate: No effect.

(3) Effects on Biota

(a) Primary Production, Photosynthesis: No effect.

(b) Suspension/Filter Feeders: No effect.

(c) Sight Feeders: No effect.

d. Contaminant Determinations: Excavated material would be analyzed for concentrations of metals and potential contaminants to verify that the material is suitable for disposal.

e. Aquatic Ecosystem and Organism Determinations

(1) Effects on Plankton: No effect.

(2) Effects on Benthos: A slight increase in benthic area would result.

(3) Effects on Nekton: No effect.

(4) Effects on Aquatic Food Web (refer to section 230.31): No effect.

(5) Effects on Special Aquatic Sites (discuss only those found in project are or disposal site)

(a) Sanctuaries and Refuges: Not applicable.

(b) Wetlands (refer to section 230.41): Not applicable.

(c) Mud Flats (refer to section 230.42): Not applicable.

(d) Vegetated Shallows (refer to section 230.43): Not applicable.

(e) Coral Reefs (refer to Section 230.44): Not applicable.

(f) Riffle and Pool Complexes (refer to section 230.45): Not applicable.

(6) Threatened and Endangered Species: Section 6.4 of the GRR/SEIS-II, and the Biological Assessment in Appendix C, evaluates the potential effects to listed species and their designated or proposed critical habitats in the study area. The following determinations were made:

| | | |
|---|---|---|
| Southwestern Willow Flycatcher | May affect, not likely to adversely affect | May affect, likely to adversely affect critical habitat |
| Western Yellow-billed Cuckoo | May affect, not likely to adversely affect | May affect, likely to adversely affect critical habitat |
| Rio Grande silvery minnow | May affect, likely to adversely affect | May affect, likely to adversely affect critical habitat |
| New Mexico Meadow Jumping Mouse | No effect | No effect |
| Pecos sunflower | No effect | No effect |
| Interior Least Tern | No effect | No effect |
| Northern Aplomado Falcon | No effect | No effect |

Pursuant to Section 7 of the Endangered Species Act, USACE has completed formal consultation with the U.S. Fish and Wildlife regarding the proposed project. The Service's Biological Opinion will include reasonable and prudent measures to minimize the potential take of flycatchers, cuckoos and minnows during construction.

(7) Other Wildlife: All clearing or removal of vegetation would be limited the period between September 1 and April 15. Wildlife in and adjacent to the construction area may be temporarily displaced during active construction periods.

f. Proposed Disposal Site Determinations

(1) Mixing Zone Determination (consider factors in section 230.22(f)(2))

(2) Determination of compliance with applicable water quality standards: Water quality would be monitored during bankline and in-channel construction to ensure compliance with state water quality standards for turbidity, pH, temperature, and dissolved solids.

(3) Potential effects on human use characteristic

(a) Municipal and Private water supply: No effect.

(b) Recreational and commercial fisheries: Not applicable.

(c) Water related recreation: No effect.

(d) Aesthetics: No effect.

(e) Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and similar preserves (refer to section 230.54): Not applicable.

g. Determination of Cumulative Effects on the Aquatic Ecosystem: None.

h. Determination of Secondary Effects on the Aquatic Ecosystem: No effect.

III. Findings of Compliance or Non-Compliance with the restrictions on discharge

a. Adaptation of the Section 404(b)(1) Guidelines to this Evaluation: None.

b. Evaluation of Availability of Practicable Alternatives to the Proposed Discharge site which would have less adverse impact on the aquatic ecosystem: Alternatives evaluated included four levee heights (see Chapters 3 and 4 of the GRR/SEIS). The recommended plan was determined to be the most practicable, defined as available and capable of being accomplished after taking into consideration cost, existing technology, and logistics in light of overall project purposes, while meeting environmental compliance requirements.

c. Compliance with applicable State Water Quality Standards: USACE will obtain State Water Quality Certification from the New Mexico Environment Department prior to the start of construction activities.

d. Compliance with applicable toxic effluent standard or prohibition under

Section 307 of the Clean Water Act: Not applicable.

e. Compliance with Endangered Species Act of 1973: Pursuant to Section 7 of the Endangered Species Act, USACE has formally consulted with the U.S. Fish and Wildlife regarding the proposed project.

f. Compliance with specified protection measures for marine sanctuaries designated by the Marine Protection, Research and Sanctuaries Act of 1972: Not Applicable

g. Evaluation of Extent of Degradation of the Waters of the United States

(1) Significant adverse effects on human health and welfare:

(a) Municipal and private water supplies: Not applicable.

(b) Recreation and commercial fisheries: Not applicable.

(c) Plankton: None.

(d) Fish: None.

(e) Shellfish: None.

(f) Wildlife: None.

(g) Special Aquatic sites: Not applicable.

(2) Significant adverse effects on life stages of aquatic life and other wildlife dependent on aquatic ecosystems: None.

(3) Significant adverse effects on aquatic ecosystem diversity, productivity and stability: None.

(4) Significant adverse effects on recreational, aesthetic, and economic values: None.

h. Appropriate and practicable steps taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem: See section I.e.(8) above for best management practices to be employed.

i. On the basis of the guidelines, the proposed discharge of dredged or fill material is specified as complying with the requirements of these guidelines

#### *4.1.1.1 References*

Parametrix. 2008. Restoration Analysis and Recommendations for the Isleta Reach of the Middle Rio Grande, NM. Prepared for the Middle Rio Grande Endangered Species Collaborative Program, USBR Contract No. 06CR408146. Prepared by Parametrix, Albuquerque, New Mexico. July 2008.

Natural Resources Conservation Service (NRCS). 2017. Soil survey of study area. Accessed 1/11/2017. https://websoilsurvey.nrcs.usda.gov/app/.

U.S. Army Corps of Engineers (USACE). 1979. Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico – Interim Feasibility Report. Albuquerque District, NM.

**Finding of Compliance for**

**Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico:**

**Mountain View, Isleta and Belen Units**

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The planned disposal of excavated material at would not violate any applicable State water quality standards.

3. The proposed deposition of fill material has the potential to harm any the endangered Rio Grande silvery minnow; however, the USFWS has issued an Incidental Take Permit including reasonable and prudent measures that minimize that potential, and which the Corps will employ during project construction.

4. The proposed deposition of fill material will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values will not occur.

5. Appropriate steps to minimize potential adverse impacts of the discharge on aquatic systems include:

   - Stream flow would be maintained at all times during construction and the streambed contoured so that fish can migrate through the study area during and after construction.
   - Silt curtains, cofferdams, dikes, wattles, straw bales and other suitable erosion control measures would be employed to prevent sediment-laden runoff or contaminants from entering the watercourse.
   - Work would be performed below the elevation of the ordinary high water mark only during low-flow periods. Flowing water must be temporarily diverted around the work area, but remain within the existing channel to minimize erosion and turbidity and to provide for aquatic life movement. Diversion structures must be non-erodible, such as sand bags, water bladders, concrete barriers, or channel lined with geotextile or plastic sheeting. Dirt cofferdams are not acceptable diversion structures.
   - All asphalt, concrete, drilling fluids and muds, and other construction materials will be properly handled and contained to prevent releases to surface water. Poured concrete will be will be fully contained in mortar-tight forms and/or will be placed behind non-erodible cofferdams to prevent discharge contact with surface or groundwater. Wastewater from concrete batching, vehicle washdown, and aggregate processing would be contained, and treated or removed for off-site disposal. Dumping of any waste material in or near watercourses is prohibited.
   - Fuel, oil, lubricants, hydraulic fluids and other petrochemicals would be stored outside of the floodway and at least 100 feet from surface water (including ditches and drains,). The fuel storage facility must have a

secondary containment system capable of containing twice the volume of the product. Appropriate spill clean-up materials such as booms and absorbent pads must be available on-site at all times during construction.

- Fueling of wheeled construction vehicles would not be permitted in the construction area or near the irrigation infrastructure. Only tracked vehicles may be fueled within the construction area via a fuel tender with a maximum fuel capacity of 500 gallons, thereby minimizing the consequences of any accidental spill. Refueling of all vehicles and equipment must be performed at least 100 feet from surface water.
- All heavy equipment used in the study area must be pressure washed and/or steam cleaned before the start of the project and inspected daily for leaks. A written log of inspections and maintenance must be completed and maintained throughout the project period. Leaking equipment must not be used in or near surface water. Any petroleum or chemical spills would be contained and removed, including any contaminated soil.
- Only uncontaminated earth or crushed rock would be used for backfills, and for the temporary river crossing.
- Water quality would be monitored during bankline and in-channel construction to ensure compliance with State water quality standards for turbidity, pH, temperature, and dissolved solids.
- Excavated trenches must be backfilled and compacted to match the bulk density and elevation of the adjacent undisturbed soil.
- All disturbed areas that are not otherwise physically protected from erosion will be reseeded or planted with native vegetation.
- A copy of the water quality certification must be kept at the project site during all phases of construction. All contractors involved in the project must be provided a copy of the certification and made aware of the conditions prior to starting construction.
- All construction contractors will be required to prepare and submit, for the Corps' approval, a Storm Water Pollution Prevention Plan (SWPPP) pursuant to the National Pollution Discharge Elimination System (NPDES) prior to the start of construction activity. The SWPPP will incorporate the Best Management Practices listed above, as well as any other practices which would avoid or minimize stormwater runoff due to construction activities, including clearing, grading, and excavating.

6. On the basis of the guidelines the proposed disposal site for the discharge of dredged material is specified as complying with the inclusion of appropriate and practical conditions to minimize pollution or adverse effects to the aquatic ecosystem.

## **4.2** Water Quality Certification Letter from New Mexico Environment Department

SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lt. Governor

**NEW MEXICO**
**ENVIRONMENT DEPARTMENT**

Harold Runnels Building
1190 South St. Francis Drive (87505)
P.O. Box 5469, Santa Fe, NM 87502-0160
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BUTCH TONGATE
Cabinet Secretary

BRUCE YURDIN
Acting Deputy Secretary

November 20, 2018

George H. MacDonell, Chief
Environmental Resources Section
Planning, Project and Program Division
Department of the Army
Albuquerque District, Corps of Engineers
4104 Jefferson Plaza NE
Albuquerque NM 87109-3435

**RE: U.S. Army Corps of Engineers, Middle Rio Grande Conservancy District Sponsored Project, Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico, Mountain View, Isleta, and Belen Units.**

The Surface Water Quality Bureau (SWQB) of the New Mexico Environment Department has examined the General Re-evaluation Report and Supplemental Environmental Impact Statement including Appendix E, 404(b)(1) evaluation, for the project indicated above pursuant to Section 401 of the federal Clean Water Act (CWA). As described in the Public Notice issued on October 12, 2018, this project involves removal of approximately 48 miles of spoils piles and replacing them with engineered levees capable of containing the 1% chance discharge event of approximately 18,900 cubic feet per second. Levee construction will impact 28 acres within the Ordinary Highwater Mark (OHWM).

Spoil pile material will be repurposed to construct new earthen levees. Levees will be setback from the channel by 150-1,800 feet. The toe of new levee will be reinforced with rip rap made up of locally-sourced basalt. Construction will commence in 2020 subject to the availability of funds and continue in phases for up to 20 years. All work within the OHWM will be conducted during lower flow months, September 1 through April 15.

The U.S. Army Corps of Engineers (USACE) completed the federal CWA Section 404(b)(1) Guidelines Evaluation thus a CWA Section 404 Permit will not be issued for this action. A state Water Quality Certification pursuant to the CWA Section 401 has been requested by the USACE to ensure that the activity complies with State law, including state Surface Water Quality Standards (*State of New Mexico, Standards for Interstate & Intrastate Surface Waters, New Mexico Water Quality Control Commission, 20.6.4 NMAC, as amended through March 2, 2017*), the Statewide Water Quality Management Plan/Continuing Planning Process, applicable Total

Maximum Daily Loads (TMDLs), and the Antidegradation Policy and Implementation Procedure.

Pursuant to State regulations for permit certification (20.6.2.2002 NMAC), NMED-SWQB issued a public notice of this activity and announced a public comment period on the Surface Water Quality Bureau's web site: https://www.env.nm.gov/surface-water-quality/public-notices/ on October 12, 2018. The public comment period ended on November 12, 2018. No comments were received.

The New Mexico water quality standards (20.6.4 NMAC) applicable to this project include, but are not limited to the following:

20.6.4.8 ANTIDEGRADATION POLICY AND IMPLEMENTATION PLAN: The antidegradation policy applies to all surface waters of the state.

20.6.4.13 GENERAL CRITERIA (e.g., Bottom Deposits and Suspended or Settleable Solids, Floating Solids, Oil and Grease, Toxic Pollutants, Temperature, Turbidity, and Total Dissolved Solids):
General criteria are established to sustain and protect existing or attainable uses of surface waters of the state. These general criteria apply to all surface waters of the state at all times, unless a specified criterion is provided elsewhere in this part. Surface waters of the state shall be free of any water contaminant in such quantity and of such duration as may with reasonable probability injure human health, animal or plant life or property, or unreasonably interfere with the public welfare or the use of property.

20.6.4.105 RIO GRANDE BASIN – The main stem of the Rio Grande from the headwaters of Elephant Butte Reservoir upstream to Alameda bridge (Corrales bridge), excluding waters on Isleta Pueblo.

A. Designated Uses: irrigation, marginal warmwater aquatic life, livestock watering, wildlife habitat and primary contact.
B. Criteria:
    (1) The use-specific numeric criteria set forth in 20.6.4.900 NMAC are applicable to the designated uses.
    (2) At mean monthly flows above 100 cfs, the monthly average concentration for: TDS 1,500 mg/L or less, sulfate 500 mg/L or less and chloride 250 mg/L or less.

20.6.4.900 CRITERIA APPLICABLE TO EXISTING, DESIGNATED OR ATTAINABLE USES UNLESS OTHERWISE SPECIFIED IN 20.6.4.97 THROUGH 20.6.4.899 NMAC.

Please note, New Mexico water quality standards apply at all times. A complete list of Standards is available on the web at https://www.env.nm.gov/swqb/Standards/.

*Water Quality Certification with Conditions:*

Pursuant to 20.6.2.2002 NMAC, the SWQB issues conditional certification for activities necessary to complete the project described herein. The following conditions are necessary to ensure compliance with the applicable provisions of CWA Sections 301, 302, 303 and 307 and with applicable requirements of State law. Therefore, this Certification is not valid unless the following conditions are adhered to:

1. All Best Management Practices identified in Appendix E, Section 3 of the 404(b)(1), General Reevaluation Report/Supplemental Environmental Impact Statement II, Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico: Mountain View, Isleta, and Belen Units, shall be implemented and maintained through the duration of the project.

2. All Environmental Commitments and Conservation Measures identified in Enclosure 2, Section 1.1.1 of the 404(b)(1), General Reevaluation Report/Supplemental Environmental Impact Statement II, Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico: Mountain View, Isleta, and Belen Units, shall be implemented and maintained through the duration of the project.

3. Fuel, oil, hydraulic fluid, lubricants, and other petrochemicals must not be stored within the 100-year floodplain and must have a secondary containment system capable of containing twice the volume of the product. Appropriate spill clean-up materials such as booms and absorbent pads must be available on-site at all times during construction.

4. All heavy equipment used in the project area must be pressure washed and/or steam cleaned off-site before the start of the project and inspected daily for leaks to ensure surface waters are protected from contaminants. A written log of inspections and maintenance must be completed and maintained throughout the project period. Equipment cleaning activities must not occur near surface water. Leaking equipment must not be used in or near surface water. Heavy equipment must not be parked within the stream channel. Refuel equipment at least 100 feet from surface water.

5. Flowing water must be temporarily diverted around the work area but remain within the existing channel to minimize erosion and to provide a continuous zone of passage for aquatic life through or around the project area. Water quality in the zone of passage shall meet all applicable water quality standards criteria including turbidity.

6. Diversion structures must be non-erodible. Dirt cofferdams are not acceptable diversion structures.

7. Work in the stream channel must be limited to periods of low flow. Work in flowing water must be minimized. Project activities must avoid times of predictable flooding (seasonal monsoons or snowmelt) to avoid working in high water. Releases from dams must be incorporated into the work schedule to avoid working in high water.

8. Disturbed areas outside stream channels that are not otherwise physically protected from erosion must be restored to pre-disturbance conditions. Stabilization measures are required at the earliest practicable date but by the end of the first full growing season following construction.

9. Wetland crossings must be restricted to a single location and constructed perpendicular to and at a narrow point of the wetland. Temporary crossings should be restricted to specific designated locations.

10. Wetland vegetation and excavated top soil must be retained and reused to improve seeding success. Flows to non-impacted wetlands must not be permanently disrupted.

11. All areas adjacent to the watercourse that are disturbed because of the project, including temporary access roads, stockpiles and staging areas, must be restored to pre-project elevations.

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

13. The permittee or their agent shall allow NMED representatives to inspect the certified activity and any mitigation areas at any time deemed necessary to determine compliance with applicable State Water Quality Standards.

14. NMED must be notified immediately if the project results in an exceedance of applicable surface water quality standards. Contact the Surface Water Quality Bureau, Main Office at (505) 827-0187.

If dredging activities proceed as described and the above conditions are adhered to, compliance with water quality regulations including the federal Clean Water Act and state Water Quality Standards should be achieved. If you have any questions regarding this conditional certification, please feel free to contact Chris Cudia of my staff at (505) 827-2795. Thank you for your cooperation.

Sincerely,

Shelly Lemon

Shelly Lemon, Chief
Surface Water Quality Bureau

George H. MacDonell
November 20, 2018

cc:
Allison Fontenot, Wetlands Section, Region 6, USEPA
Matthew Wunder, New Mexico Department of Game and Fish
Allan Steinle, USACE
401 Certification File

# 5 - BERNALILLO TO BELEN LEVEE HABITAT MITIGATION MONITORING AND ADAPTIVE MANAGEMENT PLAN

## 5.1 INTRODUCTION

### 5.1.1 Purpose and Goals

Mitigation for habitat loss is a requirement to compensate for the loss of habitat due to a Federal action. Section 906(d) of the Water Resources Development Act (WRDA) of 1986 states that project alternatives must support recommendations with a specific plan to mitigate fish and wildlife losses. Mitigation in the 1979 EIS was formulated to provide fill for the levee from the constructed wetlands, and convert agricultural land into riparian forest. The reduced fill requirements for the proposed levee along with the loss of riparian habitat from the construction footprint have changed the direction of mitigation from wetlands to native forest. The conversion of agricultural land into forest outside the floodway is expensive to acquire with a lower likelihood of providing habitat for threatened and endangered species. Additionally, the Endangered Species Act (ESA) states that the purpose of compensatory mitigation is to offset environmental losses resulting from unavoidable impacts. The Biological Opinion (USFWS 2018) requires replacement of 265.8 acres of floodway habitat loss from the construction footprint through enhancement of existing habitat in the Rio Grande floodway in the vicinity of the proposed levee. Reclamation and MRGCD (non-federal sponsor) manage the riparian lands in the floodway. USACE is coordinating with both agencies to identify suitable areas for habitat mitigation that complement their mitigation requirements for water operations (USFWS 2016).

Due to the inherent uncertainty in some aspects of ecosystem restoration theory, planning and methods, success can vary based on a variety of technical and site-specific factors. Recognizing this uncertainty, it is prudent to allow for contingencies to address potential problems in meeting restoration goals that may arise during or after project implementation. Recent USACE guidance (*Implementation Guidance for Section 2039 of the Water Resources Development Act of 2007 – Monitoring Ecosystem Restoration*) requires that a plan be developed for monitoring the success of the ecosystem restoration. This monitoring plan shall include "1) 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." Therefore, Section 2039 also directs that a Contingency Plan (Adaptive Management Plan) be developed for all ecosystem restoration projects.

The primary purpose of habitat monitoring is to determine the level of ecological function at each mitigation site as a part of an overall plan to create sites that offset the loss of habitat affected by construction of the proposed project. The Bernalillo to Belen Levee Habitat Mitigation Monitoring and Adaptive Management Plan (HMMAMP) describes the types of habitats that will be impacted, the potential impacts caused by the project, and the types and amounts of mitigation that would be established in order to compensate for habitat losses. This plan also establishes methods to evaluate the success of these sites and includes adaptive management measures to be implemented for identifying mitigation sites, evaluate pre-project habitat values, and supplemental measures if success criteria are not being met to ensure the goals and requirements of the project's mitigation are accomplished. This HMMAMP is a living document and may be modified as part of an adaptive management strategy to allow for goals and requirements to be accomplished in a constantly changing environment. This HMMAMP will accompany the final SEIS as part of the project addenda, and will be updated throughout the project design phase as detailed design efforts allow for finalizing the mitigation plans.

The goal of the HMMAMP is to ensure that the conservation values of the mitigation sites are maintained in good condition in perpetuity. The plan's biological goals are to: (1) preserve the abundance and diversity of native species (particularly special status species) in the established habitats in the study area; (2) protect the habitat features from the effects of indiscriminate land use changes that may adversely impact mitigation habitats; and (3) mitigate any adverse impacts within the study areas. Monitoring would be conducted in a manner compatible with the type of mitigation site. Mitigation requirements were provided by the USFWS through a biological opinion (BO) received through the Endangered Species Act Section 7 consultation process. Additional mitigation recommendations from USFWS are included in the project's Fish and Wildlife Coordination Act Report (2016).

Habitat mitigation for replacing floodway habitat was negotiated during formal consultation process with the USFWS to 1) replace 265.8 acres of riparian habitat lost during levee construction, including the vegetation-free zone, 2) replace 44.5 acres of suitable flycatcher habitat, 3) increase floodplain inundation by 110.2 acres for silvery minnow, 4) mitigate for 130 acres of suitable cuckoo habitat and 5) maintain water surface area of affected ponds. Approximately 265.8 acres of riparian habitat will be mitigated by removing non-native riparian vegetation and planting native plants to increase the area of native riparian vegetation by about 15%. The mitigation area of flycatcher, cuckoo and silvery minnow habitat are subsets of the 265.8 acres of riparian habitat. Wetland and pond mitigation was described in the Clean Water Act 404(b)(1) evaluation submitted to the state of New Mexico Environment Department. The wetland and small pond effects can be mitigated by excavation to maintain the pond surface area.

The HMMAMP would be implemented by USACE staff through coordination with USFWS, Reclamation, and MRCGD. Monitoring would be conducted by qualified biologists from the USACE, in coordination with the USFWS. Upon completion of construction (to include the plant establishment period for the site), the land would be turned over to the non-Federal sponsor to be maintained in perpetuity.

#### 5.1.2 Project Description

The general action area for the Middle Rio Grande Flood Protection Bernalillo to Belen, New Mexico Mountain View, Isleta, and Belen Units General Re-evaluation Report and Supplemental EIS (GRR-SEIS), includes the floodway, and the outlying floodplain on one or both sides of the Rio Grande from the South Diversion Channel downstream nearly to the Bosque Bridge (Highway 346). Specifically, the proposed action includes four units: Mountain View, Isleta West, Belen East, and Belen West (USACE 2017). The levee construction footprint reduces floodway riparian habitat by 265.8 acres.

### 5.1.3 Description of Proposed Levee Measures

The proposed action consists of replacing approximately 47.8 miles of non-engineered spoil banks with engineered levees along one or both sides of the Rio Grande. The new earthen levee would follow the alignment of the existing spoil bank. The construction of the proposed levee entails removing the existing spoil bank with heavy machinery, and processing the material removed to obtain suitable fill material for new construction. Selected materials required for construction (i.e., riprap and bentonite) would be acquired from commercial sources or borrowed at approved sites.

The vegetation-free zone consists of a "root-free zone" within 15 feet of the riverward and landside toes of the levee assures that the roots of woody vegetation would not penetrate and weaken the levee structure. During construction, existing vegetation would be removed adjacent to the riverward and landside toes by clearing and grubbing, and root-plowing where salt cedar occurs. Following construction, disturbed soils including the levee side slopes would be seeded with native grass species to prevent wind and water erosion. The riverward 15-foot-wide vegetation-free zone is approximately 87 acres in size along the length of the proposed levee, and would be permanently maintained to be devoid of any vegetation other than grasses.

### 5.1.4 Types of Affected Habitats

Levee construction reduces existing floodway riparian habitat by approximately 265.8 acres.

#### *5.1.4.1 Riparian Forest Community*

The cottonwood-willow forests along the Rio Grande in New Mexico are remnants of a unique and diminishing habitat known locally as the bosque (Spanish for forest). The cottonwood-willow forest depends on lateral stream movement, and sand bars formed by the meandering river (USACE 2015). Dense stands of riparian forest provide the Primary Constituent Elements (PCEs) for endangered Southwestern Willow Flycatcher and threatened Yellow-billed Cuckoo critical habitat (USACE 2017).

#### *5.1.4.2 Wetland Plant Community*

Small areas of wetlands are scattered throughout the Rio Grande Valley including wet meadows, marshes, sloughs, ponds, and small lakes. In combination, these wetland areas are a significant component of the floodplain ecosystem, greatly affecting the vegetation and animals present. Wetlands were formed in part by the meandering nature of the river and partly by the high water table in the valley; in some areas, the water table existed at the ground surface, supporting water-loving plants. Marshes are dominated by broad-leaved cattail and hardstem bulrush along the riverbank or in poorly drained depressions within the overbank area.

#### *5.1.4.3 Endangered and Threatened Species Habitat*

Endangered species habitat affected by the levee footprint includes about 45 acres of suitable flycatcher habitat, 130 acres of cuckoo habitat, and 110.2 acres of silvery minnow habitat (USFWS 2018).

## **5.2** ENVIRONMENTAL BASELINE

The major plant communities in the active floodplain of the Middle Rio Grande valley include woodlands, shrublands, grasslands, and emergent wetlands (Tetra Tech, 2004). Plant communities based on the Hink and Ohmart (1984) have been recently mapped (Parametrix 2008; Siegle et al. 2013). Spatial analysis for the affected vegetation and habitat has summarized riparian and wetland vegetation in the proposed study area.

## **5.3** POTENTIAL PROJECT IMPACTS

### 5.3.1 Riparian Forest Community

The basal extent of the proposed levee footprint was superimposed on the most recent riparian vegetation coverage, for spatial analysis of effects on existing vegetation and changes in floodway area. Generally, the proposed levee construction footprint would extend beyond the riverward toe of the existing spoil bank, affecting approximately 265.8 acres of vegetation within the levee footprint. There would be a loss of about 68.9 acres of native riparian forest, 167.3 acres of mixed non-native forest, and 29.6 acres of open areas. Approximately 87.5 acres (of the 265.8 acres) would be planted and maintained as grassland within the riverside corridor of the vegetation-free zone.

### 5.3.2 Wetland Plant Community

Two freshwater ponds with peripheral wetlands, as defined in Section 404(b)(1) of the Clean Water Act, have been identified within the proposed study area. The two perennial freshwater pond (PUBFh) are located within the proposed levee footprint. One or both of the ponds would be partially filled adjacent to the levee to support wet meadow or sedges for the vegetation-free zone. The perimeter of the ponds may extended away from the levee by excavation to maintain the same surface area and wetland vegetation, and provide necessary fill for the levee side of the pond.

### 5.3.3 Endangered and Threatened Species Habitat Mitigation

The USFWS Biological Opinion (2018) views mitigation of 265.8 acres of floodway habitat loss (Table 5-1) from the construction footprint as essential to protect endangered species. The Coordination Act Report (USFWS 2017) recommends limiting the loss of floodway habitat to the extent possible, and improving riparian habitat in the floodway as warranted. USACE (2017) and subsequent revisions documented the construction footprint beyond the existing spoil pile for determining the habitat affected by the project. This acreage provided the basis for negotiation with the USFWS during ESA consultation. The effects analyses sections for the three endangered species emphasizes the loss of floodway / riparian habitat (USFWS 2018). The minimum acceptable mitigation for the USFWS was managing mixed riparian forest to a predominantly native cottonwood-willow forest for the same area (265.8 acres). This approach improves floodway habitat and is cost effective relative to acquiring land.

Mitigation shall be implemented in the floodway of the Belen East and West Units. The specific sites shall be identified during PED in collaboration with Reclamation and MRGCD. Within the overall 265.8 acre mitigation area, suitable flycatcher habitat would be mitigated by 45 acres (as 9 - five acre units, USFWS 2018) of terrace lowering and willow swales. Silvery minnow habitat would be mitigated by strategic placement of the 45 acres of terrace lowering and willow swales (flycatcher habitat features) to increase floodplain connectivity over 110 acres. Cuckoo habitat (130 acres) would also be mitigated through strategic placement of terrace lowering and willow swales within the 265.8 acres of riparian habitat mitigation.

**Table 5-1 Biological opinion (USFWS 2018) mitigation requirements. Affected species habitat are subset acreages within the riparian habitat.**

| Construction footprint | | | Mitigation measures | | |
|---|---|---|---|---|---|
| **RPM** | **Affected Habitat** | **Acres** | **Non-native Tree Removal (A)** | **Riparian Shrub / Tree Planting (B)** | **Terraces / Swales (D)** |
| 4.1 | Riparian | 265.8 | 220.8 | 220.8 | 45 |
| 4.2 | Flycatcher | 44.5 | | | 45 |
| 6.1 | Cuckoo | 130 | 123 | 123 | 7 |
| 1.3, 2.3 | Silvery Minnow | 110.2 | Connectivity to 65.2 acres | | 45 |
| **Total** | | | | | |
| | Acres | 265.8 | 220.8 | 220.8 | 45 |
| | Estimated costs | | $824,874 | $1,148,721 | $6,014,108 |

## 5.4 HABITAT EVALUATION

### 5.4.1 Habitat Analysis and Performance Screening

Evaluating the ecological benefits of proposed ecosystem restoration plans requires an assessment methodology that captures the complex ecosystem processes and patterns operating at both the local and landscape levels across multiple habitat types. USACE guidance on ecosystem restoration requires that benefits from the project meet the objectives listed in Engineer Regulation 1105-2-100, specifically, "The objective of ecosystem restoration is to restore degraded ecosystem structure, function and dynamic processes to a less degraded, more natural condition. Restored ecosystems should mimic, as closely as possible, conditions which would occur in the absence of human changes to the landscape and hydrology". The proposed ecosystem mitigation measures were evaluated for cost effectiveness and incremental benefits during the formulation process. The preliminary recommended mitigation plan provides a reasonable approach to habitat benefits relative to the costs.

### 5.4.2 Hink and Ohmart Vegetation Classification

The Hink and Ohmart (1984) classification delineated distinct Rio Grande riparian vegetation classes based on species and structure. Riparian woodlands have a canopy of Rio Grande cottonwood (*Populus fremontii var. wislizenii*), and, less extensively, Goodding's willow (*Salix nigra var. gooddingii*) (Parametrix, 2008), with an understory of native shrub species composed primarily of coyote willow (*Salix exigua*) and seep-willow (*Baccharis salicifolia*). The majority of bosque has an understory dominated by invasive saltcedar (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolia*).

The USFWS (2018), USACE (2017), and other agencies rely on the Hink and Ohmart vegetation classification as the primary unit for estimating Rio Grande habitat quality and loss from the construction footprint, and as the appropriate unit for habitat mitigation (1105-2-100). In addition, habitat suitability for the endangered flycatcher is based on additional criteria for the Hink and Ohmart classification. The USFWS provided GIS for quantifying suitable flycatcher habitat (~1100 acres of native and mixed riparian forest in the project area).

## **5.5** PROPOSED MITIGATION MEASURES

### 5.5.1 Vegetation management measures

Measure A: Non-native tree removal

The Belen reach has thick patches of mixed gallery forest vegetation (dominated by Russian olive and salt cedar) that are moderately suitable flycatcher habitat (10.1 acres). The footprint of the proposed levee would remove 265.8 acres of riparian habitat. The 44.5 acres of affected flycatcher habitat is a subset of the riparian habitat lost by levee construction (USACE 2016; USFWS 2018). The affected suitable cuckoo habitat is about 130 acres. Affected minnow habitat is 110.2 acres. The loss of riparian habitat will be mitigated by identifying areas for selective tree removal, and planting with native shrubs (Measure F: Land acquisition for habitat restoration

Riparian habitat mitigation on federal/sponsor lands within the floodway would be implemented through no-cost agreements with Reclamation and MRGCD (NFS). Riparian habitat mitigation within the floodway, but outside the study area may be used to replace habitat loss due to encroachment on the floodway by the recommended levee alignment.

Alternatively, lands adjacent or near the floodway could be acquired for habitat mitigation and planted with native riparian vegetation (USACE 1979). The acquisition of 200 acres of farmland (USACE 1979) would partially mitigate habitat loss from levee construction. The U.S. Fish and Wildlife Service acquired almost 500 acres for the Valle de Oro National Wildlife Refuge (NWR) near Albuquerque, NM from a willing seller. Estimated cost for acquiring active agricultural lands is $60,000 per acre.

Methods for reducing the density of non-native vegetation include both manual and mechanical treatment methods (USACE 2011). Removal of non-native vegetative species, will take place between September 1 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. Follow-up treatment with herbicides, or root ripping (raking approximately 6-12 inches into the ground in order to remove roots) may be implemented.

Manual treatment will process trees by cutting into small pieces using a chain saw. Large material will be hauled off for use as aquatic habitat and fire wood. Smaller material will be processed using a chipper on site (USACE 2011). Wood chips will either be tilled into the ground prior to revegetation or hauled off, depending on the volume. No more than 2 inches (depth) of chipped material will be left on site. The stump of any live non-native trees that is cut will be treated immediately with herbicide, if not entirely removed. This method will be used in areas where the bosque is not very wide and equipment will not fit, or areas where there are a large number of native trees and shrubs to protect.

Mechanical treatment is the removal of aerial portions of the tree (trunk and stems) by large machinery such as a tree shear or large mulching equipment (USACE 2011). Both dead material and live non-native trees will be treated mechanically. Where possible, trees will be removed with the root-ball intact. Otherwise, the stump will be treated immediately with herbicide.

The combination of manual treatment, mechanical and herbicidal treatment has been the most efficient approach for treatment of dead material and non-native vegetation in the MRG (USACE 2011). 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 will be evaluated on a site-by-site basis.

Re-sprouts will be treated with either herbicide or by root-ripping prior to revegetating the area with native species (USACE 2011). Thinning and removal of non-native vegetation under this Proposed Action will include herbicide treatment in many locations. Herbicide application will be used where root ripping is not an option. Herbicide will be immediately applied to the plant using a backpack sprayer, hand application with a brush, or other equipment that allows direct application.

Measure B: Riparian shrub and tree planting

The footprint of the proposed levee would displace approximately 265.8 acres of riparian vegetation, consisting primarily of dense shrubs. The equivalent acreage shall be planted with variable densities native riparian trees, shrubs, forbs and grasses (Table 4) to create a mosaic of vegetation at and among sites to mitigate for the loss of riparian habitat (USFWS 2018). These habitat patches will range between 0.5 and 5.0 acres with plantings seep-willow and Goodding's willow poles, New Mexico Olive, and other native shrubs (Table 4).

Measure C: Grass seeding along the riverside corridor of the Vegetation-Free Zone

The 15-foot-wide corridor along the riverside toe of the proposed levee (87.5 acres) will be seeded with suitable riparian grass species to minimize the potential for post-construction erosion; reduce the potential for colonization by invasive weed species; and to provide vegetation usable by wildlife. Engineer Technical Letter (ETL) 1110-2-583, *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures* (USACE 2014), requires that plantings in this zone be limited to grass species. Periodic mowing and herbicidal spot-treatment may be required to control woody and invasive herbaceous species within this corridor. These maintenance activities will be performed by USACE in the year following seeding, and, by the project sponsor thereafter as part of the OMRR&R requirements. The area requiring such seeding along the proposed 48-mile levee is approximately 87.5 acres.

Table 5-2 Recommended vegetation for mitigation.

| Plants | Measure | Densities | Acres |
|---|---|---|---|
| Rio Grande cottonwood (*Populus deltoides* spp. *wislizenii*)<br>Goodding's willow (*Salix gooddingii*)<br>peach leaf willow (*Salix amygdaloides*). | Pole planting | 10-50 stems / acre<br>25-75 stems / acre | 30+ |
| New Mexico olive (*Forestiera pubescens*)<br>four wing saltbush (*Atriplex canescens*)<br>chamisa (*Ericameria nauseosus*)<br>false indigo (*Amorpha fruticosa*)<br>golden currant (*Ribes aureum*)<br>three leaf sumac (*Rhus trilobata*)<br>pale wolfberry (*Lycium pallidum*)<br>coyote willow (*Salix exigua*)<br>black willow (*Salix*. *gooddingii*)<br>seep willow (*Baccharis salicifolia*) | Bare root | 100-500 stems / acre | 287 |
| Yerba mansa (*Anemopsis californica*)<br>native sedge (*Carex* spp.)<br>native rush (*Scirpus* spp.)<br>saltgrass (*Distichlis stricta*). | Plug | 100-500 plugs / acre | 50 |
| Indian rice grass (*Achnatherum hymenoides*)<br>galleta grass (*Pleuraphis jamesii*)<br>side oats grama (*Bouteloua curtipendula*)<br>blue grama (*Bouteloua gracilis*)<br>sand dropseed (*Sporobolus cryptandrus*) | Seeding | | 250 |
| sunflower (*Helianthus annuus*)<br>yerba mansa (*Anemopsis californicus*)<br>emory sedge (*Carex emoryi*)<br>salt grass (*Distichlis stricta*) | Seeding | | 250 |

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 will be applied. Timing of seeding will 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, will be placed strategically to provide additional habitat once seeding is completed.

Measure D: Enhanced riparian habitat features (terrace lowering, channels, swales)

The construction footprint of the proposed levee would remove approximately 44.5 acres of suitable flycatcher habitat (USACE 2017; USFWS 2018). The flycatcher habitat would be mitigated by construction of 45 acres of terrace lowering adjacent to the river, and willow swales within 300 feet of the river. The 45 acres of enhanced riparian habitat would partially mitigate for 110.2 acres of silvery minnow habitat affected by levee construction.

The enhanced habitat sites will be designed and constructed to produce high quality cottonwood and willow riparian habitat features. The enhanced habitat sites will be located in the Belen reach on both sides of the river to reduce transportation costs and distribute habitat mitigation through about 26 river miles of the study area (Belen East and West levee). The area of individual sites would range between 5 and 25 acres.

The process for identifying enhanced habitat sites will start with mapping to identify low quality riparian vegetation areas in the study area. Potential sites should be evaluated for sediment quality and depth to groundwater.

The target excavation depth for each site will be limited to within 1 foot above the site groundwater elevation. USACE biologists will coordinate with USBR, USFWS, and MRGCD staff to design the site plan. The feature design plan will define the site perimeter, shape, topography, and other habitat elements to be excavated. Each site will be less than 25 acres in area.

Grubbing and clearing of enhanced habitat features will only be permitted to occur outside the breeding bird season (September through March). Excavation shall be scheduled to reduce activity during spring runoff and breeding bird season as appropriate based on input from the Service, water operations, and environmental resources. Excavated material may be temporarily stockpiled proximal to the levee on the cleared feature footprint. Enhanced habitat sites shall be replanted with the target native vegetation prior to spring runoff.

Measure E: Pond and wetland

The Isleta west reach has a wetland pond abutting the levee immediately upstream of the railroad crossing. Value Engineering identified that realigning the levee toward the river and redesigning the irrigation wasteway will eliminate effects on the wetland and streamline construction.

In the Belen west reach, there is a recreational pond upstream of the main highway through Belen on the floodway side of the levee. The NFS has a management plan for the recreational pond to support the planning and design process. Mitigation may focus on riverward excavation of the pond to maintain the surface area or moving the levee footprint landward within the MRGCD owned land. Excavation of 75 acres of wetland (USACE 1979) may partially mitigate for habitat loss from levee construction. However, wetland habitat would not mitigate for the affected endangered species habitat.

Measure F: Land acquisition for habitat restoration

Riparian habitat mitigation on federal/sponsor lands within the 5,633 acre floodway (Table 1-2) would be implemented through no-cost agreements with Reclamation and MRGCD (NFS). A subset of 3,707 acres of mixed forest is nominally available for 265.8 acres of mitigation. Riparian habitat mitigation within the floodway, but outside the study area may be used to replace habitat loss due to encroachment on the floodway by the recommended levee alignment.

Alternatively, lands adjacent or near the floodway could be acquired for habitat mitigation and planted with native riparian vegetation (USACE 1979). The acquisition of 200 acres of farmland (USACE 1979) would partially mitigate habitat loss from levee construction. The U.S. Fish and Wildlife Service acquired almost 500 acres for the Valle de Oro National Wildlife Refuge (NWR) near Albuquerque, NM from a willing seller. Estimated cost for acquiring active agricultural lands is $60,000 per acre.

### 5.5.2 Location of Mitigation Sites

Mitigation sites shall be identified during the design phase of the project due to uncertainties in funding and schedule over 16 phases (years). The Middle Rio Grande Water Management Agencies Biological Opinion (USFWS 2016) requires habitat restoration by federal (Reclamation) and state (MRGCD) agencies overlapping the study area. Site identification during the design phase supports flexible planning and reduces costs for relocating mitigation sites. Mitigation implementation will be coordinated with construction phases (USACE 2017; USFWS 2018).

Implementing habitat mitigation in the existing 5,633 acres riparian forest managed by Reclamation and MRGCD between the levees (in the floodway) is more cost effective than acquiring agricultural land for conversion into forest (Figure 5-1; Table 5-3). A subset of 3,707 acres of mixed forest is nominally available for 265.8 acres of mitigation. Sites proximal to the river (within 100 m) are preferred due to the lower depth to groundwater and increased likelihood of seasonal inundation improving habitat quality and reducing implementation costs. Mitigation for flycatcher habitat must be adjacent to the river (RPM 4.2, USFWS 2018).

Spatial analysis shall combine vegetation mapping (Siegle et al. 2013) with geological layers to screen preliminary sites based on lower habitat value and suitable soils for mitigation. Sites with higher densities of invasive salt cedar and Russian Olive (3875 acres) generally have lower value than native vegetation (1550 acres). Sites with higher percentages of silt and clays (>20%) have better soils for supporting native riparian vegetation. Terrace lowering for habitat restoration will require excavation of materials. Suitable excavated material may be spoiled into the levee to reduce hauling costs for fill. Suitable excavated material from other agency restoration projects may also be available for levee construction.

### 5.5.3 Compensation Timing

Compensation timing refers to the time between the initiation of construction at a particular site and the attainment of the habitat benefits to targeted species from designated compensation sites. For example, compensation time would be the time required for on-site plantings to provide significant amounts of shade or structural complexity from instream woody material recruitment to provide habitat for fish species. Significant long-term benefits have often been considered as appropriate to offset small short-term losses in habitat for listed species in the past, as long as the overall action contributes to recovery of the listed species. The authority to compensate prior to or concurrent with project construction is given under WRDA 1986 (33 United States Code [USC] § 2283). Additionally, ER 1105-2-100, Appendix C states that authorized ecological resource mitigation activities and features should occur before construction of the project, concurrent with the acquisition of lands, or concurrent with the physical construction of the project.

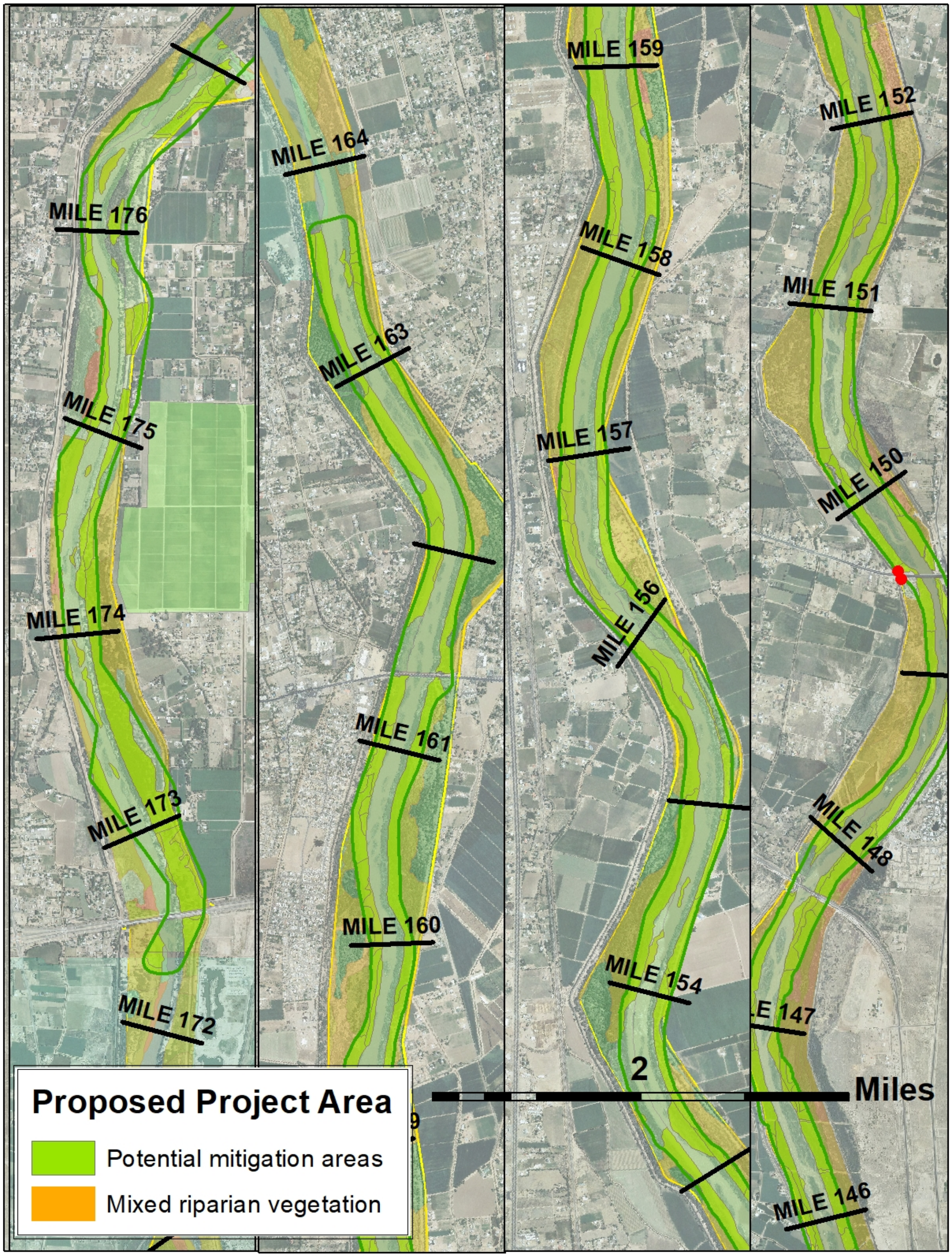


**Figure 5-1 Map of potential mitigation areas (1711 acres).**

## **5.6** MITIGATION AND MANAGEMENT STRATEGY

### 5.6.1 Riparian Habitat - non-native tree removal (Measure A)

The identification of potential mitigation sites shall be based on the Hink and Ohmart (1984) vegetation classification (Hink and Ohmart 1984). The criteria for site selection will be based on identification as mixed gallery forest that is not suitable flycatcher habitat.

#### *5.6.1.1 Objectives and Implementation Strategy*

The primary objective is to mitigate for the area of valuable riparian habitat in the study area for the life of the project. Non-native tree removal should improve 265.8 acres of riparian habitat (including 45 acres of enhanced riparian habitat).

#### *5.6.1.2 Success Criteria*

Monitoring of riparian habitat would focus on: (1) the percentage cover of native species, and (2) the percentage of overall vegetative cover. Selective removal would reduce the percentage the coverage or composition of non-native trees and shrubs to less than 5% within the treated areas. Non-native stem densities should be less than 5 per acre. The partially mitigated habitat would be considered successful if 80 percent of the trees and shrubs on site consists of native species following removal. Additionally, the overall vegetative cover on site must be 95 percent.

#### *5.6.1.3 Mitigation Monitoring Strategy*

Vegetation survey of the mitigation area prior to tree and shrub removal to document the non-native percent cover, determine approximate numbers of non-native shrubs and trees, and mark plants to be removed. Immediately follow non-native plant removal with vegetation survey to verify the reduction in non-native percent cover, and that all marked plants have been removed.

Mitigation monitoring shall be continued until the project has been determined to be successful (performance standards have been met), as required by Section 2039 of WRDA 2007, as noted in paragraph 3.c of the implementation guidance. Monitoring of mitigation vegetation based on the Hink and Ohmart (1984) classification would be conducted for up to five consecutive years following construction. Years 1 and 2 will evaluate the establishment period for the plantings. Mitigation monitoring would be coordinated with the sponsor and incorporated with ongoing efforts to reduce duplicate effort.

#### *5.6.1.4 Adaptive Management Strategy*

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

**Adaptive Management Triggers**

- Desired Outcome: significantly lower density of non-native shrubs and trees
  Trigger: greater than 5 non-native trees per acre following removal
- Desired Outcome: significantly lower density of non-native shrubs and trees
  Trigger: non-native percent cover of more than 5% following removal

**Adaptive Management Measures**

If the triggers established above occur, the following measures would be implemented for riparian habitat in order to adaptively manage the site for success.

- If the performance criteria are not met following removal, the contract officer shall notify the contractor to address the deficiency. Monitoring will be repeated until desired outcomes are documented.

### 5.6.2 Riparian Habitat- native riparian shrub and tree planting

The identification of potential mitigation sites shall be based on the Hink and Ohmart (1984) vegetation classification (Hink and Ohmart 1984). The criteria for site selection will be based on identification as mixed gallery forest that is not suitable flycatcher habitat.

#### *5.6.2.1 Objectives and Implementation Strategy*

The primary objective is to mitigate for the area of valuable riparian habitat in the study area for the life of the project. Native shrub and tree planting should improve 265.8 acres of riparian habitat (including 45 acres of enhanced riparian habitat).

#### *5.6.2.2 Success Criteria*

Monitoring of riparian habitat would focus on: (1) the percentage cover of native species, and (2) the percentage of overall vegetative cover. Native shrub and tree planting would increase the percent cover and stem density of native shrubs and trees within the treated areas. The restored habitat would be considered successful if 80 percent of the vegetation on site consists of native shrub and tree species. Additionally, the overall vegetative cover on site must be 95 percent.

#### *5.6.2.3 Mitigation Monitoring Strategy*

Vegetation survey of the mitigation area prior to tree and shrub removal to document the non-native percent cover, determine approximate numbers of non-native shrubs and trees, and mark plants to be removed. Mitigation monitoring shall be continued until the project has been determined to be successful (performance standards have been met), as required by Section 2039 of WRDA 2007, as noted in paragraph 3.c of the implementation guidance. Monitoring of mitigation vegetation based on the Hink and Ohmart (1984) classification would be conducted for up to five consecutive years following construction. Years 1 and 2 will evaluate the establishment period for the plantings. Mitigation monitoring would be coordinated with the sponsor and incorporated with ongoing efforts to reduce duplicate effort.

#### *5.6.2.4 Adaptive Management Strategy*

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

**Adaptive Management Triggers**

- Desired Outcome: establishment of native shrubs and trees
  Trigger: native shrub/tree cover less than 80 percent
- Desired Outcome: significantly lower density of non-native shrubs and trees
  Trigger: non-native shrub/tree cover greater than 10 percent

**Adaptive Management Measures**

If the triggers established above occur, the following measures would be implemented for riparian habitat in order to adaptively manage the site for success.

- If the performance criteria are not met within one year, additional monitoring would be implemented in order to ensure that the site is successful.
- If non-native species are outcompeting the native species, measures would be implemented to manage presence of invasive species, principally selective removal of non-native species at optimal times for native growth.
- If non-native species are outcompeting the native species and targets for overall cover are not being met, then supplemental re-vegetation of native species would occur.
- Supplemental watering if targets for overall cover are not being met.

### 5.6.3 Grass seeding along the riverside corridor of the Vegetation-Free Zone

Grass seeding for herbaceous cover will occur on the levee and the vegetation-free zone to stabilize the soil and suppress establishment of invasive weed species. This measure is required by Engineer Technical Letter (ETL) 1110-2-583 (USACE 2014).

#### *5.6.3.1 Objectives and Implementation Strategy*

The primary objective of this measure to protect the levee slope from erosion and reduce the spread of invasive weed species. Grass seeding is included in the mitigation plan to support the establishment of native vegetation at nearby mitigation sites.

#### *5.6.3.2 Success Criteria*

Monitoring of grass seeding on the levee and the vegetation-free zone would focus on: (1) the percent cover of native grasses and (2) the percent cover of invasive weeds.

#### *5.6.3.3 Mitigation Monitoring Strategy*

Weekly surveys of the levee slope and vegetation-free zone during the germination and early growth periods.

#### *5.6.3.4 Adaptive Management Strategy*

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

**Adaptive Management Triggers**

- Desired Outcome: establishment of native grasses and herbaceous vegetation
  Trigger: native grass and herbaceous cover less than 50 percent
- Desired Outcome: suppression of invasive weeds

Trigger: invasive weed cover greater than 10 percent

**Adaptive Management Measures**

If the triggers established above occur, the following measures would be implemented for levee slope and vegetation-free zone in order to adaptively manage the site for success.

- Supplemental watering may be required to support successful germination of grasses
- Selective mowing of invasive weeds and reseeding
- If the performance criteria are not met following seeding, the contract officer shall notify the contractor to address the deficiency. Monitoring will be repeated until desired outcomes are documented.

### 5.6.4 Riparian Habitat- enhanced riparian features (Measure B)

The identification of potential mitigation sites shall be based on the Hink and Ohmart (1984) vegetation classification (Hink and Ohmart 1984). The criteria for site selection will be based on identification as mixed gallery forest adjacent to the river that is not suitable flycatcher habitat.

#### *5.6.4.1 Objectives and Implementation Strategy*

The primary objective is to mitigate for suitable flycatcher habitat in the study area for the life of the project. Terrace lowering and swales proximal to the Rio Grande should improve 45 acres of habitat with increased floodplain connectivity during spring runoff, and higher densities of native shrubs and trees. This habitat would mitigate for both flycatcher (45 acres), cuckoo (7+ acres), and silvery minnow (45 acres) habitat. Strategic placement of these features should also increase floodplain connectivity for an additional 65 acres of adjacent habitat for the silvery minnow.

#### *5.6.4.2 Success Criteria*

Monitoring of the enhanced riparian habitat would focus on: (1) increased river connectivity, (2) the percentage cover of native species, and (3) the percentage of overall vegetative cover. Excavating the floodplain surface would increase overbank flooding at lower spring flows. Removal of non-native plants, followed by native plantings would increase the percent cover and stem density of native shrubs and trees within the enhanced riparian features. The restored habitat would be considered successful if 90 percent of the vegetation on site consists of native tree and shrub species. Additionally, the overall vegetative cover on site must be 95 percent.

#### *5.6.4.3 Mitigation Monitoring Strategy*

Pre-construction LiDAR data and GPS mapping shall be used to determine excavation depth of mitigation sites. Post-construction GPS mapping shall verify perimeter and excavation depth for enhanced mitigation sites. Other mitigation monitoring shall be continued until the project has been determined to be successful (performance standards have been met), as required by Section 2039 of WRDA 2007, as noted in paragraph 3.c of the implementation guidance. Monitoring of mitigation vegetation based on the Hink and Ohmart (1984) classification would be conducted for up to five consecutive years following construction. Years 1 and 2 will evaluate the establishment period for the plantings. Mitigation monitoring would be coordinated with the sponsor and incorporated with ongoing efforts to reduce duplicate effort.

#### *5.6.4.4 Adaptive Management Strategy*

If the habitat is not meeting the success criteria established above, then adaptive management would be implemented in order to ensure that the habitat establishment is successful. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

**Adaptive Management Triggers**

- Desired Outcome: improved floodplain connectivity with river
  Trigger: inundate sites at lower river flow (reduce flow 1000 cfs for inundation)
- Desired Outcome: establishment of native shrubs and trees
  Trigger: native shrub/tree cover less than 90 percent
- Desired Outcome: establishment of native shrubs and trees
  Trigger: non-native shrub/tree cover greater than 5 percent

**Adaptive Management Measures**

If the triggers established above occur, the following measures would be implemented for riparian habitat in order to adaptively manage the site for success.

- If the performance criteria are not met within one year, additional monitoring would be implemented in order to ensure that the site is successful.
- If non-native species are outcompeting the native species, measures would be implemented to manage presence of invasive species, principally selective removal of non-native species at optimal times for native growth.
- If non-native species are outcompeting the native species and targets for overall cover are not being met, then supplemental re-vegetation of native species would occur.
- Supplemental watering if targets for overall cover are not being met.

### 5.6.5 Pond and Wetland Habitat

Mitigation of the two wetland ponds would follow Section 404(b)(1) of the Clean Water Act. Avoidance of fill would be preferable. If one or both of the ponds (PUBFh) are partially filled adjacent to the levee, excavation of comparable area would be implemented for mitigation of wetland habitat.

#### *5.6.5.1 Objectives and Implementation Strategy*

The primary objective is to mitigate the two wetlands ponds following Section 404(b)(1) of the Clean Water Act. Avoidance of fill is preferable to excavation to maintain the pond surface area. Ponds that are partially filled adjacent to the levee would be excavated to the same area for mitigation.

#### *5.6.5.2 Success Criteria*

Success criteria for the pond and wetland mitigation are an equal or greater pond area post-construction compared to the pre-construction pond area. Pond mitigation would be considered successful only if the post-construction area is the same (within 2 $m^2$) or larger than the pre-construction area

#### *5.6.5.3 Mitigation Monitoring Strategy*

Mapping surveys of the ponds prior to construction would document the existing surface area, the area of levee fill, and identify areas for excavating to fulfill mitigation requirements. Mapping of mitigation areas immediately prior to, and following construction would support timely adaptive management if necessary. As-built drawings and mapping would verify compliance.

#### *5.6.5.4 Adaptive Management Strategy*

If the pond area was insufficient for meeting the success criteria established above, then adaptive management would be implemented while construction equipment is readily available to enlarge the pond area to the pre-determined mitigation requirements. The following subsections identify triggers that would indicate the need to implement adaptive management measures and the measures that would be implemented accordingly.

**Adaptive Management Triggers**

- Desired Outcome: post-construction pond area the same as pre-construction
  Trigger: post-construction pond area less than pre-construction pond area

**Adaptive Management Measures**

If the triggers established above occur, the following measures would be implemented for pond and wetland habitat in order to adaptively manage the site for success.

- If the pond area criteria are insufficient at the completion of construction, the contract officer shall notify the contractor to address the deficiency.

### 5.6.6 Conservation Measures

The following is a list of conservation measures and stipulations that would be complied with during construction of the proposed action to protect water resources and endangered species habitat from degradation:

1. Beginning with the breeding season prior to the initiation of construction in each segment, USACE would perform or fund annual Southwestern Willow Flycatcher and Yellow-billed Cuckoo protocol surveys along the floodway, eventually extending from Mountain View to Jarales. Annual surveys would continue until the completion of construction and would continue for three years following the phased construction of each levee unit.
2. Levee construction may occur throughout the calendar year; however, no construction would be performed within 0.25 mile of occupied flycatcher breeding territories (generally, late May through August 15). Traffic associated with construction activities may continue along the construction alignment adjacent to occupied flycatcher breeding territories. All construction equipment and large trucks would be restricted to the maintenance roads adjacent to the spoil bank and MRGCD infrastructure. The levee and/or spoil bank would serve as a buffer between this traffic and flycatchers within the floodway. Small vehicles (e.g., pickup trucks and SUVs) would occasionally travel along the top of the spoil bank / levee, as they do currently.

3. Construction activities on Isleta Pueblo land would use the Isleta Pueblo Riverine Management Plan as guidelines for protecting riparian habitat.
4. Vegetation removal and clearing-and-grubbing activities would only be performed between September 1 and April 15. If needed, vegetation removal between April 15 and September 1 would only be performed if inspection by a qualified biologist determines that flycatchers and cuckoos (including both migrant and territorial birds) are not present within 500 feet of the vegetation patch to be removed.
5. Work would be performed below the elevation of the ordinary high water mark only during low-flow periods. No erodible fill materials would be placed below the elevation of the ordinary high water mark.
6. Fuels, lubricants, hydraulic fluids and other petrochemicals would be stored outside the 1%-chance floodplain, if practical. At the least, staging and fueling areas would be located outside of the floodway, landward of the existing spoil bank alignment, and at least 100 feet from any surface water or channel. All storage areas would include spill prevention and containment features.
7. Construction equipment would be inspected daily to ensure that no leaks or discharges of lubricants, hydraulic fluids or fuels occur in the aquatic or riparian ecosystem. Any petroleum or chemical spills would be contained and removed, including any contaminated soil.
8. Only uncontaminated earth or crushed rock for backfills would be used.
9. Silt curtains, cofferdams, dikes, straw bales and other suitable erosion control measures would be employed to prevent sediment-laden runoff or contaminants from entering any watercourse.
10. If appropriate, water quality would be monitored during construction to ensure compliance with state water quality standards for turbidity, pH, temperature, and dissolved solids.
11. USACE will provide an annual report on progress to the USFWS during the construction period of the proposed action. Copies of the report will be furnished to the project sponsors, and pertinent Federal and local resource agencies. Annual reports will include:

a. A summary of construction activities performed during the preceding year.
b. A description of construction activities anticipated in the upcoming year.
c. A description of refinements in design or construction activities, if any.
d. A description and evaluation of Conservation Measures employed.
e. A summary of the status of listed species, including the results of species-specific surveys.
f. A description and evaluation of compliance with Reasonable and Prudent Alternatives in the Programmatic Biological Opinion, and with stipulations in its associated Incidental Take Statement.
g. The status and success of mitigative re-vegetation measures and associated results of monitoring activities.

#### 5.6.7 Endangered Species Reasonable and Prudent Measures

The Rio Grande silvery minnow is restricted to a variably perennial reach of the Rio Grande in New Mexico with critical habitat that overlaps the study area. Mitigation measures described above will avoid or minimize the potential for adverse effects to water quality during construction will also serve to avoid or minimize direct effects to the Rio Grande silvery minnow.

The following Reasonable and Prudent Measures (RPM) were specified in the Biological Opinion (USFWS 2018) for the proposed project.

RPM 1.1 Conduct and implement results of a noise disturbance study to minimize the adverse effects to silvery minnows from levee project construction.

RPM 1.2 Monitor the incidental take of silvery minnows due to levee construction noise and minimize take by implementing noise reduction BMPs. Qualified fisheries biologists will evaluate whether measures are required to exclude fish from construction areas. Cofferdams, silt curtains, or bubble barriers will be deployed by USACE biologists from the shoreline into the channel to exclude fish from construction areas where required. If appropriate, biologists will coordinate with USFWS personnel to seine areas prior to placement of barriers in the construction area.

RPM 1.3 Conduct one-time monitoring to determine if juvenile or adult silvery minnows are present and therefore utilize the constructed or enhanced habitat mitigation sites (110.2 acres) during spring runoff inundation. Corps shall contract qualified biologists to use standard sampling methods and conduct the presence/absence monitoring of juvenile or adult silvery minnows once at each mitigation site.

RPM 2.1 Determine the spatial extent and location of levee fills prior to construction.

RPM 2.2 Develop a mitigation site plan to offset levee fills area and locations, along with sediment deposition to maintain floodway capacity.

RPM 2.3 Develop a sediment accounting model for the floodway prior to levee construction.

RPM 2.4 Implement the Entrapment Monitoring Protocol (Appendix B) on enhanced mitigation sites to enumerate and reduce incidental take of silvery minnows.

RPM 2.5 Conduct a water temperature regimes field study monitoring to evaluate effects of the Vegetation Free Zone on floodplain water temperature during spring runoff.

RPM 3.1 Conduct and implement results of a noise disturbance study to minimize the adverse effects to flycatchers from levee project construction.

RPM 3.2 Complete flycatcher protocol presence/absence surveys as proposed. Beginning with the breeding season prior to the initiation of proposed construction, USACE will perform or fund annual protocol surveys (5 visits per season) within the floodway from South Diversion Channel to Highway 346. Annual surveys will continue until the completion of construction and will continue for five years following the phased construction of each levee segment. Flycatcher surveys for each anticipated segment of construction will be conducted in the anticipated construction area one season prior to the anticipated construction. Additional segments will be added as overall construction progresses. The anticipated cost of flycatcher monitoring starting with pre-construction is $845,300 (16 phases at current dollars). This cost has been included in the estimate for the total project cost. Information resulting from these surveys will be used to update resource conditions, avoid direct effects from construction activities, and to revise the determination of effects of the proposed project, if needed.

RPM 3.3 All vegetation removal prior to and post construction shall occur between September 1st to April 15th to avoid bird breeding bird season.

RPM 3.4 Ensure application of low-drift herbicide follows the Service guidance on herbicide use (White 2009).

RPM 4.1 All 265.8 acres of habitat restoration activities will use the goal of establishing 50% vegetation cover.

RPM 4.2 All 45 acres of proposed lowered terraces or swales must be at least 5 acres in size and at least 10 meters wide.

RPM 4.3 All 45 acres of proposed swales or terraces lowering shall excavated to a depth within 3 feet of groundwater (anticipated over the proposed action period).

RPM 4.4 The amount of sediment material removed for the enhanced habitat measures shall equal or exceed the 16 acre feet of estimated aggradation.

RPM 4.5 The Corps shall determine how many acres of suitable habitat will be removed in each phase of construction, and complete the same amount or more acreage of restoration simultaneous to the removal of suitable habitat

RPM 4.6 longer than 12 hours to recharge or the groundwater depth increases past 6.6 feet in willow habitat or 7.5 feet for cottonwoods, the pumping portion of the proposed action will need to cease in that area until the area re-wets or is watered during the growing season.

RPM 5.1 Conduct and implement results of a noise disturbance study to minimize the adverse effects to cuckoos from levee project construction.

RPM 5.2 Conduct cuckoo protocol presence/absence monitoring surveys proposed in USACE (2017).

RPM 6.1 Site locations for 45 acres enhanced mitigation measures adjacent to at least 7 acres of potential cuckoo nesting habitat to ensure the 12 acres patch size.

RPM 7.1 USACE and/or their agents will prepare annual reports that include specific information pertaining to each of the monitoring elements. These reports will include information about all equipment and techniques used for monitoring purposes. Annual reports will be submitted to the MRGCD, USFWS, and USBR, Pueblo of Isleta (as appropriate), and other interested parties by April 1st of each year.

RPM 7.2 USACE will meet with the USFWS NMESFO staff to discuss progress and findings prior to submitting the final 5-year reviews.

Several of the Conservation Measures in Section 2.2.7 of this BA include construction and monitoring activities that would avoid or minimize the potential for adverse effects during construction and would serve to avoid or minimize direct effects to listed species. Qualified biologists would monitor all construction activities. Information resulting from these surveys would be used to update resource conditions, avoid direct effects from construction activities, and to revise the determination of effects of the proposed action, if needed.

Construction contracts will include warranties or performance standards for the establishment of vegetation. For seeding, the requirements will specify that planted areas will exhibit vigorous growth after a one-year establishment period. Requirements typically will include stem density or percent cover measures which the Contracting Officer will use to verify that the performance standards have been, or have not been, met. Any additional planting activities to meet the performance standard will be performed at the contractor's expense. The stem density or percent cover criteria included in each contract will vary depending on location-specific soil and moisture conditions, as well as the specified seed mix. For woody plantings (trees and shrubs), the performance standard will require at least 85% survival of planted material at the end of the third growing season following planting. If survival is less than this criterion, the contractor will install additional plantings to assure at least 85% living trees or shrubs.

The success of re-vegetation mitigation measures will be based on the acceptable development of vegetation and its likelihood of continued development into a mature stand. Monitoring will be conducted by USACE once each year during the summer growing season for five years following planting. Monitoring requirements beyond five years (to be determined during ongoing consultation and coordination) would be conducted by the project sponsor.

#### 5.6.8 Operation and Maintenance

Upon completion of each functional segment of the new levee, that portion of the project would be turned over to the project sponsor, MRGCD, for operations and maintenance (O&M). USACE would provide the MRGCD with a manual describing the duties necessary for proper O&M of the segment, and the entire project.

In general, O&M would consist of maintaining the vegetation management zone free of woody vegetation larger than 0.5-inch-diameter stems or trunks. MRGCD would be responsible for maintaining levee integrity by repairing runoff erosion, eliminating rodent burrows in the levee, replacing riprap lost in flow events, and inspecting and cleaning seepage infrastructure regularly. USACE and MRGCD also would perform annual inspections of the levee system.

## 5.7 ADAPTIVE MANAGEMENT COSTS

Measure A entails removal of non-native vegetation in support of increasing native vegetation density and the incremental cost per unit output. Measure B entails the establishment of shrubs and trees, and their incremental cost per unit output increases with successively dense planting prescriptions. Measure C entails seeding to establish vegetation and their incremental cost per unit output are similar.

Measure D, the excavation of enhanced habitat features will create habitat with shallower depth to groundwater and improved floodplain connectivity to the river hydrograph for establishing native riparian vegetation. Measure E entails the mitigating wetland features, and the incremental cost per unit output increases with successively dense planting prescriptions.

Mitigation on land within the floodway provides better opportunities for increasing the area of quality riparian vegetation than land acquisition outside the floodway. Land within the floodway already has connectivity for wildlife corridors. Measure F, land acquisition is not as cost-effective for mitigation, as the purchase price is an additional cost prior to implementation of mitigation measures. Continued coordination with Valle de Oro NWR may provide opportunities for wildlife habitat mitigation outside the floodway.

Therefore, the District recommends that all proposed re-vegetation (A-D), and wetland measures (E) be included in the mitigation plan.

### 5.7.1 Compensatory value of mitigation measures

USACE Planning Guidance Notebook and Section 2036 of WRDA 2007 state that losses of fish and wildlife resources will be mitigated in-kind, or include compensatory measures that provide no less than the in-kind condition, to the extent possible. In the proposed project, a relatively large area of shrub-dominated habit will be converted to grassland per the requirements of ETL 1110-2-5823, and the unsuitability of some areas to support native shrub species (as opposed to exotic salt cedar). Woody riparian vegetation has been included in mitigation measures to more fully compensate for the unavoidable effects on those habitat types.

### 5.7.2 Cost Effectiveness / Incremental Cost Analysis

The Hink and Ohmart (1984) vegetation types were used to define planting requirements for estimating mitigation costs. The costs of vegetation planting measures were estimated using MCASES Version MII software. All costs include material and installation, weed-control maintenance, success monitoring, contingency (15.8%), contract supervision and administration, and sponsor operation and maintenance. Implementation and O&M costs were annualized over the expected life of the project and the average annual cost served as model input for each measure. IWR-Plan software was used to perform cost effectiveness and incremental cost analyses.

The cost effectiveness for the mitigation commitments in the biological opinion (USFWS 2018) were compared to the suggested mitigation in the original EIS (275 acres, USACE 1979) and a forthcoming ecosystem restoration feasibility study (~250.5 acres, Sandia Pueblo to Isleta Pueblo, New Mexico).

Cost Measures A and B were estimated as mitigation for the 1979 levee (the authorized plan). Cost Measure B has purchase and plant activities within them and are considered inseparable in this analysis. There is no reasonable way to re-sequence the activities within Cost Measure B (such as plant prior to purchasing land) and therefore the activities within Cost Measure B are considered one and only one measure, with no means of further subdividing the effort. Activities comprising Cost Measure C are also in the "plant" and "purchase" variety and are evaluated in cost effectiveness analysis the same as Cost Measure B.

Cost Measures A and D are similar "terrace lowering" activities that add acreage to their complementary "remove exotics/plant natives" activities, but have been modeled as separable in this analysis. Thus it is possible to have purchase and planting measures (B and C) combined with either A or D. This analysis also presents the opportunity for alternatives that include Cost Measures A and/or D without other measures.

Activities in Cost Measure E are currently evaluated as a single unit as a preliminary suite of activities for an ecosystem restoration feasibility study over a similar area. Removing exotic vegetation is a necessary precursor step to planting native vegetation on the same land. The terrace lowering and "lowering w/ planting" appear to be additive tasks to the larger exotic planting removal followed by native planting. With no additional dependencies created, this array of measures generated 32 plans within IWR Planning Suite. Ranking by output, the cost effectiveness follows:

The combination of Cost Measures C and D were identified as mitigation required for this study this year, and is deemed cost effective when implemented in isolation. This combination has been highlighted in isolation in Table 2. Implementing Cost Measures B and C do fall within the two first Best Buys as a cost effective means to incrementally add output to the first Best Buy (Cost Measure C). Alternatives don't cost effectively contain this measure until the alternative containing B, C and D. Alternatives which contain C and D as a Best Buy start with the alternative containing B, C, D, and E, which puts it close do "Do Everything."

**Table 5-3 CE/ICA analyses for mitigation required by the Biological Opinion (USFWS 2018).**

| Name | Cost | Output | Cost Effectiv |
|---|---|---|---|
| No Action Plan | 0 | 0 | Best Buy |
| A0B0C0D1E0 | 6014108 | 45 | No |
| A1B0C0D0E0 | 21810700 | 75 | No |
| A1B0C0D1E0 | 27824808 | 120 | No |
| A0B1C0D0E0 | 12974317.66 | 200 | No |
| A0B0C1D0E0 | 1973595 | 235.8 | Best Buy |
| A0B1C0D1E0 | 18988425.66 | 245 | No |
| A0B0C0D0E1 | 23797136 | 250.5 | No |
| A1B1C0D0E0 | 34785017.66 | 275 | No |
| A0B0C1D1E0 | 7987703 | 280.8 | Yes |
| A0B0C0D1E1 | 29811244 | 295.5 | No |
| A1B0C1D0E0 | 23784295 | 310.8 | No |
| A1B1C0D1E0 | 40799125.66 | 320 | No |
| A1B0C0D0E1 | 45607836 | 325.5 | No |
| A1B0C1D1E0 | 29798403 | 355.8 | No |
| A1B0C0D1E1 | 51621944 | 370.5 | No |
| A0B1C1D0E0 | 14947912.66 | 435.8 | Best Buy |
| A0B1C0D0E1 | 36771453.66 | 450.5 | No |
| A0B1C1D1E0 | 20962020.66 | 480.8 | Yes |
| A0B0C1D0E1 | 25770731 | 486.3 | Yes |
| A0B1C0D1E1 | 42785561.66 | 495.5 | No |
| A1B1C1D0E0 | 36758612.66 | 510.8 | No |
| A1B1C0D0E1 | 58582153.66 | 525.5 | No |
| A0B0C1D1E1 | 31784839 | 531.3 | Yes |
| A1B1C1D1E0 | 42772720.66 | 555.8 | No |
| A1B0C1D0E1 | 47581431 | 561.3 | No |
| A1B1C0D1E1 | 64596261.66 | 570.5 | No |
| A1B0C1D1E1 | 53595539 | 606.3 | No |
| A0B1C1D0E1 | 38745048.66 | 686.3 | Best Buy |
| A0B1C1D1E1 | 44759156.66 | 731.3 | Best Buy |
| A1B1C1D0E1 | 60555748.66 | 761.3 | Yes |
| A1B1C1D1E1 | 66569856.66 | 806.3 | Best Buy |

32 Plans

# 6 - PUBLIC SCOPING

USACE has conducted several public meetings in the last 10 years to inform stakeholders and the general public about plans for the proposed Bernalillo to Belen Levee (Table 6-1). The meetings have been attended by federal, state, tribal, and local government representatives along with members of other organizations.

Table 6-1 Schedule of recent public meetings.

| Location | Audience | Attendees | Date |
|---|---|---|---|
| Village of Los Lunas Office | Village of Los Lunas, Our Tomorrow, MRCOG, public | 5 | 7/21/2008 |
| Mountain View Community Center | MRGCD, Sandoval County, UNM, SWCA, MRCOG | 5 | 7/23/2008 |
| Pueblo of Isleta Tribal Offices | Pueblo of Isleta Tribal Council, MRGCD, public | 9 | 7/24/2008 |
| Pueblo of Isleta Tribal Council | Pueblo of Isleta Tribal Council | NA | 10/25/2010 |
| Pueblo of Isleta Tribal Offices | Pueblo of Isleta staff and residents | 6 | 2/26/2013 |
| Middle Rio Grande Conservancy District Office | MRGCD staff | 2 | 9/5/2013 |
| Pueblo of Isleta Tribal Council | Pueblo of Isleta Tribal Council | NA | 11/12/2013 |
| Valencia County Commissioner's Chambers - Los Lunas, NM | Los Lunas, public | 12 | 12/3/2013 |
| Mountain View Community Center | USFWS, UNM, MRGCD, City of Albuquerque, Albuquerque Bernalillo County Water Utility Authority, Albuquerque Metropolitan Area Flood Control Authority, Sierra Club, Amigos Bravos, | 16 | 12/4/2013 |
| Pueblo of Isleta Senior Center | Pueblo of Isleta staff and residents, public | 5 | 12/19/2013 |
| US Army Corps of Engineers District Office | Pueblo of Isleta staff | 3 | 4/17/2014 |
| US Army Corps of Engineers District Office | MRGCD, Pueblo of Isleta, USFWS, USBR, Village of Bosque Farms, Friends Valle de Oro NWR, BikeABQ, Mountain View Neighborhood Association, South Valley Civitan Club, Audubon New Mexico, Hawks Aloft | 17 | 4/21/2014 |

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# 8 - PREVIOUS ENVIRONMENTAL IMPACT STATEMENTS

CUNICO

United States Army
Corps of Engineers

# Albuquerque District

MAY 1979

# MIDDLE RIO GRANDE FLOOD PROTECTION
# BERNALILLO TO BELEN, NEW MEXICO
# INTERIM FEASIBILITY REPORT
## VOLUME I

1941 FLOOD

# MAIN REPORT
# AND
# ENVIRONMENTAL IMPACT STATEMENT

73

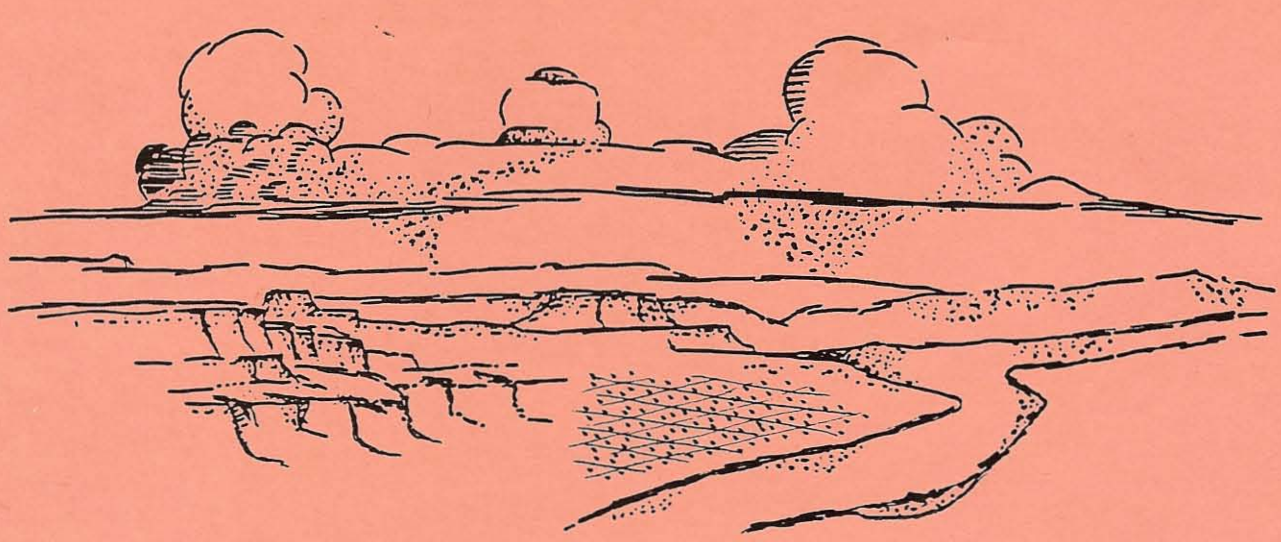
# MIDDLE RIO GRANDE FLOOD PROTECTION PROJECT

# BERNALILLO TO BELEN, NEW MEXICO

## CORRALES UNIT

## LIMITED REEVALUATION REPORT

Final



AUGUST 1994

U.S. Army
Corps of Engineers
Albuquerque District

# 9 - ENDANGERED SPECIES ACT CONSULTATION

## **9.1** Draft Programmatic Biological Assessment of U.S. Army Corps of Engineers Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico: Mountain View, Isleta and Belen Units

USACE initiated consultation with the USFWS on January 6, 2017. A revised Biological Assessment was provided the USFWS on March 8, 2018.

# PROGRAMMATIC
# BIOLOGICAL ASSESSMENT OF
# U.S. ARMY CORPS OF ENGINEERS
# MIDDLE RIO GRANDE FLOOD PROTECTION, BERNALILLO TO BELEN, NEW MEXICO:
# MOUNTAIN VIEW, ISLETA AND BELEN UNITS

January 6, 2017

Revised February 7, 2018

Prepared by

U.S. Army Corps of Engineers

4101 Jefferson Plaza NW

Albuquerque, New Mexico 87109

US Army Corps
Of Engineers
Albuquerque District

CONVERSION FACTORS

| | From | Multiplier | To |
|---|---|---|---|
| Distance: | inches (in) | 25.4 | millimeters (mm) |
| | feet (ft) | 0.3048 | meters (m) |
| | miles (mi) | 1.6093 | kilometers (km) |
| Area: | acres (ac) | 0.0407 | hectares (ha) |
| | square miles ($mi^2$) | 2.590 | square kilometers ($km^2$) |
| Volume: | cubic yards (CY) | 0.7646 | cubic meters ($m^2$) |
| | acre-feet (ac-ft) | 1,233.5 | cubic meters ($m^2$) |
| | acre-feet (ac-ft) | 325,851 | gallons (gal) |
| Discharge: | cubic feet/second (cfs) | 0.0283 | cubic meters/second (cms) |
| Mass (weight) : | tons [short] | 0.9072 | metric tons [long] |
| Velocity: | feet/second (fps) | 0.3048 | meters/second (cms) |
| Salinity: | µSiemens/cm or µmhos/cm | 0.32379 | parts/million NaCl or mg/liter NaCl |
| Temperature: | ° Fahrenheit (°F) | (°F-32)/1.8 | ° Celsius (°C) |

# Figures



# Tables

# 1 - Introduction

## 1.1 Scope of the Programmatic Biological Assessment

The U.S. Army Corps of Engineers (Corps) is submitting this Programmatic Biological Assessment (PBA) to the U.S. Fish and Wildlife Service (Service) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA). This PBA evaluates the effects of constructing the Corps' Mountain View, Isleta, and Belen Units of the Middle Rio Grande Flood Protection project on Federally listed species and designated and proposed critical habitat in the action area.

Because of the relatively long duration of anticipated construction (approximately 18 years), this consultation is being conducted programmatically. During the construction period, changes in design, construction methods, or the condition of ecological resources could alter the determinations of effects made by the Corps or Service at the present time. Should there be a change in the determination of effects, or in the suitability of stipulations of a Biological Opinion or Incidental Take Statement, the Corps will provide to the Service a supplemental Biological Assessment tiered to this PBA. The Corps also will provide annual reports on progress to the Service during the construction period.

When determining the proposed action for this consultation, the Corps carefully considered the water management activities of non-Federal and other Federal entities in the action area. Activities that are interdependent or interrelated (as defined in 50 CFR §402.02) with the Corps' action could be included as a proposed action in this PBA. However, none of the water management activities of other entities met these criteria for inclusion. Therefore, the proposed action in this Section 7 consultation includes construction, operation and maintenance of the Middle Rio Grande Flood Protection, Mountain View, Isleta, and Belen Units.

This PBA considers the effects of the Corps' proposed action (Chapter 2) on Federally listed species and their designated critical habitat occurring from the South Diversion Channel (Mountain View area) through Isleta Pueblo to an area downstream of Belen, New Mexico. A detailed description of the action area is provided in Section 2.1 of this document. The BA focuses on the endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*) (flycatcher), the Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*) (cuckoo), and Rio Grande silvery minnow (*Hybognathus amarus*) (minnow).

Chapter 1 summarizes the general location, description of the project authorization, and purpose and need for the action. Chapter 2 includes a detailed description of the proposed action. Chapter 3 describes historic and existing conditions. Chapter 4 contains detailed information regarding the status of listed species. Chapter 5 includes the analysis of the proposed action. Table 13 summarizes the Corps' determination of effects.

The three threatened and endangered species considered for analysis of effects in this document either occur in the action area and/or have critical habitat or proposed critical habitat in the action area. The other species of interest identified by the Service (Consultation code 02ENNM00-2014-SLI-0302, 19 Mar 2015) do not meet the criteria for further analysis because there is no critical habitat in the action area, the lack of suitable habitat for the species or primary constituent elements (PCEs), or the species is unlikely to occur in the action area. The species include the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*), the Interior Least Tern (*Sternula antillarum athalassos*), the Northern Aplomado Falcon (*Falco femoralis*), Mexican Spotted owl *(Strix occidentalis lucida),* Piping Plover *(Charadrius melodus),* Chiricahua leopard frog (*Lithobates chiricahuensis*), Alamosa springsnail *(Tryonia alamosae)*, Chupadera springsnail *(Pyrgulopsis chupaderae)*, Socorro springsnail *(Pyrgulopsis neomexicana)* and Socorro isopod *(Thermosphaeroma thermophilus),* and the Pecos sunflower (*Helianthus paradoxus* Heiser).

## 1.2 History of Consultation

In May 1979, the Corps completed a feasibility report and environmental impact statement addressing the construction of selected units of the Middle Rio Grande Flood Protection, Bernalillo to Belen project (USACE 1979). The Corps determined that the proposed construction would not affect the then-endangered Bald Eagle (*Haliaeetus leucocephalus*), American Peregrine Falcon (*Falco peregrinus anatum*), and Whooping Crane (*Grus americana*).

In November 1997, the Corps submitted to the Service a Biological Assessment on the effects of constructing the Belen East and West Units (USACE 1997). The Corps determined that the proposed action may affect, but would not likely adversely affect the Rio Grande silvery minnow, the Southwestern Willow Flycatcher, the Bald Eagle, and the Whooping Crane. It also was determined that the project may adversely affect then-proposed critical habitat for the minnow. Neither concurrence with the Corps determination nor a Biological Opinion was received from the Service. In a letter dated March 3, 2000, the Corps informed the Service that the need to reformulate project alternatives rendered the November 1997 BA obsolete (Consultation No. 2-22-95-F-158).

The Corps initiated consultation for the Middle Rio Grande Flood Protection Bernalillo to Belen, New Mexico: Mountain View, Isleta and Belen Units Project General Reevaluation Report (MRG GRR) on January 6, 2017. Following discussion and revisions to the Biological Assessment, the Service initiated formal consultation (Consultation code 02ENNM00-2014-F-0302) on November 28, 2017.

## 1.3 General Project Background

The project's study area along the Rio Grande extended from the South Diversion Channel in Bernalillo County, downstream for approximately 36 river-miles to the Bosque Bridge south of Jarales in Valencia County (Figure 1). The project is further divided into four units: Mountain View, Isleta West, Belen East and Belen West. The Mountain View Unit is mainly rural with some industrial and small businesses, and includes the recently established Valle de Oro National Wildlife Refuge. Agriculture fields of alfalfa or hay and mini-farms still remain along the existing spoil banks. The Isleta West Unit is almost completely rural with housing generally scattered throughout, the main housing area being the actual Isleta Pueblo itself and with a few businesses found along the major paved roads. The Belen East and West Units have substantial municipalities along both banks of the Rio Grande with the remainder of the floodplain consisting of agricultural fields of mainly alfalfa or hay, scattered housing developments, mini-farms and businesses.

Figure 2 depicts the valley cross-section of the action area showing the relationship of the spoil bank to the Rio Grande floodway, including the riparian zone, and the floodplain outside the floodway.

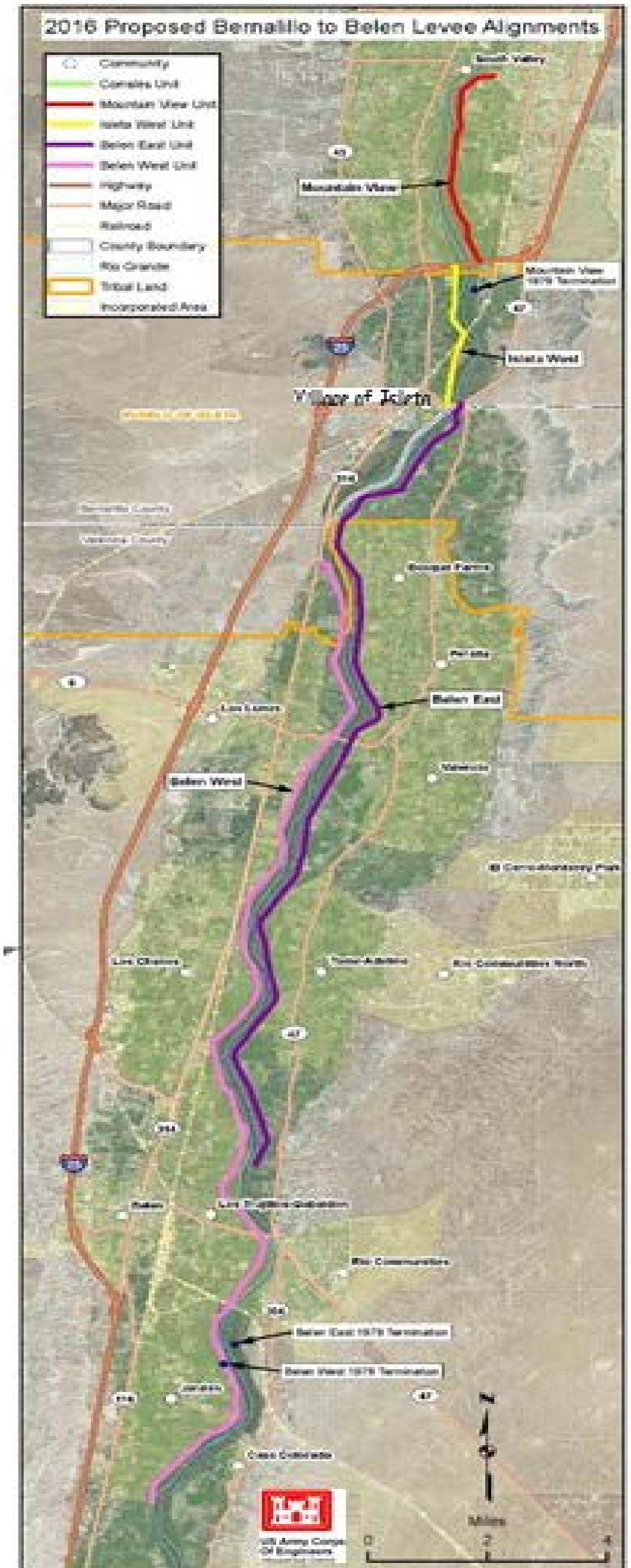



**Figure 1. Map of study area.**

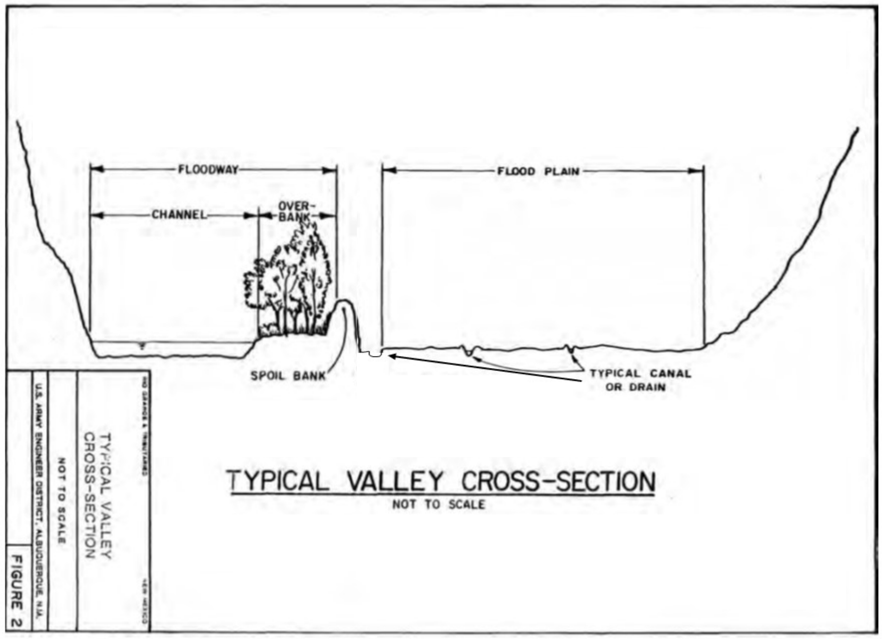



**Figure 2. Typical cross-section of the river channel.**

Flood protection activities in the Middle Rio Grande were initially authorized for construction by the Flood Control Act of 1948 (Public Law 80-858, Section 203). The specific construction authorization for the Middle Rio Flood Protection project is contained in section 401(a) of the Water Resource Development Act of 1986 (P.L. 99-662, November 17, 1986, 99th Congress). The proposed action is a single-purpose, flood risk management project. The proposed action includes updated hydrologic analysis, engineering criteria, and effects evaluation; the MRG GRR will be resubmitted to Congress for reauthorization.

The local sponsor for the project is the Middle Rio Grande Conservancy District (MRGCD) who will pay 25% of the construction costs and maintain the structures following construction.

## 1.4 Purpose and Need for Action

Floods on record, prior to spoil bank and levee construction, include those occurring during the following years: 1828, 1851, 1865, 1874, 1886, 1903, 1905, 1911, 1920, 1928, 1929, 1935, 1941 and 1942. Most flooding resulted from heavy spring runoff caused by either especially heavy winter snows or snowpack melting quickly after warm spring rains. Other flood events were the results of large storms within the Rio Grande and tributary watersheds during the summer and fall.

In 1889, streamflow gaging began and future flood events could more accurately be measured: 1903 (18,900 cfs), 1904 (33,000 cfs), 1920 (22,500 cfs), 1929 (24,000 cfs), 1935 (15,000 cfs; Figure 3), 1941 (24,600 cfs) and 1942 (18,400 cfs). The flood of 1929 again flooded much of the low lying land outside the banks of the Rio Grande. From 1930 to 1935, MRGCD constructed 190 miles of spoil banks (non-engineered levees) in the middle Rio Grande valley from

Bernalillo to San Acacia, New Mexico as part of their district wide plan to protect infrastructure and valley farmland. The spoil banks were built by piling material excavated by MRGCD during the construction of the riverside drain system without regard to modern levee engineering design principles.

**Figure 3. Aerial photo of flooding at Los Lunas, NM, May 5, 1935 (15,000 cfs).**

Due to the age of these structures and the lack of predictability and reliability associated with their construction, Federal and State agencies, local municipalities and agencies, and individuals requested Congress to address the flood problems of the Middle Rio Grande Basin. The Corps was tasked with defining the problems of the basin, formulating and evaluating various solutions to these problems, evaluating their applicability under existing Federal programs, and recommending a corrective course of action. Many miles of the original spoil banks have since been replaced with engineered levees that provide predictable flood protection, and the current agency action continues this process.

# 2 - Description of Proposed Action

## 2.1 Action Area

The general action area includes the floodway, and the outlying floodplain on one or both sides of the Rio Grande from the South Diversion Channel downstream nearly to the Bosque Bridge (Highway 346). Specifically, the proposed action includes four units: Mountain View, Isleta West, Belen East, and Belen West (Figure 1). Appendix A shows the floodplain with and without the recommended project.

The Mountain View Unit (4.35 miles) begins at the southern embankment of the outlet of the South Diversion channel and extends along the current spoil bank alignment to I-25. The action [or affected] area in this unit entails the floodway between the South Diversion Channel and I-25 and the floodplain on the east side of the river. The Valle del Oro NWR is included in the properties that would be protected by the proposed action. The floodplain on the west side of the river is protected by an engineered levee. The Isleta West Unit (3.18 miles) starts at I-25 and extends downstream past the railroad crossing to State Highway 147 Bridge. The action area would provide protection to the village of Isleta Pueblo and transportation infrastructure. The Belen West Unit (22.14 miles) starts the irrigation wasteway downstream of Isleta Marsh. The proposed levee will extend downstream through Los Lunas and Belen, with the downstream terminus 2 miles upstream of the State Highway 346 Bridge near Jarales. This unit includes bridge crossings at Highway 6, 309, and the railroad south of Belen. There are also 4 utility crossings between Highways 309 and 346. The Belen East Unit (18.13 miles) starts at the Highway 147 Bridge, extending downstream to approximately 1.7 miles upstream of the Highway 304 Bridge. This unit includes the Highway 147 and 6 Bridge crossings.

## 2.2 Description of the Proposed Action

This section provides a description of the recommended plan and its various features (generally, from the north to south).

### 2.2.1 General Description

The proposed action consists of replacing approximately 47.8 miles of non-engineered spoil banks with engineered levees along one or both sides of the Rio Grande. The Corps regularly considers 50 years as the functional life of flood control structures and expected non-Federal operations and maintenance requirements following construction.

Appendix A depicts the with- and without-project floodplains of the 1%-chance flood event (colloquially known as the “100-year flood”). Appendix B to this PBA contains plates showing the layout for the recommended action and will be referenced in the following sections.

### 2.2.2 Earthen Levee Construction

Given the beginning and end points described in section 2.1, the new earthen levee would follow the alignment of the existing spoil bank throughout a given unit. The construction of the proposed levee would entail removing the existing spoil bank with heavy machinery, and processing the material removed to obtain suitable fill material for new construction. Selected materials required for construction (i.e., riprap and bentonite) would be acquired from commercial sources or borrowed at approved sites.

Generally, the base width of the proposed levee approximates the width of the existing spoil bank, positioning the landward toe of the proposed levee would be as close as practicable to the riverside drain in order to minimize floodway encroachment by the structure. The base width of the proposed levee would be at least as wide as the existing spoil bank, but may be wider. The base width is influenced by the required levee height, which varies throughout the overall project reach. For the Mountain View and Isleta West Units, the new levee height would be approximately 4 four feet above the water surface elevation of the 1%-chance event; and the Belen East and West Unit levees would be 5 feet above that flood level. Overall levee height (bottom to top) would range from 4 to 14 feet.

The proposed levee would remain trapezoidal in cross-section with a 15-foot-wide crest (Appendix C, 35% design sheets). Side slopes would vary between 1 vertical to 2.5 horizontal and 1 vertical to 3 horizontal, depending on the height of the levee. Perforated pipe toe drains, discharge pipes into the riverside drain, and risers would be required for levee heights greater than 5 feet. In addition, a 2-foot-wide bentonite slurry trench extending downward from the design water surface elevation would be required for levee heights greater than 5 feet. The slurry trench would extend from 2 feet below the levee embankment crest to 5 feet into the foundation material. The slurry trench and toe drain system would decrease the likelihood of the levee becoming saturated during long-duration floods.

Turnarounds would be located sporadically along the levee, preferably at already disturbed locations used for spoil bank maintenance. Ramps to the riverside or maintenance road also would be replaced. Specific locations for ramps and turnarounds would be determined after further coordination with parties currently using the levee for access.

The contractor will not be permitted to construct any new haul roads for the construction of this project. Only the existing haul road adjacent to and between the existing spoil bank and the drain will be used for the construction of the levee. A relatively small amount of surplus material will be stockpiled during construction of a given levee segment. Short-term stockpiles will be located within the disturbed footprint during construction of a given segment. Long-term stockpiles will only be located at staging areas or previously disturbed sites outside of the floodway. On certain reaches a waterside earthen bench is present and staging could take place on either the landside or riverward of the levees; however any riverward use would be restricted to the approved construction season and mandatory environmental safeguards would be strictly enforced.

#### 2.2.3 Vegetation Management Zone

The Corps' Engineer Technical Letter 1110-2-583 (30 April 2014) provides guidelines to assure that landscape planting and vegetation management provide aesthetic and environmental benefits without compromising the reliability of levees. The vegetation management zone requires that no vegetation, other than approved grass species, be allowed to grow on the levee. A “root-free zone” within 15 feet of the riverward and landside toes of the levee assures that the roots of woody vegetation would not penetrate and weaken the levee structure. During construction, existing vegetation would be removed adjacent to the riverward and landside toes by clearing and grubbing, and root-plowing where salt cedar occurs. Since the landward side of the levee is currently maintained as an access road very little vegetation exists. Following construction, disturbed soils including the levee side slopes would be seeded with native grass species to prevent wind and water erosion. A 15-foot-wide vegetation management zone approximately

87.5 acres in size along the length of the proposed levee would be permanently maintained to be devoid of any vegetation other than grasses. Vegetation management zones would be mowed, when dry, and any time the grass reaches a height of 12 inches. Mowing would be triggered by grass heights of less than 12 inches if important to the health maintenance of the particular grass species.

### 2.2.4 Structures to Accommodate Return Flow to River

The recommended action includes construction of concrete culverts through the levee at the Atrisco Riverside Drain (Isleta West Unit), the 240 Wasteway and the Lower Belen Wasteway (Belen West Unit), and the Peralta Main Canal (Belen East Unit). The culverts will be gated to regulate flow from the wasteway canals back into the Rio Grande.

### 2.2.5 Levee Riprap Slope Protection

The total volume of riprap protection on the levee slope would be approximately 42.5 acre-ft, with 0.99 acre-ft of riprap used around culverts. The 35% design drawings protection (Appendix C, Sheet C-142) describe levee slope protection. The levee riprap slope protection where needed, for all units will be 2.5 feet thick and keyed at the toe for a depth of 3 feet. The levee riprap slope protection will be begin 2 feet from the top of the levee.

Coloration for rock used for riprap would vary; however, suitable material in the local area consists of dark colored basalt or grey metamorphic rock. Jetty jacks are currently located in and around the proposed action area and would continue to provide erosion protection to the proposed action.

### 2.2.6 Material Quantities and Waste Spoil

The existing spoil bank was built from material excavated by MRGCD during the construction of the riverside drain system. The volume of material in the existing spoil bank therefore has no correlation to the volume of material needed for the proposed engineered levee, which is designed to accommodate the mean water surface elevation of the 1%-chance flood event. After construction of the proposed levee, a large amount of excavated spoil material would remain unused. Hauling the waste spoil to a disposal location can be more expensive than incorporating that material into a larger levee structure. A levee which is larger than needed to accommodate the 1%-chance flood event could therefore be more cost-effective. As required for all Corps-built flood risk management projects, the proposed levee was designed to maximize National Economic Development (NED) benefits. The cost of increasing the levee’s height in one-foot increments was evaluated relative to the increment benefit of reduced flood damages afforded by the taller levee. NED benefits were maximized by a levee structure 4 feet taller than the 1%-annual chance event (ACE) structure in the Mountain View and Isleta West Units, and 5 feet taller than the 1%-chance event structure in the Belen East and West Units. Still, a significant amount of spoil material requiring disposal results from the proposed levee’s design.

The amount of excavation, usable soil material, and disposal requirements of the proposed action will be updated in the GRR/SEIS. The proposed levee would use approximately all of the suitable excavated material. Unusable excavated materials for disposal are estimated at 310,094 cubic yards.

Three potential alternatives for the disposal of spoil waste would be employed in the proposed action. A number of existing borrow areas occur near the project area and could be used as disposal locations for the spoil waste generated during levee construction. The Corps would evaluate the cost effectiveness of utilizing these disturbed areas as disposal locations. Only locations that are devoid of significant ecological or cultural resources would be utilized.

**Table 1. Excavation and disposal quantities for the proposed action.**

| Levee Unit | Total Excavation (cubic yards) | Total Borrow Fill (cubic yards) | Total Disposal (cubic yards) | Pervious Fill Needed (cubic yards) | Riprap (cubic yards) |
|---|---|---|---|---|---|
| Mountain View | 309,273 | None | 30,927 | 54,268 | 6,889 |
| Isleta West | 139,563 | 9,075 | 13,956 | 17,333 | 5,921 |
| Belen East | 1,237,529 | 722,748[a] | 123,753 | 119,992 | 37,042 |
| Belen West | 1,262,433 | 492,069[a] | 126,243 | 228,269 | 20,296 |
| | 2,948,798 | 1,223,892[a] | 310,094 | 419,862 | 70,148 |

a. Quantities will be revised in the Supplemental Environmental Impact Statement

### 2.2.7 Project Schedule

Based on anticipated Federal funding, the total construction period for the project spans approximately 14-18 years. The current levee plan has been divided into four units to provide manageable project construction phases (Table 2). The first segment anticipated to be constructed is the Mountain View Unit. The Plans and Specifications for this unit would be initiated upon the completion and approval of the GRR/SEIS. Construction in this unit is anticipated to begin after FY 2019. Subsequent units would be constructed dependent on annual funding. Depending on the timing and seasonality of construction or presence of species of concern, construction of levee portions within a given unit may not be contiguous. Construction of concrete structures may occur prior to or after earthwork has been completed in a particular levee unit.

**Table 2. Construction Schedule for the proposed action.**

| Segment | Location | Levee length (mi) | Number of annual contracts | Fiscal Years |
|---|---|---|---|---|
| 1 | Mountain View | 4.35 | 2 | FY 2020-21 |
| 2 | Isleta West | 3.18 | 1 | FY 2022 |
| 3 | Belen East | 18.13 | 7-8 | FY 2023-2038 |
| 4 | Belen West | 22.14 | 7-8 | FY 2023-2038 |
| | Approximate total | 47.8 | 17-19 | |

### 2.2.8 Conservation Measures

The following is a list of conservation measures and stipulations that would be complied with during construction of the proposed action to protect water resources and endangered species habitat from degradation:

1. Beginning with the breeding season prior to the initiation of construction in each segment, the Corps would perform or fund annual Southwestern Willow Flycatcher and Yellow-billed Cuckoo protocol surveys along the floodway, eventually extending from Mountain View to Jarales. Annual surveys would continue until the completion of construction and would continue for three years following the phased construction of each levee unit.
2. Levee construction may occur throughout the calendar year; however, no construction would be performed within 0.25 mile of occupied flycatcher breeding territories (generally, late May through September 1). Traffic associated with construction activities may continue along the construction alignment adjacent to occupied flycatcher breeding territories. All construction equipment and large trucks would be restricted to the maintenance roads adjacent to the spoil bank and MRGCD infrastructure. The levee and/or spoil bank would serve as a buffer between this traffic and flycatchers within the floodway. Small vehicles (e.g., pickup trucks and SUVs) would occasionally travel along the top of the spoil bank / levee, as they do currently.
3. Monitor Rio Grande silvery minnow (larval, juvenile, adult) use of the inundated floodplain during spring runoff to document habitat use at the river-floodplain interface for comparison with the maximum extent of inundation. This monitoring would provide data to evaluate use of the vegetation management zone during the 10% chance runoff events.
4. All construction equipment and large trucks would limit engine noise levels to 60 dB or less.
5. Construction activities on Isleta Pueblo land would use the Isleta Pueblo Riverine Management Plan as guidelines for protecting riparian habitat.
6. Vegetation removal and clearing-and-grubbing activities would only be performed between September 1 and April 15. If needed, vegetation removal between April 15 and September 1 would only be performed if inspection by a qualified biologist determines that flycatchers and cuckoos (including both migrant and territorial birds) are not present within 500 feet of the vegetation patch to be removed.
7. Work would be performed below the elevation of the ordinary high water mark only during low-flow periods. No erodible fill materials would be placed below the elevation of the ordinary high water mark.
8. Fuels, lubricants, hydraulic fluids and other petrochemicals would be stored outside the 1%-chance floodplain, if practical. At the least, staging and fueling areas would be located outside of the floodway, landward of the existing spoil bank alignment, and at least 100 feet from any surface water or channel. All storage areas would include spill prevention and containment features.
9. Construction equipment would be inspected daily to ensure that no leaks or discharges of lubricants, hydraulic fluids or fuels occur in the aquatic or riparian ecosystem. Any petroleum or chemical spills would be contained and removed, including any contaminated soil.

10. Only uncontaminated earth or crushed rock for backfills would be used.
11. Silt curtains, cofferdams, dikes, straw bales and other suitable erosion control measures would be employed to prevent sediment-laden runoff or contaminants from entering any watercourse.
12. Use herbaceous nitrogen-fixing groundcover to stabilize levee slopes to reduce erosion, support re-vegetation, and suppress woody vegetation.
13. If appropriate, water quality would be monitored during construction to ensure compliance with state water quality standards for turbidity, pH, temperature, and dissolved solids.
14. Coordinate with Reclamation and other action agencies to spoil suitable excavated sediment from habitat restoration project onto the spoil banks for subsequent incorporation into engineered levee.
15. The Corps will conduct fish surveys in both the river and the riverside drains of the proposed project area ahead of design and construction. Data from these survey will be used to refine environmental protection measures.
16. The Corps will provide an annual report on progress to the Service during the construction period of the proposed action. Copies of the report will be furnished to the project sponsors, and pertinent Federal and local resource agencies. Annual reports will include:

- A summary of construction activities performed during the preceding year.
- A description of construction activities anticipated in the upcoming year.
- A description of refinements in design or construction activities, if any.
- A description and evaluation of Conservation Measures employed.
- A summary of the status of listed species, including the results of species-specific surveys.
- A description and evaluation of compliance with Reasonable and Prudent Alternatives in the Programmatic Biological Opinion, and with stipulations in its associated Incidental Take Statement.
- The status and success of mitigative re-vegetation measures and associated results of monitoring activities.

### 2.2.9 Operation and Maintenance

Upon completion of each functional segment of the new levee, that portion of the project would be turned over to the project sponsor, MRGCD, for operations and maintenance (O&M). The Corps would provide the MRGCD with a manual describing the duties necessary for proper O&M of the segment, and the entire project.

In general, O&M would consist of maintaining the vegetation management zone free of woody vegetation larger than 0.5-inch-diameter stems or trunks. MRGCD would be responsible for maintaining levee integrity by repairing runoff erosion, eliminating rodent burrows in the levee, replacing riprap lost in flow events, and inspecting and cleaning seepage infrastructure regularly. The Corps and MRGCD also would perform annual inspections of the levee system.

### 2.2.10 Monitoring and Reporting

Several of the Conservation Measures in Section 2.2.7 of this BA include construction and monitoring activities that would avoid or minimize the potential for adverse effects during construction and would serve to avoid or minimize direct effects to listed species. Qualified biologists would monitor all construction activities. Information resulting from these surveys would be used to update resource conditions, avoid direct effects from construction activities, and to revise the determination of effects of the proposed action, if needed.

Construction contracts will include warranties or performance standards for the establishment of vegetation. For seeding, the requirements will specify that planted areas will exhibit vigorous growth after a one-year establishment period. Requirements typically will include stem density or percent cover measures which the Contracting Officer will use to verify that the performance standards have been, or have not been, met. Any additional planting activities to meet the performance standard will be performed at the contractor's expense. The stem density or percent cover criteria included in each contract will vary depending on location-specific soil and moisture conditions, as well as the specified seed mix. For woody plantings (trees and shrubs), the performance standard will require at least 85% survival of planted material at the end of the third growing season following planting. If survival is less than this criterion, the contractor will install additional plantings to assure at least 85% living trees or shrubs.

The success of mitigative re-vegetation measures will be based on the acceptable development of vegetation and its likelihood of continued development into a mature stand. Monitoring will be conducted by the Corps once each year during the summer growing season for five years following planting. Monitoring requirements beyond five years (to be determined during ongoing consultation and coordination) would be conducted by the project sponsor.

Avian utilization of re-vegetated areas will be documented through variable-distance point counts Ralph et al., 1993; Martin et al., 1997; Bibby et al., 2000; Buckland et al., 2001), and vegetation characteristics will be measured using commensurate methods (James and Shugart, 1970; Noon, 1981; Martin et al., 1997). Photographs will be taken at permanently established photo points.

## 2.3 Consideration of Related Actions

In addition to activities authorized, funded, or carried out by Federal agencies, Section 7 consultation regulations also require agencies to consult on interrelated and interdependent actions. Interdependent actions are those having no independent utility apart from the proposed action (defined in 50 CFR §402.02). Interrelated actions are those actions that are part of a larger action and depend on the larger [proposed] action for their justification (defined in 50 CFR §402.02).

When determining the proposed action for this consultation, the Corps carefully considered the water management activities of non-Federal and other Federal entities in the action area. None of the water management activities of other entities met the statutory criteria for inclusion.

# 3 - Environmental Baseline

## 3.1 Law and Regulation

Under Section 7(a)(2) of the ESA, agencies are required to consult with the Service to insure a proposed action is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of habitat. Defining the effects of an agency's action first requires consideration of the environmental baseline. As defined in 50 CFR §402.02, environmental baseline includes the past and present impacts of all Federal, State, Tribal, or private actions and other human activities in the action area; the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early Section 7 consultation; and the impacts of State and private actions that are contemporaneous with the consultation in progress. This regulation further states that effects of the agency's action only includes those effects which will be *added* to the environmental baseline. In addition, under the provisions of Section 7(c) of the ESA, a federal agency is not required to assess the effects of projects constructed prior to November 10, 1978, the date of the enactment of the ESA. Finally, for each species, the environmental baseline describes its current status and its habitat in the action area as a point of comparison to assess the effects of the action now under consultation. Therefore, by regulation, an accurate assessment of the agency's action must include an accurate definition of environmental baseline, and *exclude* those baseline effects.

## 3.2 Application of Regulatory Criteria

### 3.2.1 Description of Habitat in the Action Area

The baseline habitat consists of the floodplain and river channel within the floodway bordered by the spoil piles (Figure 1) on both sides of the Rio Grande from the South Diversion Channel downstream nearly to the Bosque Bridge (Highway 346).

*Physical Setting*

The proposed action is located within the Middle Rio Grande, a 219-mile-long reach of the river in New Mexico extending from Velarde to Elephant Butte Reservoir. In this reach, the historical floodplain is entrenched in an alluvium-filled rift valley that ranges from less than 1 mile to about 12 miles wide. The Rio Grande floodway has been delineated by the existing spoil banks constructed by MRGCD as early as the 1930s. Due to the fact that the spoil banks have been in place in most cases for over three-quarters of a century, the environmental baseline correctly excludes ongoing effects of the existing spoil banks. The only impacts properly attributable to the proposed action are those associated with the incremental difference between the existing spoil banks and the proposed engineered levee units.

The area for habitat analysis is the current floodway (~7000 acres) within the spoil banks. The Principal tributaries to the Rio Grande below Cochiti Dam are Galisteo Creek, Rio Jemez, Rio Puerco, and Rio Salado. The project area extends from South Diversion Channel on the north side of the Mountain View Unit, downstream through Isleta Pueblo, Los Lunas, and the railroad bridge near Belen, New Mexico. One alternative extends 5 miles downstream of the railroad bridge along the west bank. The Mountain View, Isleta, and Belen Units are located in

Bernalillo and Valencia Counties, New Mexico. This area includes off-channel wetlands, riparian woodlands, floodplain farmland, river terraces and piedmont (bajada) surfaces covered in grasses and shrubs. The basalt-capped mesas, and nearby mountains characterize a cross-section of the rift from the river to the adjoining uplands. The floodplain and bordering terraces are mostly rural and used for irrigated farmland, livestock grazing, and wildlife conservation.

The cities of Los Lunas and Belen are major municipalities, with smaller communities scattered throughout the project area. Most communities are unincorporated. Isleta Pueblo, Los Lentes, Los Lunas, Los Chavez, Belen, Bacaville, Jarales and Pueblitos are located west of the Rio Grande. The communities of Mountain View, Bosque Farms, Peralta, Valencia, Tome, Adelino, La Constancia and Madrone are located east of the bank of the Rio Grande.

Agriculture fields of alfalfa or hay and mini-farms still remain along the existing levees. The Isleta Pueblo is almost completely rural with housing generally scattered throughout, the main housing area being the actual pueblo itself and with a few businesses found along the major paved roads. The Belen East and West Units have substantial municipalities along both banks of the Rio Grande with the remainder of the floodplain consisting of agricultural fields of mainly alfalfa or hay, scattered housing developments, mini-farms and businesses.

Historically, the segment of the Rio Grande in the proposed action area was a large, braided, and meandering river system with a diversity of channels, oxbows, and marshes, influenced by cycles of frequent floods and periodic channel desiccation. Conversion of riparian areas to farmland and diversion of water for irrigation began as early as AD 1350, and peaked about 1880, when an estimated 125,000 acres in the Middle Rio Grande Valley were in cultivation (Scurlock 1998). Tree harvest for fuelwood and building materials, first by the Pueblo people and later by early European settlers, further depleted the larger woody riparian vegetation. The introduction of exotic (non-native) trees and shrubs, including Russian olive, saltcedar, and Siberian elm, which started during the late nineteenth century, created habitat competition for the native species. Large-scale grazing has been important in the valley since the 18th Century. Collectively, these activities narrowed the bosque, reduced and altered the species composition of its woodlands, and increased the sediment yield from the watershed (Crawford *et al. et al.* 1993). There is evidence that drier climatic conditions also affected the watershed's sediment yield by reducing vegetation ground cover (Lagasse 1980), a phenomena that may increase with climate change.

*Geology and Soils*

The project area lies within the Albuquerque Basin, the largest of a series of complex structural basins collectively forming the Rio Grande Rift tectonic province. The basin is bounded to the west by the Albuquerque Volcanoes and to the east by the Sandia and Manzano Mountains. Basin formation was contemporaneous with the uplift of the Sandia-Manzano-Los Pinos easterly dipping fault block range. As this fault block range was uplifted, detritus from the highlands washed into the basin to comprise what is now a relatively unconsolidated and inter-bedded sequence of gravel, sand, silt, clay, caliché and volcanic deposits known as the Santa Fe formation. The Rio Grande transports sediment eroded from mountains to the north and the east. The floodplain on either side the Rio Grande is filled with Quaternary sediments ranging from clay to gravel size.

Rifting (extension and uplifting) began in the region approximately 36 million years ago resulting in a central valley surrounded on both sides by faulted, upthrown mountain ranges. The rift valley itself is segmented by faults, with different structural basins (half grabens) tilted strongly to the east or west depending on the location of the master structural faults (Keller and Cather 1994). The Tertiary Datil Volcanic Field borders the project area to the west. Silic and andesitic volcanic rocks of the Datil field overlie older Mississippian, Pennsylvanian, and Permian sedimentary rocks (Keller and Cather 1994). The Socorro, Magdalena, and San Mateo mountains that bound the western part of the study area are composed of uplifted, faulted blocks of Datil volcanic and older sedimentary rocks (Keller and Cather 1994).

As uplift and volcanism occurred, sediment eroded from the highlands and was washed into the basin producing a complex sequence of gravel, sand, silt, clay, and volcanic deposits known as the Santa Fe Formation. Much of the Santa Fe Formation is overlain by unconsolidated Quaternary alluvium and locally thick piedmont detritus. The thickness of the deposits in the deeper parts of the basin is estimated at 15,000 feet. Soils within the proposed action area are generally silty sands and sandy clays.

Typical alluvial deposits and soils are quite variable and discontinuous. Foundation materials along the proposed levee alignment are generally sands, silty sands, and sandy clays. These foundation soils are generally considered suitable provided adequate preparation is provided at locations of identified low-density material. Weak clay layers composed of high-plasticity clay are also present in the foundation. Exploration indicates that the layers are generally randomly located, are relatively thin, and have sand layers above and below that allow dissipation of excess pore pressures upon construction of the new levee, leading to consolidation and increased strength. During construction of the new levee, soft clay layers near the foundation surface can be over-excavated and removed. Lower layers of existing spoil bank foundations have been previously consolidated by the upper layers placed on the existing spoil bank; therefore, only the weight of fill required to increase the height of the existing spoil bank would contribute to additional consolidation and settlement of the foundation. Since in most cases the new levee would be smaller than the existing spoil bank, consolidation and settlement of the foundation is considered to be minimal for the project. Areas where the new levee height is greater than the spoil bank would be evaluated for potential consolidation or settlement issues by analysis of the boring logs at those locations. The levee section would be overbuilt at locations where consolidation or settlement is deemed an issue by further analysis.

#### *Hydrology and Hydraulics*

The Rio Grande watershed upstream of Albuquerque is comprised of 17,440 square miles. Of the total watershed upstream of Albuquerque, Cochiti, Jemez, and Galisteo Dams regulate 16,535 square miles. Downstream of these structures, the remaining 900 square miles are unregulated and contribute directly to flooding in the Rio Grande floodway in Albuquerque.

The “Middle Rio Grande Flow Frequency Study” by the USACE Hydrologic Engineering Center (HEC), June 2006, studied flood frequencies for the Rio Grande at the Central Avenue Bridge, where the Albuquerque gage is located. The HEC Middle Rio Grande flow frequency is a combined frequency based on regulated flood flows from the reservoirs upstream of Albuquerque, predominantly snowmelt floods, and flood flows from unregulated local areas downstream of the reservoirs, primarily from rainfall runoff. The Albuquerque levee was designed prior to Cochiti Dam being constructed. The design flow for the Albuquerque levee was 42,000 cfs. The present day probability of a flow of 42,000 cfs is significantly different than it was before the dams were put into operation. The probability of a flood flow of 42,000 cfs was determined by extrapolating it from the combined frequency curve. It is 0.000168, and the return period is 5,950 years.

*River Geomorphology and Sedimentation*

Present water management in the Middle Rio Grande valley was implemented as a result of the 1948 authorization for the Rio Grande Floodway includes flood risk and sediment management dams and reservoirs, irrigation storage reservoirs, levees, channel maintenance, irrigation diversions, drainage systems, and runoff conveyance systems. In addition, the river has been laterally stabilized in the floodplain by the installation of jetty jacks in the 1950s and 1960s (Crawford *et al. et al.* 1993). River sediment loads and debris settled in the jacks, creating stable banks and a riparian zone of cottonwood, Russian olive, willow, and saltcedar (Crawford *et al. et al.* 1993). All these activities affect channel morphology through alterations in discharge and sediment load. The river discharge influences the size of the channel, whereas the type of material transported influences the character of the channel. The existing spoil bank limits meandering to the area within the floodway between the spoil banks and controls the degradation/aggradation process. The increased vegetation hastens aggradation/accretion in the overbanks through increased roughness and lowered velocities and energy. The channel and overbank elevations were relatively stable for the entire reach. The current status of the channel morphology is a result of these earlier and ongoing activities and water management.

*Existing Condition Hydraulic Models*

The Rio Grande in the study area is characterized by setback non-engineered spoil banks that contain the floodway. The non-engineered spoil banks have been in place for approximately three-quarters of a century, and in that period of time sediment has deposited between them.

FLO-2D is a 2-dimensional hydraulic model used for without-project conditions to evaluate flooding once flows leave the river channel and move onto the floodplain. The URGWOPs FLO-2D model extends upstream and downstream of the project area, and is used by multiple agencies for evaluating and coordinating reservoir releases. Due to FLO-2D model updates, flows found in the hydraulic analysis do not precisely match those given previously in the Hydrology Analysis. However, the magnitudes are very similar and do not affect the conclusions.

*Existing Condition Floodplains*

The hydrology for the study area is a combined frequency that is based on Albuquerque hydrology (separate snowmelt and rainfall-runoff hydrographs) and rainfall-runoff flooding from the Albuquerque South Diversion Channel which includes the Tijeras Arroyo. Flooding in the study reach is dominated by one of the three sources of flooding at any given location: (1) regulated spring snowmelt runoff floods (2) unregulated and primarily rainfall-runoff floods, or (3) rainfall-runoff from the Albuquerque South Diversion Channel (SDC). Therefore, to adequately model the floodplains, it was necessary to model all three floods for each frequency event for a total of 15 scenarios. Five frequencies were modeled: the 10%-chance flood, the 2%-chance flood, the 1.0%-chance flood, the 0.5%-chance flood and the 0.2%-chance flood.

*Hydrology and Flooding*

Frequency flood events for three sources of flooding (regulated and unregulated floods in Albuquerque and floods from the SDC) were routed downstream in the Rio Grande to evaluate the characteristics of these floods as they move through the project area. A FLO-2D model was used for routing flood flows for the Rio Grande between the Rio Grande gage at Central Avenue in Albuquerque and the Rio Grande gage at Bernardo. The without-project scenario for the hydrologic routing model represents existing conditions. The spoil banks were removed from the model, to reflect the assumption that non-engineered structures will not retain their structural integrity in a flooding situation. A second model scenario represents with-project conditions. It is essentially the same model, but the proposed levee is represented in the model data, to evaluate flood conditions with the proposed action.

Surface flows of the Middle Rio Grande are of two general types: snowmelt runoff and stormwater runoff. Snowmelt runoff generally occurs from April through June as a result of snowmelt, which may be augmented by general precipitation (USACE *et al.* 2007). Spring flows are characterized by gradual rises to moderate discharge rates, large runoff volumes, and approximately two-month-long flow durations, with shorter duration peak flows included. Since it was completed in 1975, flow regulation upstream at Cochiti Dam substantially limits potential for spring flooding through the proposed action area.

Stormwater runoff is typified by summer monsoonal flash flows that may occur from May through October. Summer monsoon flows are characterized by sharp, high peak flows that recede quickly and generally contain smaller runoff volumes (USACE *et al*. 2007). The potential for significant floods within the proposed action area originating through either of these tributary watersheds remains largely unaltered from historical flood potentials. Currently, flows above 7,000 cubic feet per second (cfs) through the Middle Rio Grande valley are considered flood flows. During years of low snowmelt runoff and precipitation, surface flows in the main channel of the river can be eliminated for extended periods because of irrigation or water delivery diversions. The river channel below Isleta can be dry for several months due to upstream diversions during the irrigation season (USACE *et al.* 2007).

There are two different methods commonly used for referring to the likelihood or frequency of a flood event of a specific magnitude. In the past, the Corps has used periods of time (e.g., the 100 year-event) to describe a flooding event that is expected to happen on the order of once every 100 years. However, this convention is somewhat misleading because a 100-year-event can happen multiple times within a single century. For that reason, the description of these flooding events has been updated to reflect the percent chance that these events have of being equaled or exceeded in any given year. For example, the 100-year-event has a 1% chance of occurring or being exceeded any given year. The Corps used hydrologic routing models to predict flood routing and magnitudes at various cross-sections in the action area without construction of the proposed levee. Table 3 includes flood peaks predominantly associated with the snowmelt flood events.

**Table 3. Peak flows for the Rio Grande gage in Albuquerque (at Central Avenue) both from stream regulated areas and upstream unregulated areas.**

| Recurrence Interval | % Chance Exceedance | Flood Events from Regulated Areas- Peak Flows in cfs | Flood Events from Unregulated Areas- Peak Flows in cfs |
|---|---|---|---|
| 0.5 | 50 | 5600 | 5260 |
| 0.2 | 20 | 7380 | 8100 |
| 0.1 | 10 | 7510 | 10300 |
| 0.02 | 2 | 7750 | 16100 |
| 0.01 | 1 | 7750 | 18900 |
| 0.005 | 0.5 | 10300 | 22100 |
| 0.002 | 0.2 | 14300 | 26700 |

### *Flood Frequency for the South Diversion Channel at its Confluence with the SDC*

Because the hydrologic model results are reasonably consistent, it was concluded that a composite of the model results could be used to estimate South Diversion Channel flows entering the Rio Grande. The purpose of this study is to evaluate flood reduction alternatives for the Rio Grande. Table 4 shows peak flow frequency values for the South Diversion Channel used for this study.

**Table 4. Peak Flood Flows Entering the Rio Grande from the Tijeras Arroyo.**

| Recurrence Interval | % Chance Exceedance | Peak Flow (CFS) | Notes |
|---|---|---|---|
| 0.5 | 50 | 1560 | From The 1990 City Of Albuquerque Hydrology |
| 0.2 | 20 | 4200 | Graphical Solution |
| 0.1 | 10 | 6285 | From The 1990 City Of Albuquerque Hydrology |
| 0.02 | 2 | 14300 | FEMA 2003 (Coincides W Graphical Solution) |
| 0.01 | 1 | 18065 | From The 1990 City Of Albuquerque Hydrology |
| 0.005 | 0.5 | 26000 | Graphical Solution |
| 0.002 | 0.2 | 37000 | From The 1979 Corps Of Engineers Hydrology |

*Ecoregion*

The ecology of the valley is conditioned by the Great Basin Grassland, Semidesert Grassland, and Chihuahuan Desert Scrub biotic communities through which the river flows (Crawford *et al. et al.* 1993). The major plant communities in the active floodplain of the Middle Rio Grande Valley include woodlands, shrublands, grasslands, and emergent wetlands (Tetra Tech 2004). Vegetation mapping produced by Parametrix (2008) has been used to quantitatively characterize the vegetation composition and is the most complete digitized coverage available to date.

The proposed action area has an arid to semi-arid continental climate characterized by light precipitation, abundant sunshine, low relative humidity, and wide diurnal and annual range of temperature (Crawford *et al. et al.* 1993). Summer daytime temperatures can exceed 100 degrees Fahrenheit (°F). Average maximum temperatures in January range from the upper 30°F range to the upper 40°F range. Temperatures below freezing are common during the winter. Relative humidity is usually low, mitigating considerably the effects of the temperature extremes in both winter and summer. Humidity during the warmer months is below 20% much of the time. Wind speeds are usually moderate; however, relatively strong winds often accompany frontal activity in late winter and spring, and may exceed 30 miles per hour for several hours. Sources of these moisture-laden air masses are the Pacific Ocean and the Gulf of Mexico. Average annual precipitation is less than 10 inches throughout the proposed action area. Approximately 50% of the annual precipitation occurs during the three-month period of July through October, usually as brief, intense thunderstorms. Winter precipitation, most of which comes from the Pacific Ocean, falls primarily in connection with frontal activity associated with the general movement of storms from west to east. In winter and spring, moisture transported from the Pacific by westerly winds can be amplified by the El Niño/La Niña phenomenon, which ties regional precipitation to global climate (Crawford *et al. et al.* 1993).

*Existing Floodplain*

The current floodplain area bounded by the spoil banks constructed during the 1930s by MRGCD is the baseline area for species and habitat analysis (Figure 1). The riparian ecosystem consists of cottonwood gallery forest, with invasive salt cedar (*Tamarix ramosissima*), Russian olive (*Elaeagnus angustifolia*), and Siberian Elm (*Ulmus pumila*). The riparian habitat was classified based on Hink and Ohmart (1984; Table 10) with the most recent coverage mapped in 2012 (Siegle *et al.* 2013). Scurlock (1998) has summarized trends for historic Rio Grande riparian communities over the last 150 years.

The baseline habitat in the proposed action area comprises approximately 5633 acres with an additional 1766 acres of wetted river channel at winter base flows (Table 10). Native bosque vegetation (27.6%) comprises about 1055 acres of the forest with another 3874 acres of mixed native and invasive vegetation (68.8%). Approximately 3.6% of the proposed action area is classified as roads or irrigation infrastructure (203 acres).

#### 3.2.2 Past and Present Impacts of All Federal, State, Tribal, Private or Other Human Actions

The Rio Grande in the study area is currently characterized by setback spoil banks that contain the floodway that have been in place for more than 75 years (Figure 1). Prior to the formation of the MRGCD in 1925, site-specific irrigation and flood protection structures, mainly community specific acequias, were already in place. However, the first formal, organized attempt at flood risk management began with the MRGCD. From 1930 to 1935, the MRGCD constructed 190 miles of spoil banks (non-engineered levees) in the middle Rio Grande valley as part of their district wide plan to drain the valley farmlands and to provide flood protection. The spoil banks from Bernalillo to San Acacia, New Mexico date to this time.

The Rio Grande is culturally important to the pueblos for their history, religion, and way of life. Pueblo (tribal) communities were established from 400 to 1600 AD prior to Spanish exploration in the region, and Native American occupation and use of the Rio dates back some 10,000 years. For centuries, the pueblos have used the floodplain and uplands in the Middle Rio Grande for their residences, farming (both on the floodplain and in the uplands), hunting and gathering, religious practices and ritual purposes.

All past and current effects of the confinement of the Rio Grande channel due to construction of the spoil banks associated with the irrigation infrastructure and river canalization are accurately attributable to environmental baseline.

### 3.2.3 Recent and Contemporary Actions

*U .S. Army Corps of Engineers*

The Corps originally consulted on the effects of levee construction in the San Acacia reach downstream of the project area (USACE 2013a; Service 2013c). The consultation evaluated the effects of levee construction actions on Federally-listed species and designated critical habitat within the middle Rio Grande valley of New Mexico. Consultation was reinitiated in 2015 when the Corps supplemented its programmatic biological assessment to include newly-listed species (USACE 2015). Consultation concluded with the Service’s issuance of its Programmatic Biological and Conference Opinion (Service 2016).

The Corps has also consulted on Middle Rio Grande Bosque Restoration Project in Bernalillo and Sandoval Counties (USACE 2010; Service 2011a). This restoration project overlaps the Mountain View Unit for the currently proposed project.

*U. S. Bureau of Reclamation*

Maintenance of the current channel alignment and repairs to threatened portions of the existing spoil banks are conducted by the Bureau of Reclamation (Reclamation) through its River Maintenance Program. This program has been consulted upon in 2001 and 2003 (Service 2001, 2003b). Due to the timeframes associated with the Service’s 2003 Biological Opinion, Reclamation (Reclamation 2015) submitted a new biological assessment that addresses its water management operations, including spoil bank maintenance, in the Middle Rio Grande. This assessment includes spoil banks that will be replaced with engineered levees that are the subject of this proposed action. Reclamation’s 2015 BA also assessed the actions of its non-federal partners, including MRGCD. A description of MRGCD’s maintenance program for the existing spoil banks is also included in Reclamation’s 2015 BA. Conservation measures are proposed by Reclamation, MRGCD, the State of New Mexico and other non-federal partners, such as the Albuquerque-Bernalillo County Water Utility Authority. Offsetting actions taken by participants of the Middle Rio Grande Endangered Species Collaborative Program are also described.

*Rio Grande Compact*

Water uses on the Middle Rio Grande must be conducted in conformance with the Compact administered by the Rio Grande Compact Commission. The four-member Commission is composed of Commissioners from Colorado, New Mexico, and Texas, as well as a Federal representative who chairs Commission meetings. Colorado is prohibited from accruing a debit, or under-delivery to the downstream States, of more than 100,000 ac-ft, while New Mexico's accrued debit to Texas is limited to 200,000 ac-ft. These limits may be exceeded if caused by holdover storage in certain reservoirs, but water must be retained in the reservoirs to the extent of the accrued debit. Any deviation from the terms of the Compact requires unanimous approval from the three state Commissioners.

In order to meet delivery obligations under the Compact, depletions within New Mexico are carefully controlled. Allowable depletions above Otowi gage (located outside of Santa Fe, near the Pueblo of San Ildefonso) are confined to levels defined in the Compact. Allowable depletions below Otowi gage and above the headwaters of Elephant Butte Reservoir are calculated based on the flows passing through Otowi gage. The maximum allowable depletions below Otowi gage are limited to 405,000 ac-ft in addition to tributary inflows. In an average year, when 1,100,000 ac-ft of water passes the gage, approximately 393,000 ac-ft of water is allowed to be depleted below Otowi gage, in addition to tributary inflows. Depletion volumes are lower in dry years. For instance, in 1977, allowable depletions were 264,600 ac-ft in addition to tributary inflows. No Indian water rights may be impaired by the State's Compact management activities.

*State of New Mexico*

The State of New Mexico has a wide range of agencies that actively represent different aspects of the State's interest in water management:

*New Mexico Office of the State Engineer*

The New Mexico State Engineer has general supervision of the waters of the State and of the measurement, appropriation, and distribution thereof (N.M. Stat. Ann. 72-2-1 Repl. Pamp. 1994). The Office of the State Engineer (OSE) grants state water rights permits, ensures that applicants meet state permit requirements, and enforces the water laws of the State. The OSE is responsible for administering water rights, including changing points of diversion and places or purposes of use. The OSE uses the "Middle Rio Grande Administrative Area Guidelines for Review of Water Right Applications" to assess the validity and transfer of pre-1907 water rights.

*New Mexico Interstate Stream Commission*

The New Mexico Interstate Stream Commission (NMISC) is authorized to develop, conserve, protect and to do any and all things necessary to protect, conserve, and develop the waters and stream systems of the State. It is responsible for representing New Mexico's interests in making interstate stream deliveries, as well as for investigating, planning, and developing the State's water supplies. The State cooperates with Reclamation to perform annual construction and maintenance work under the State of New Mexico Cooperative Program. In the past, this work has included some river maintenance on the Rio Chama, maintenance of Drain Unit 7, drain and canal maintenance within the BDANWR, similar work at the state refuges, and temporary pilot channels into Elephant Butte Reservoir.

*New Mexico Department of Game and Fish*

The New Mexico Department of Game and Fish (NMDGF) administers programs concerned with conservation of endangered species and of game and fish resources. It also manages the La Joya Wildlife Management Area and Bernardo Wildlife Area.

*New Mexico Environment Department*

The New Mexico Environment Department (NMED) administers the State's water quality program including compliance with various sections of the Clean Water Act. Section 303 of the Clean Water Act allows NMED to establish water quality standards for water bodies and total maximum daily loads for each pollutant. Section 402 of the Clean Water Act includes the National Pollutant Discharge Elimination System Storm Water Permit Program.

*Counties*

All counties that border the Rio Grande and Rio Chama and their respective tributaries perform actions or can perform actions that may at least indirectly affect these rivers. The primary area in which county actions may influence water management is providing for general development and infrastructure of these counties, and activities may include pumping of wells or land-use regulations within the immediate Middle Rio Grande watershed.

*Villages, Towns, and Cities*

Citizens in a multitude of villages, towns, and cities are served with municipal and industrial water systems. While most use groundwater exclusively, Santa Fe also uses surface water supplies, and both the cities of Albuquerque and Santa Fe use San Juan-Chama surface water in addition to groundwater. To the extent that future groundwater pumping or use of surface water depletes the river, the New Mexico State Engineer requires that these depletions be offset, either by acquiring other water rights or with San Juan-Chama Project water. Many of these contractors have voluntarily entered into annual lease programs with Reclamation to enhance Middle Rio Grande valley water management. Municipalities also manage wastewater treatment systems that are point source discharges into the Rio Grande. Municipalities also release storm water discharge into the Rio Grande.

*Irrigation Interests*

Irrigation interests include a variety of the acequias, pueblos, individual irrigators, and ditch associations, as well as the MRGCD, which have water rights to divert the natural flow of the Rio Grande for beneficial use and then return unused water to the Rio Grande. Many of these irrigation interests have existed for hundreds of years. The MRGCD was established under state law in 1928, to address issues such as valley drainage and flooding, and currently operates the diversion dams of the Middle Rio Grande Project to deliver irrigation water to lands in the middle valley, including areas on six pueblos.

## 3.3 Summary of Environmental Baseline Conditions Excluded from Agency Action

Impacts attributable to environmental baseline may affect listed species, but are not attributable to the current agency action. Unlike many construction projects undertaken by the Corps, the proposed action simply replaces existing, structurally unpredictable spoil banks with an engineered levee system that has quantifiable risk. Even if the proposed engineered levees were never constructed, the spoil banks would continue to exist. Accordingly, the effects ascribed to the spoil banks cannot reasonably be said to cause any modification to the land, water or air within the meaning of ESA regulations. For this reason, these effects are excluded from this assessment, and only those effects caused by construction activities and the incremental change from spoil bank to engineered levee considered. The effects of the continued existence of the spoil banks are not properly attributable to the proposed agency action.

# 4 - Species Status and Life History

USACE requested information on federally listed species and habitat from the Service through the automated IPACs system (http://ecos.fws.gov/ipac), Consultation Code: 02ENNM00-2014-SLI-0302. The effects of the recommended action will be discussed for Southwestern Willow Flycatcher (*Empidonax traillii extimus*), the Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*), and Rio Grande silvery minnow (*Hybognathus amarus*) based on their observed presence and critical habitat in the project area.

## 4.1 Southwestern Willow Flycatcher

### 4.1.1 Status and Distribution

A final rule was published in the February 27, 1995, Federal Register to list the southwestern U.S. population of the Willow Flycatcher as an endangered species under the ESA with proposed critical habitat. The flycatcher also is classified as endangered (Group I) by the State of New Mexico (NMDGF 1987). The current range of the listed subspecies includes southern California, Arizona, New Mexico, southern portions of Nevada and Utah, and southwestern Colorado (Service 1995). The species is likely extirpated from west Texas (Durst *et al. et al.* 2007). A recovery plan for the flycatcher was completed in 2002 (Service 2002).

*Critical Habitat*

The original final rule designating critical habitat for the species range-wide (Service 1997) did not include the Rio Grande. A proposal to re-designate critical habitat was published in October 2004, and final designation was published October 19, 2005 (Service 2005), which did include portions of the action area in the Middle Rio Grande. In 2011, the Service again proposed to revise critical habitat for the flycatcher, and final designation was published on January 3, 2013 (Service 2013a). Within the action area, designated critical habitat occurs from the southern boundary of Isleta Pueblo downstream to Elephant Butte Reservoir. Flycatcher critical habitat consists of riparian vegetation adjacent to the floodway in the action area (Service 2013a).

*Status and Distribution in the Middle Rio Grande*

In New Mexico, the flycatcher has been observed along the Rio Grande, Rio Chama, Zuni River, San Francisco River, and Gila River. Because observations were not consistent or extensive prior to the listing of this species, a comparison of historic numbers to current status is not possible; however, the available native riparian habitat along the Rio Grande has declined, and it is assumed populations may have declined from historic numbers as well (Service 1995).

Since the initial surveys of the Rio Grande valley in the 1990s, breeding pairs have been found in scattered locations from Elephant Butte Reservoir upstream to the vicinity of Española. Several locations along the Rio Grande have consistently harbored breeding flycatchers. These areas have one or more flycatcher pairs that have established a territory in an attempt to breed. In some locations, these local populations appear to be expanding with increasing numbers of territories being detected. Some local populations have remained small (10 territories or fewer) but stable; other sites have been abandoned and no longer contain territorial flycatchers.

In the Middle Rio Grande, surveys for flycatchers in selected areas have been conducted during environmental compliance activities for various projects throughout the riparian corridor of the Rio Grande. Presence/absence surveys and nest monitoring in selected areas of the Rio Grande between Velarde and Elephant Butte Reservoir have been conducted by Reclamation from 1993 to 2014. With expanded or increased survey efforts throughout this 22-year period, several sites have been located where flycatcher territories have consistently occurred. Once located, these core breeding areas have been monitored annually. The summaries of flycatcher surveys and nest monitoring in the Middle Rio Grande from 2003 to 2014, previous consultations, and surveys conducted during the 2015 breeding season, and other pertinent data are considered the environmental baseline for breeding flycatchers within the action area. These data are further discussed below.

Since 1993, flycatchers have been reported from 19 sites within the Rio Grande basin; however, several of these sites no longer support flycatchers. The majority of sites within the Rio Grande basin support isolated populations of fewer than six territories. Elephant Butte Reservoir has consistently supported the largest subpopulation of breeding flycatchers along the Rio Grande in New Mexico. Table 5 summarizes the locations of known territories (that is, occupied by a male or pair of flycatchers) in the Upper and Middle Rio Grande Management Units from 2003 through 2015. Excluding Tribal lands, most suitable habitat has been regularly surveyed within the main stem of the Middle Rio Grande. It is highly unlikely that any large concentrations of flycatchers have gone undetected; however, sites supporting a few undetected territories may exist in some isolated patches of habitat throughout the basin. Occupied territories are more abundant in the southern half of the Middle Rio Grande (from the Sevilleta NWR south) than in the northern half. During the 2014 breeding season, 67 flycatcher territories were found within the Middle Rio Grande (Moore and Ahlers 2014). Occupied sites were scattered from Belen downstream to Elephant Butte Reservoir (approximately 100 river-miles). Section 4.1.4 discusses past and present occupation within the action area.

### 4.1.2 Life History and Ecology

*Flycatcher Breeding Chronology*

The flycatcher is a late spring/summer breeder that builds nests and lays eggs in late May and early June, and fledges young in late June or early July (Sogge *et al.* 1995, 2010; Tibbitts *et al.* 1994). When re-nesting or second broods occur, young will fledge into mid-August (Service 2002). Based on data from flycatcher surveys and nest monitoring along the Middle Rio Grande, particularly in the San Marcial reach, flycatchers have been found in the area as early as May 6; however, actual nest initiation has been documented to occur later in May (Moore and Ahlers 2014).

**Table 5. Known Southwestern Willow Flycatcher territories[a] along the Rio Grande, New Mexico, 2003-2015.**

| River Reach | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| UPPER RIO GRANDE MANAGEMENT UNIT | | | | | | | | | | | | | |
| Velarde to Rio Chama confluence | n/s[b] | 1 | 0 | 1 | n/s | n/s | n/s | n/s | n/s | n/s | n/s | n/s | n/s |
| Frijoles reach of Rio Grande | n/s | n/s | n/s | n/s | n/s | 1 | 1 | n/s | 2 | 0 | 1 | 0 | 0 |
| MIDDLE RIO GRANDE MANAGEMENT UNIT | | | | | | | | | | | | | |
| Belen Reach | n/s | 0 | 4 | 1 | 10 | 4 | 3 | 6 | 9 | 14[e] | 23[e] | 18[e] | 17[e] |
| Sevilleta reach | 17 | 19 | 17 | 21 | 14 | 31 | 18 | 13 | 9 | 6 | 4 | 4 | 8 |
| San Acacia Diversion Dam – RM 62 | 7 | 17 | 3 | 14 | 11 | 16 | 26 | 43 | 61 | 75 | 39 | 35 | 19 |
| Total | 24 | 36 | 24[d] | 36 | 35 | 51 | 47 | 62 | 79 | 95 | 66 | 57 | 44 |

[a] *"Territories" = pair or single male present in June and July surveys.*
[b] *NS = Not surveyed.*
[c] *Protocol surveys were performed only in limited areas. Anecdotal information supports its absence throughout the reach.*
[d] *High flows hampered access during surveys throughout the Middle Rio Grande.*
[e] *Includes territories in the Belen Reach that are currently downstream of the proposed action area.*

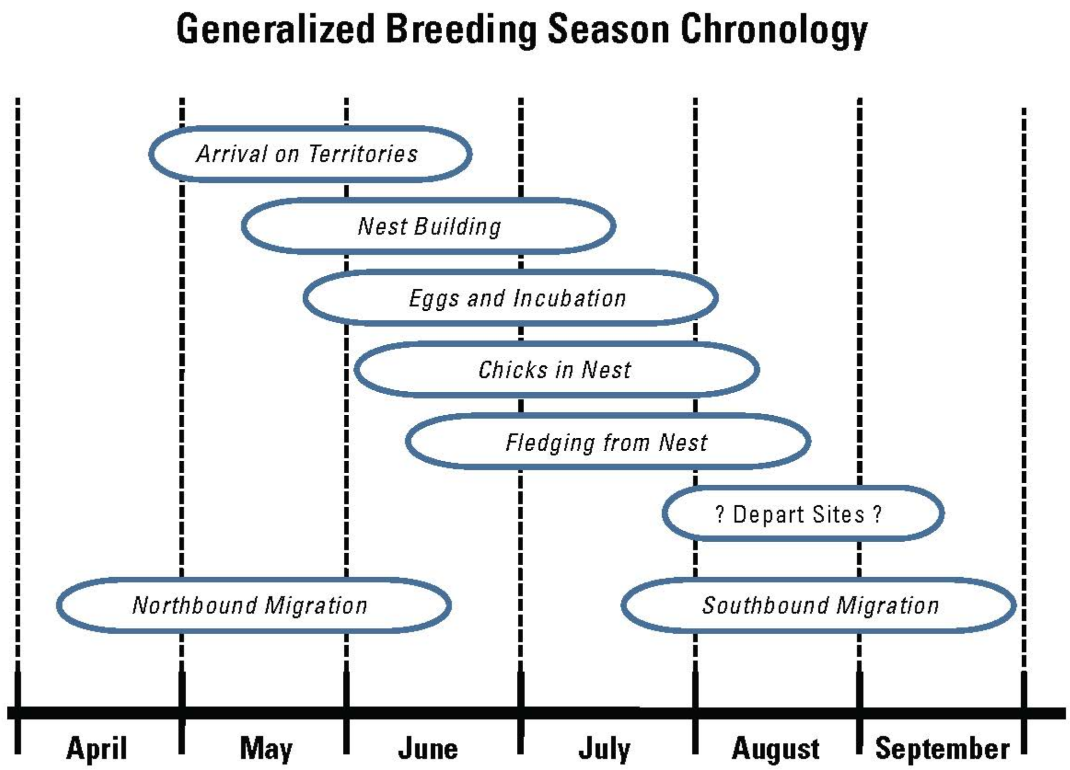



**Figure 4. Generalized breeding chronology of the Southwestern Willow Flycatcher (from Sogge *et al. et al.* 2010).**

A generalized Southwestern Willow Flycatcher breeding chronology is presented in Figure 4 and is based on Unitt (1987), Brown (1988), Whitfield (1990), Maynard (1995), Sogge (1995), Skaggs (1996), Sferra *et al.* (1997), and Sogge *et al.* (2010). Extreme dates for any given stage of the breeding cycle may vary as much as a week from the dates presented. Egg laying begins as early as late May but more often starts in early to mid-June. Young can be present in nests from mid-June through early August. Young typically fledge from nests from late June through mid-August but remain in the natal area 14 to 15 days. Adults depart from breeding territories as early as mid-August, but may stay until mid-September in later nesting efforts. Fledglings probably leave the breeding areas a week or two after adults.

Each stage of the breeding cycle represents a greater energy investment in the nesting effort by the flycatcher pair and may influence their fidelity to the nest site or their susceptibility to abandon if the conditions in the selected breeding habitat become adverse.

*Southwestern Willow Flycatcher Habitat Characteristics*

The Primary Constituent Elements (PCEs) of flycatcher critical habitat (Service 2013a) are:

1. Primary Constituent Element 1— Riparian vegetation. Riparian habitat along a dynamic river or lakeside, natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs [that can include Goodding’s willow, coyote willow, boxelder, tamarisk,

Russian olive, buttonbush, cottonwood, stinging nettle, alder, seep willow, rose, false indigo, and Siberian elm[1]] and some combination of:

a. Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 2 m to 30 m (about 6 to 98 ft). Lower-stature thickets (2 to 4 m or 6 to 13 ft tall) are found at higher elevation riparian forests and tall-stature thickets are found at middle- and lower-elevation riparian forests; and/or

b. Areas of dense riparian foliage at least from the ground level up to approximately 4 m (13 ft) above ground or dense foliage only at the shrub or tree level as a low, dense canopy; and/or

c. Sites for nesting that contain a dense (about 50 percent to 100 percent) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground);

d. Dense patches of riparian forests that are interspersed with small openings of open water or marsh or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.1 ha (0.25 ac) or as large as 70 ha (175 ac); and

2. Primary Constituent Element 2— Insect prey populations. A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, which can include: flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies, moths, and caterpillars (Lepidoptera); and spittlebugs (Homoptera).

The flycatcher is an obligate riparian species occurring in habitats adjacent to rivers, streams, or other wetlands characterized by dense patches of willows (*Salix* spp.), seep-willow (*Baccharis* sp.), arrowweed (*Pluchea* sp.), saltcedar (*Tamarix* spp.), or other species (Sogge *et al. et al.* 2010). A critical component for suitable nesting conditions is the presence of saturated soil or surface water at or near the nest site, usually provided by overbank flooding or some other hydrologic source.

Habitat patches comprised of native vegetation accounted for approximately 44% of 209 nests monitored in the Middle Rio Grande during 2013 (Moore and Ahlers 2014). Approximately 27% of these nests occurred in patches dominated by exotic shrubs and 29% were in mixed native-exotic stands. In many cases, exotics are contributing significantly to the habitat structure by providing the dense lower-strata vegetation that flycatchers prefer. Nests located at the Sevilleta NWR and La Joya State Wildlife Management Area (WMA) have been established in areas dominated by saltcedar and Russian olive; however, the overall vegetation type of most of the flycatcher territories established in the Middle Rio Grande is dominated by native species and not saltcedar (Moore and Ahlers 2005, 2008).

Many flycatcher breeding sites are composed of spatially complex habitat mosaics, often including both exotic and native vegetation. Within a site, flycatchers often use only a part of the patch, with territories frequently clumped or distributed near the patch edge. Therefore, vegetation composition of individual territories may differ from the overall composition of the

[1] Only tree and shrub species likely to occur in the action area for this consultation were included in this list.

patch (Sogge *et al. et al.* 2002).

The shrub species selected as the substrate to support the nest varies widely by site; however, species composition appears less important than plant and twig structure (Sogge *et al. et al.* 2010), as slender stems and twigs are important for nest attachment. Data collected and analyzed on nest substrate and surrounding habitat patch communities in the Middle Rio Grande (specifically in the Sevilleta NWR/La Joya State WMA, and San Marcial river reaches) indicate that flycatchers may key in on areas dominated by native vegetation, but often select an exotic shrub, particularly saltcedar, as a nest substrate. Saltcedar may be used by flycatchers' within primarily native stands of riparian vegetation. From 1999-2002, approximately 49% of 156 nests located in these river reaches were on exotic Russian olive and saltcedar (Moore and Ahlers 2008).

Nest height is highly variable and depends on the available plant structure; nests have been observed at heights ranging from 2 to 66 feet (Sogge *et al. et al.* 2010). Along the Middle Rio Grande, breeding territories have been found in young and mid-age riparian vegetation dominated by dense growths of willows at least 15 feet high, as well as in mixed native and exotic stands dominated by Russian olive and saltcedar (Moore and Ahlers 2008).

Flycatchers usually breed in areas that are saturated or are inundated by surface water for some portion of the growing season. If saturation or inundation in such suitable habitat decreases, the growth of substrate plants may be adversely affected and habitat quality may decline. The presence of surface water at or near the nest site may also affect nesting success and food availability. In some instances — *e.g.*, recent breeding sites at Sevilleta NWR — flycatchers may select areas lacking saturation or inundation, but choose areas located relatively close to surface water.

Along the Rio Grande, 95% of all flycatcher nests in the Reclamation-surveyed areas were located within 328 ft (100 m) of surface water, and 91% occurred within 164 ft (50 m; Moore and Ahlers 2008). The presence of surface water at the onset of nest site selection and nest initiation is likely critical, though not absolutely necessary.

In New Mexico, the flycatcher has been observed in the Rio Grande, Rio Chama, Zuni River, San Francisco River, and Gila River drainages. Flycatchers were first reported at Elephant Butte State Park in the 1970s, although the exact locations of the sightings were not documented (Hubbard 1987). Because surveys were not consistent or extensive prior to the listing of this species, a comparison of historic numbers to current status is not possible; however, the available native riparian habitat overall along the Rio Grande has declined, and it is assumed populations may have declined from historic numbers as well.

The Upper Rio Grande Management Unit, New Mexico, extends from the Taos Junction Bridge (State Route 520) downstream to the northern boundary of the Ohkay Ohwingeh Pueblo, and includes a 1.1 km (0.4 mi) segment of the Rio Grande between the Ohkay Ohwingeh and Santa Clara Pueblos (Service 2013a). The Ohkay Ohwingeh, Santa Clara, and San Ildefonso Pueblos (approximately 17 miles of river) are essentially excluded from the final flycatcher critical habitat designation due to their conservation efforts on the Rio Grande (Service 2013a). The Middle Rio Grande Management Unit, New Mexico, was designated as critical habitat as a 180.4-km (112.1-mi) segment of the Rio Grande from Isleta Pueblo downstream and to the upper part of Elephant Butte Reservoir (Service 2013a).

The Service discussed the benefits of excluding Isleta Pueblo from designated flycatcher critical habitat (Service 2013a). The pueblo has shown that by managing their resources to meet their traditional and cultural needs, they also address the conservation needs for the flycatcher and other species that may be listed. The pueblos employ tribal members who work on holistic habitat improvement and management, including endangered species and their habitat (Service 2013a).

In the Upper and Middle Rio Grande Management Units, surveys for flycatchers in selected areas have been conducted during environmental compliance activities for various projects. Flycatcher surveys in the project area are conducted by the sponsors, in partnership with the Service. Although a systematic survey effort throughout the entire riparian corridor of the Middle Rio Grande has not occurred, reaches of the river with the most suitable habitat for flycatchers have been surveyed fairly thoroughly. Presence/absence surveys and nest monitoring along selected areas of the Rio Grande have been conducted from 1993 to 2008. With expanded or increased survey efforts during this 12-year period, several sites have been located where flycatcher territories have consistently been established. Once located, most of these core breeding areas have been monitored annually.

Five general locations of flycatcher populations have been established throughout the Middle Rio Grande (Figure 5). These areas have consistently held several territories; however, the number of territories, pairs, nest attempts, and successful nests has varied through the years.


**Figure 5. Location of flycatcher populations along the Middle Rio Grande in New Mexico.**

The status of the flycatcher has been closely followed in conjunction with water operations (Service 2003b). Ongoing surveys at selected sites along the Rio Grande from Velarde, New Mexico, to the delta of Elephant Butte Reservoir establish the environmental baseline for the current flycatcher population in the Middle Rio Grande for this Biological Assessment. Table 5 summarizes the locations of known territories (that is, occupied by a male or pair of flycatchers) in the Upper and Middle Rio Grande Management Units during 2003 through 2013.

### 4.1.3 Reasons for Flycatcher Decline

During the last two centuries, human-induced hydrological, geomorphological, and ecological changes have strongly influenced the composition and extent of riparian vegetation along the Middle Rio Grande (Bullard and Wells 1992; Dick-Peddie 1993; Crawford *et al.* 1993). The invasion of exotic shrub species, such as saltcedar and Russian olive, has decreased the availability of dense willows and associated desirable vegetation and habitat important to flycatchers. In addition, the rapid rate of deforestation in tropical areas has been cited as a possible reason for population declines in forest-dwelling migrant land birds (Lovejoy 1983; Robbins *et al.* 1989, Rappole and McDonald 1994), such as the flycatcher.

Brood parasitism by Brown-headed Cowbirds (*Molothrus ater*) has been implicated in the decline of songbirds, including those found in the western riparian habitats (Gaines 1974, 1977; Goldwasser *et al.* 1980; Laymon 1987). Brown-headed Cowbirds have increased their range with the clearing of forests and the spread of intensive grazing and agriculture. Flycatchers are particularly susceptible to Brown-headed Cowbird nest parasitism because of the ease of egg laying in the flycatcher’s open-cup nest design. Habitat fragmentation and forest openings allow cowbirds easy access to host nests located near these edges. Nest parasitism, combined with declining populations and habitat loss, has placed the flycatcher in a precarious situation (Mayfield 1977; Rothstein *et al.* 1980; Brittingham and Temple 1983; Laymon 1987).

In the Middle Rio Grande, past and present Federal, State, and private activities that potentially may affect the flycatcher include urban and agricultural development, river maintenance, flood control, dam operation, water storage and diversion, and downstream Rio Grande Compact deliveries. The Rio Grande and associated riparian areas are a dynamic system in constant change. Sediment deposition, scouring flows, inundation, base flows, and channel and river realignment are processes that help to maintain and restore the riparian community diversity. Without these dynamic processes, the riparian community will likely decrease in diversity and productivity.

### 4.1.4 Southwestern Willow Flycatchers in the Action Area

#### *Habitat Use during Migration*

Flycatchers and many other species of Neotropical migrant land birds use the Rio Grande riparian corridor as stop-over habitat during migration. Studies have shown that during the spring and fall migration, flycatchers are more commonly found in willow habitats than in other riparian vegetation types (Yong and Finch 1997). These birds utilize a variety of vegetation types during migration, many of which are classified as “unsuitable” for breeding habitat (Moore and Ahlers 2013, Siegle *et al.* 2013). During 2013 protocol surveys, 110 migrants were observed between Isleta Pueblo and the Bosque Bridge (NM Hwy. 346; Moore and Ahlers 2014). It is assumed that flycatchers may be present throughout the action area during both spring and fall migration periods.

Mountain View Unit

Suitable flycatcher breeding habitat does not currently exist within this reach (Service 2011a).

The majority of the riparian vegetation in this reach consists of mature cottonwoods with a very sparse understory. Potentially suitable habitat is developing in willow swales and other areas recently established by restoration projects by the NM Interstate Stream Commission (2010), NM State Land Office (2010), and USACE (2011). The Mountain View Unit is currently monitored in conjunction with habitat restoration by USACE.

*Isleta Pueblo*

Protocol surveys following established Service were first performed on the Pueblo in 1994. A small area partially abutting the existing spoil bank alignment near River-mile 165.3 harbored 3 territories in 1994 (Mund *et al.* 1994) and 4 in 1995 (Mehlman *et al.* 1995); although no territorial flycatchers occurred in this stand between 2003 and 2007 (see Smith and Johnson 2004 through 2007). In 1997, the Corps shifted the alignment of the proposed levee rehabilitation away from the spoil bank bordering this site to follow the existing berm of the 240 Wasteway and avoid encroachment on the stand (USACE 1997).

Historically, flycatchers were encountered in the breeding season in the vicinity of Isleta Marsh during bird surveys conducted by Hink and Ohmart (1984) in 1980 and 1981. A core area of territorial flycatchers was documented between River-miles 166 and 167 (immediately south of Isleta Marsh) in 2000 (Johnson and Smith 2000). This site harbored 14 territories in 2000 (Johnson and Smith 2000), 6 in 2003 (Smith and Johnson 2004), 7 in 2004 (Smith and Johnson 2005), and 9 in 2005 and 2006 (Smith and Johnson 2006, 2007). This site has not been occupied, or has not warranted surveys, since 2006.

Both of these Isleta Pueblo sites are sufficiently wet as groundwater begins ponding on the surface when river flows are as low as 3,000 cfs at the Albuquerque gage (Smith and Johnson 2007). One or two territories have been detected in other, isolated areas of the Pueblo in some years between 2000 and 2008 during surveys conducted relative to USACE habitat restoration activities.

*South of Isleta Pueblo to the Bosque Bridge*

In the study area south of the Pueblo of Isleta, flycatcher surveys have been conducted during the breeding season by the Corps in 1994, 1995 and 2000; the Service in 1996 and 1997; and the Bureau of Reclamation in 2002, and 2004 to 2014. Only 1 or 2 isolated, unpaired males were detected through 2010; the first pair was observed in 2011 (Table 6). The number of territories increased from 3 in 2011 to 7 in 2013, but decreased to 3 in 2014. Of 11 nests found in 2011 through 2013, approximately 64% were successful in fledging at least one young. This success rate was significantly greater than the 39% rate for all Middle Rio Grande nests (n = 724) during this three-year period.

All of the occupied breeding sites in the action area during 2011 to 2015 occurred on river bars or lower riverside terraces adjacent to the Rio Grande channel (Table 6). Stands are composed of relatively young cottonwood and a mix of willows, saltcedar, and Russian olive (Moore and Ahlers 2012-15). All occupied habitat has been classified as “moderately suitable” for flycatcher breeding (Siegle *et al.* 2013).

**Table 6. Breeding season flycatchers in the Belen Reach survey area, 2002-2015 (Reclamation 2016).**

| Year | Lone males | Pair | Total |
|---|---|---|---|
| 2002 | 1 | 0 | 1 |
| 2003 | n/s | n/s | n/s |
| 2004 | 0 | 0 | 0 |
| 2005 | 0 | 0 | 0 |
| 2006 | 0 | 0 | 0 |
| 2007 | 1 | 0 | 1 |
| 2008 | 1 | 0 | 1 |
| 2009 | 0 | 0 | 0 |
| 2010 | 0 | 0 | 0 |
| 2011 | 1 | 2 | 3 |
| 2012 | 1 | 4 | 5 |
| 2013 | 2 | 5 | 7 |
| 2014 | 1 | 2 | 3 |
| 2015 | 0 | 2 | 2 |

No territorial flycatchers were detected from the southern Isleta Pueblo boundary downstream to the Los Lunas Bridge. Surveys by Reclamation have detected 1 or 2 flycatcher territories in 2011 through 2013 between the Los Lunas Bridge and the Belen Bridge: No territorial flycatchers were detected from the Belen Bridge downstream to the BNSF railroad bridge (RM-149.5 to RM-147.7). South of the railroad bridge, the number of territories has been increasing since 2011 between River-miles 145.1 and 143.1 at sites BL-09 to BL-14 (Reclamation 2016). Sites BL-09 and BL-10 (12 territories) are downstream of the terminus of the Belen West levee segment. In 2016, the two territories at the BL-11 site occur within 0.25 miles of the proposed Belen West levee segment.

## 4.2 Western Yellow-billed Cuckoo

### 4.2.1 Status and Distribution

On October 3, 2014, the Service published the final rule to list the Western U.S. Distinct Population Segment ("DPS") of the Yellow-billed Cuckoo (*Coccyzus americanus occidentalis;* cuckoo) as a Federally threatened species (Service 2014a). The listing included information on the cuckoo's biology, range, and population trends, including: habitat requirements for feeding, breeding, and sheltering; genetics and taxonomy; historical and current range including distribution patterns; population levels; conservation measures; and population and breeding season data.

Two factors were considered to be threats to the species (Service 2014a). The first factor includes threats from habitat destruction, modification, and degradation from dam construction and operations; water diversions; river flow management; stream channelization and stabilization; floodplain conversion to agricultural uses, such as crops and livestock grazing; urban and transportation infrastructure; and increased incidence of wildfire. These activities may also contribute to fragmentation and promote conversion to nonnative plant species, particularly salt cedar. The threats affecting cuckoo habitat are ongoing. Such a loss of riparian habitat leads not only to a direct reduction in cuckoo numbers but also leaves a highly fragmented landscape, which can reduce breeding success through increased predation rates and barriers to dispersal by juvenile and adult cuckoos (Reclamation 2013a; Service 2014a).

The second factor includes habitat rarity and the small size and isolated nature of populations of the western yellow-billed cuckoo, which cause the remaining populations in western North America to be increasingly susceptible to further declines through lack of immigration, chance weather events, fluctuating availability of prey populations, pesticides, collisions with tall vertical structures during migration, spread of the introduced tamarisk leaf beetle as a biological control agent in the Southwest, and climate change. The ongoing threat of small overall population size leads to an increased chance of local extinctions through random events (Service 2014a).

The Service identified cuckoos west of the Continental Divide as a Distinct Population Segment (DPS) based on physical, biological, ecological and behavioral factors; but in central and southern New Mexico, the boundary of the western DPS is along the crest of the southern Rocky Mountains (Service 2014b). Cuckoos currently breed in California, Arizona, New Mexico, Utah, Wyoming, Colorado, Idaho, and Texas (Service 2014a). The State of New Mexico currently does not include the cuckoo in any formal protection category.

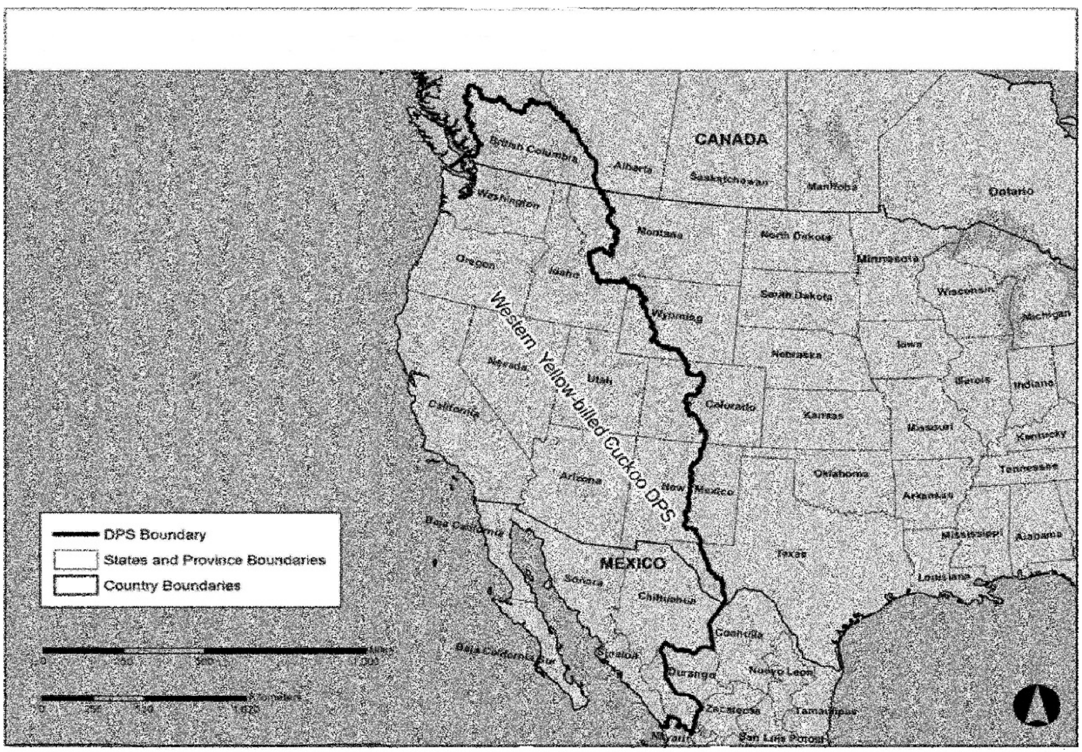



**Figure 6. Range of the Western Distinct Population Segment of the Yellow-billed Cuckoo.**

### *Population Trends in the Middle Rio Grande, 2009-2014*

Prior to 2006, Reclamation collected incidental cuckoo detection data within the Middle Rio Grande while conducting flycatcher surveys (Reclamation 2013a). In 2006, Reclamation began formal presence/absence surveys (Halterman et al 2000) to more accurately determine cuckoo distribution and abundance within the Middle Rio Grande Basin. In 2009, Reclamation extended its survey area to include Belen south to Escondida. From 2009 through 2013, Reclamation's survey area for cuckoo's remained constant. In 2014, approximately 35.5 river-miles were added to the study area, from the south boundary of Isleta Pueblo near Los Lunas downstream to Highway 60 Bridge. The Reclamation study area in the Middle Rio Grande currently extends from the south boundary of Isleta Pueblo downstream to Elephant Butte Reservoir and has documented a population of cuckoos within the Middle Rio Grande floodway. The average annual number of cuckoo territories during Reclamation' surveys from 2009-2014 was 64. The greatest extent of suitable habitat and the largest number of cuckoo detections along the Rio Grande in New Mexico have occurred in the San Marcial reach. Since 2009, sites within the exposed pool of Elephant Butte Reservoir (a subset of San Marcial) have produced 56% of all cuckoo detections within Reclamation's Middle Rio Grande Study Area. The average annual estimate of relative population size from 2009-2014 was 54 territories, but fluctuated annually.

Within the action area of the proposed action, a total of three individual cuckoo detections have occurred during the 2009-2014 surveys (2015 data is pending); of these, one was in 2014, and two in 2009. The two cuckoo detections in 2009 were determined to be a territory based on the methods in the 2015 cuckoo survey protocol methods (Halterman, *et al.* 2015). No cuckoo's were detected in this project's action area from 2010-2013 (Table 7).

**Table 7. Number of cuckoo detections and territories by river reach from 2006 to 2015 within the Middle Rio Grande Study Area (Carstensen *et al*. 2015; Ahlers et al. 2016).**

| River Reach | 2006[a] | 2007[a] | 2008[a] | 2009 | 2010 | 2011 | 2012 | 2013 | 2014[b] | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Belen* | n/s[c] | n/s | n/s | 1/0 | 3/0 | 16/4 | 44/15 | 20/6 | 24/5 | 39/10 |
| SevilettaNWR/ La Joya | n/s | n/s | n/s | 4/2 | 1/0 | 6/2 | 36/12 | 19/6 | 9/2 | 18/5 |
| San Acacia | n/s | n/s | n/s | 8/1 | 3/0 | 6/1 | 19/4 | 20/5 | 15/4 | 27/8 |
| Escondida | n/s | 3/2 | 19/10 | 29/9 | 6/2 | 15/3 | 68/21 | 80/23 | 27/7 | 62/16 |
| Bosque del Apache NWR | n/s | 22/13 | 35/14 | 47/11 | 14/3 | 17/4 | 36/10 | 29/8 | 34/12 | 40/12 |
| Tiffany | 10/6 | 12/4 | 7/3 | 10/3 | 2/0 | 4/1 | 10/2 | 4/1 | 2/0 | 2/0 |
| San Marcial[d] | 30/10 | 40/16 | 47/15 | 46/13 | 27/6 | 43/12 | 25/8 | 30/10 | 29/12 | 5/2 |
| Total | 40/16 | 75/35 | 108/42 | 145/39 | 56/11 | 107/27 | 238/72 | 202/59 | 140/42 | 193/53 |

*[a] 2006 to 2008 trends are not directly comparable due to varying degrees of survey efforts and survey area. A minimum of three surveys were conducted between 2006 and 2008. A minimum of four were conducted since 2009. Also, territories were estimated using a different technique beginning in 2009.*
*[b] In 2014 an additional 35.5 river miles were added to annual surveys.*
*[c] n/s = not surveyed.*
*[d] Observations from the Elephant Butte subset of the San Marcial reach were not included in this table.*

### *Critical Habitat*

Critical habitat for the Western U.S. DPS was proposed on August 15, 2014 (Service 2014b) in 80 separate units in Arizona, California, Colorado, Idaho, Nevada, New Mexico, Texas, Utah, and Wyoming. Proposed critical habitat in the action area is within Unit 52, NM-8, and includes the Rio Grande floodway from the southern boundary of the Pueblo of Isleta downstream to the upper reach of Elephant Butte Reservoir (river-mile 54). The proposed critical habitat unit 52 in the action area includes lands owned by Isleta Pueblo. These units are either occupied by cuckoos or provide a corridor for cuckoos moving north.

The Primary Constituent Elements (PCEs) of cuckoo critical habitat are:

1. *Riparian woodlands*. Riparian woodlands with mixed willow and cottonwood vegetation that contain habitat for nesting and foraging in contiguous or nearly contiguous patches that are greater than 325 ft (100 m) in width and 200 ac (81 ha) or more in extent. These habitat patches contain one or more nesting groves, which are generally willow dominated, have above average canopy closure (greater than 70 percent), and have a cooler, more humid environment than the surrounding riparian and upland habitats.
2. *Adequate prey base*. Presence of a prey base consisting of large insect fauna (including cicadas, caterpillars, katydids, grasshoppers, large beetles, and dragonflies) and tree frogs for adults and young in breeding areas during the nesting season and in post-breeding dispersal areas.
3. *Dynamic riverine processes*. River systems that are dynamic and provide hydrologic processes that encourage sediment movement and deposits that allow seedling germination and promote plant growth, maintenance, health, and vigor (e.g., lower gradient streams and broad floodplains, elevated subsurface groundwater table, and perennial rivers and streams). This allows habitat to regenerate at regular intervals, leading to riparian vegetation with variously-aged patches from young to old.

The Service is participating in government-to-government discussions with Pueblos on New Mexico on cuckoo conservation actions and management plans for potential exclusion from the final designation of critical habitat. The Pueblos conduct a variety of voluntary measures, restoration projects, and management actions to conserve riparian vegetation and protect riparian habitat (Service 2014b). The Pueblos may propose amendments to their management plan for other endangered species, which will contribute to the conservation of the cuckoo (Service 2014b). The Service may exclude Pueblo lands from the final designation of Western Yellow-billed Cuckoo critical habitat under section 4(b)(2) of the ESA.

### 4.2.2 Life History and Ecology

Adult cuckoos are a medium-sized bird (length 30 cm, weight 60 g) with moderate to heavy bills, somewhat elongated bodies, and a narrow yellow ring of colored bare skin around the eye (Service 2013b). The bird has a slender, long-tailed profile, with a fairly stout and slightly down-curved bill, which is blue-black with yellow on the basal half of the lower mandible. The body is grayish-brown above, white below, with boldly patterned tail feathers and short bluish-gray legs. Males have a smaller body size, smaller bill, and the white portions of the tail tend to form distinct oval spots. Females have less distinct white spots that tend to be connected (Service 2013b). Mated cuckoos have a distinctive ‘‘kowlp’’ call, which is a loud, nonmusical series of notes that slows down and slurs toward the end. Unmated cuckoos advertise for a mate using a series of soft ‘‘cooing’’ notes. Both members of a pair use the ‘‘knocker’’ call, a series of soft notes given as a contact or warning call near the nest (Service 2013b).

In the Southwestern U.S., cuckoos typically arrive at their breeding grounds by late-May/early-June and initiate migration back to their wintering grounds by late-August (Halterman *et al.* 2000). In New Mexico, nesting activities typically begin in mid-June and end in late August (Hughes 1999). Fall migration from its breeding grounds in New Mexico generally occurs from late-August through mid-September (Halterman *et al.* 2000). Males begin their “coo-coo-coo” calls upon arrival on their breeding grounds and will continue all season if they are unsuccessful in attracting a mate. Newly-formed pairs travel for several days in search of a suitable nest site, frequently giving the “kowlp” and “knocking” call. The male will chase other males during this period (Halterman 1991).

In New Mexico, cuckoo's nest in large patches of riparian vegetation with a cottonwood (*Populus deltoides*) / Goodding's willow (*Salix gooddingii*) overstory (Ehrlich *et al.* 1988) with a dense understory that may include saltcedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*) or native vegetation (e.g. *Salix* spp.) (Reclamation 2013a; Sechrist *et al.* 2009). Territories range in size from 4 to 40 ha (Halterman 2001), with an average home range size of 82 ha (Sechrist *et al.* 2009). The cuckoo prefers patch dimensions larger than 100 × 300 m, and exceeding 80 ha (200 ac) in area (Service 2014a).

Nest heights range from 1.3 to 13 m with a rapid breeding cycle at each nest; from egg laying to fledging takes approximately 17 days (Halterman 2001). Cuckoos exhibit a variety of reproductive strategies that are thought to increase population (Service 2013b). Both parents build an open cup nest, incubate the eggs, and tend the young. Clutch size varies from two to five eggs. The incubation and nestling periods are short, with the eggs hatching asynchronously in 11–12 days and young fledging in 5–7 days.

In the Southwest, the cuckoo's breeding cycle appears to be geared to taking advantage of short-term abundance of food, and is characterized by food-induced laying, a short incubation period, and the rapid development of young (Laymon 1980). Breeding often coincides with the presence of abundant cicadas, caterpillars, or other large insects (Ehrlich *et al.* 1992). Cuckoos generally forage within the tree canopy and the greater the foliage volume the more likely cuckoos are to use a site for foraging. On the South Fork Kern River in California, caterpillars (primarily big poplar sphinx moth [*Pachysphinx occidentalis*]larvae) and katydids appear to be the preferred food, while tree frogs and grasshoppers appear to be prey that can be caught quickly to placate the young while the adults then go after the preferred food (Laymon *et al.* 1997). Food availability is largely influenced by the health, density, and species of vegetation. For example, the big poplar sphinx moth larvae are found only in willows and cottonwoods, and appear to reach their highest density in Fremont cottonwoods (*Populus fremontii*; Service 2014a).

#### 4.2.3 Reasons for Cuckoo Decline

The decline of the cuckoo is primarily the result of riparian habitat loss and degradation (Service 2014a). Within New Mexico, past riparian habitat losses are estimated to be about 90 percent. Much of the habitat loss occurred historically, with past impacts having affecting the size, extent, and quality of riparian vegetation within the range of the cuckoo. The connection between riparian habitat loss and the decline of the cuckoos is well documented. Habitat loss has resulted from the construction of dams, alterations to the hydrology from water operations, surface water diversions, grazing and agriculture, and invasive plant species (Service 2014a).

### 4.3 Rio Grande Silvery Minnow

#### 4.3.1 Status and Distribution

The Rio Grande silvery minnow (*Hybognathus amarus*; silvery minnow) is currently listed as endangered on the New Mexico State list of endangered species, having first been listed May 25, 1979 as an endangered endemic population of the Mississippi silvery minnow (*Hybognathus nuchalis*; NMDGF 1988). On July 20, 1994, the Service published a final rule to list the silvery minnow as an endangered species with proposed critical habitat (Service 1994). The Service issued the final rule for silvery minnow critical habitat on February 19, 2003 (Service 2003a).

*Critical Habitat*

The Primary Constituent Elements (PCEs) for minnow critical habitat are:

1. Hydrologic regime capable of forming and maintaining a diversity of aquatic habitats, including backwaters, shallow side channels, pools, eddies, and runs to support all silvery minnow life-history stages;
2. Presence of eddies created by debris piles, pools, backwaters, or other refuge habitat within reaches of sufficient length to provide a variety of habitats with a wide range of depths and velocities;
3. Substrates of predominantly sand or silt;
4. Water temperatures that vary on a daily, seasonal and annual basis, and that annually range no lower than 1°C and no greater than 30°C; and
5. Water with reduced degraded conditions, such as decreased dissolved oxygen and increased pH.

Designated critical habitat for the Middle Rio Grande extends from Cochiti Dam downstream to the utility line crossing the Rio Grande at the upstream end of the Elephant Butte Reservoir. The designation excludes the tribal lands of Santo Domingo, Santa Ana, Sandia, and Isleta Pueblos. The Service considered the Lower Rio Grande around Big Bend National Park, and the Pecos River between Ft. Sumner Dam and Brantley Reservoir for critical habitat but elected not to so designate these areas even though they are essential to silvery minnow conservation (e.g., possible re-introduction). For all of these reaches, the lateral extent of critical habitat includes those areas bounded by existing spoil banks or their replacement levees. In areas without these structures, the lateral extent of critical habitat is defined as 300 feet (91.4 m) of riparian zone adjacent to each side of the river.

Until the late 1950s, the Rio Grande silvery minnow was distributed throughout many of the larger order streams of the Rio Grande Basin upstream of Brownsville, Texas, with a range extending to northern New Mexico (about 2000 miles) in water lying primarily below 5500 ft elevation (1676 m). This elevation coincides with the approximate vicinities of Abiquiu on the Chama River, Velarde on the Rio Grande, and Santa Rosa on the Pecos River. Today the silvery minnow is restricted to a variably perennial reach of the Rio Grande in New Mexico, from the vicinity of Bernalillo downstream to the head of Elephant Butte Reservoir, a distance that fluctuates as the size of the pool of water in storage in Elephant Butte Reservoir changes, but that approximates 150 river miles (241 km).

Historically, the silvery minnow was distributed throughout the Rio Grande Basin over a broad range of environmental parameters (including chemical, physical, hydrological, climatic, and biological attributes) that are typical of the arid southwest. Sublette *et al.* (1990) describe the taxonomic characteristics of the silvery minnow and provides an overview account of the life history and species distribution. Bestgen and Propst (1996) provide a detailed morphometric study of the silvery minnow and document the distinctiveness of the species. Population monitoring for silvery minnows has been conducted at twenty sites between Angostura Diversion Dam and the Elephant Butte Reservoir pool since 1993 (Dudley and Platania 2008). Population monitoring provides information for the October population index has rebounded starting in 2004 with spring runoff flows greater than 2000 cfs (Dudley and Platania 2007a), indicating the importance of overbanking floods in creating suitable habitat for population recruitment.

### 4.3.2 Life History and Ecology

*Rio Grande Silvery Minnow Habitat*

Floodplain habitat appears important for supporting silvery minnow recruitment (Fluder *et al.* 2007; Gonzales *et al.* 2014; Hatch and Gonzales 2008; Porter and Massong 2004a, b; SWCA 2008), and habitat fragmentation is likely a major mechanism for extirpation of the silvery minnow from most of its range (Medley and Shirey 2013; Dudley and Platania 2007b). Silvery minnow habitat is typically described as shallow (0.7- 2.6 ft) water bodies with fine grained substrate (silt, sand) and slow water velocities (<1 ft/sec) (Service 2010). Silvery minnows are most commonly collected in shallow water (<1.3 ft) with low water velocities (<0.32 ft/sec), primarily over silt and sand substrate (Dudley and Platania 1997). Silvery minnows are capable of moving through narrower incised channels with faster water velocities by remaining in the boundary layer adjacent to the bank to avoid the main current (Porter and Massong 2004b). Surveys in 1977-1978 collected large numbers of silvery minnows in adjacent aquatic habitats connected to the Rio Grande main channel (C. Painter, NMDGF, unpublished data, 1977-1978), such as the Albuquerque Oxbow, Elephant Butte Marsh (headwaters), the Low Flow Conveyance Channel, and various irrigation drains and canals.

The Rio Grande and Pecos River have been fragmented by dams and reservoirs, resulting in a total of 82 disconnected sub-reaches (Dudley and Platania 2007b). Barriers restricting upstream fish movement between sub-reaches reduce the ability of fish species to re-colonize upstream sub-reaches following downstream movement. While large dams and reservoirs prevent dispersal of fish upstream and downstream, smaller diversion dams may allow limited movement of some fish. The diversion dams on the Middle Rio Grande were designed to pass sediment, allowing passage of fish in both directions during the winter when no irrigation was occurring. Silvery minnow populations also persist in shorter reaches that are unsuitable for other pelagic spawning fishes with semi-buoyant eggs (Dudley and Platania 2007b; Hoagstrom *et al.* 2008). The role of silvery minnow dispersal and habitat connectivity within reaches may benefit from additional research (Rodriguez 2010). Less than 2% of tagged silvery minnows released downstream of the Albuquerque–Bernalillo County Water Utility Authority (ABCWUA) drinking water diversion dam were detected moving upstream through the fish passage channel (Archdeacon and Remshardt 2012).

In addition to forming barriers to silvery minnow movement, large reservoirs trap sediment, resulting in channel incision extending downstream from the dam. The extent of downstream incision is a function of scouring flows, time and sediment contribution from downstream tributaries (Massong *et al.* 2006; Schmidt *et al.* 2003). Channel incision increases the depth of turbid water reducing primary productivity within the river (J. Lusk, Service, personal communication, 2010). Channel incision also reduces annual connectivity to floodplain and riparian areas for many fish species (Coutant 2004). The loss of inundated riparian habitat for nursery areas limits recruitment by fish species with life histories that are dependent on this habitat. The correlation of October catch rates with spring flow above 2000 cfs ($r^2$ = 0.83-0.91) supports recruitment as a function of inundated habitat for the silvery minnow (Dudley and Platania 2007a). Loss of riparian connectivity within the Rio Grande floodplain has decreased the amount of critical habitat for the silvery minnow.

The USGS modeled silvery minnow habitat availability as a function of instream flow in the lower Isleta Reach between the Rio Puerco confluence and San Acacia diversion dam (Bovee *et* *al.* 2008). The study focused on hydraulic and structural habitat for juveniles (young-of-year, YOY) and adults at the lower range of flows typical of dry and normal summers in this reach of the river. The maximum area of suitable hydraulic habitat for adults was at flow between 40 to 80 cfs. The area of suitable adult habitat declined rapidly as flow increased above 150 cfs, shifting the preferred shallow, low velocity habitat to the margins of the river.

The MRGCD irrigation system may provide habitat for silvery minnows, particularly as refugia during river drying, with fish returning to the river as flow increases (Cowley *et al.* 2007). Because of this, declines in the occurrence of silvery minnows in the irrigation system since the 1970s (C. Painter, NMDGF, unpublished data, 1977-1978; Lang and Altenbach 1994) indicate the need for more information about how irrigation practices affect minnow survivorship in the ditches. Cowley *et al.* (2007) suggests several concepts for managing the irrigation system to enhance habitat values for native fish species.

Ecologically, the silvery minnow appears to be a physiological generalist with specific habitat requirements for completion of its life cycle to support recruitment, persistence and abundance of the species. Silvery minnow primarily consume diatoms, cyanobacteria, and green algae associated with sand or silt substrates in shallow areas of the river channel (Propst 1999; Service 1999; Shirey *et al.* 2007). Dudley and Platania (1997) studied habitat preferences of the silvery minnow in the Middle Rio Grande at Rio Rancho and Socorro. They characterize habitat preference and habitat availability in terms of water depth, water velocity and stream substrate. Both juvenile and adult silvery minnows primarily use mesohabitats with moderate depths (15-40 cm), low water velocities (4-9 cm/sec) and silt/sand substrates. Avoidance of swift water velocities by the silvery minnow is one means of conserving energy, a general life strategy shared by many lotic fish species (Facey and Grossman 1992). Young-of-year (YOY) silvery minnows are generally captured in shallower and lower velocity habitats than adult individuals. Silvery minnows used low velocity habitat with instream debris (cover) more frequently during winter months (Dudley and Platania 1996). At near-freezing water temperatures, silvery minnow become less active and seek habitats with cover such as debris piles and low water velocities.

*Rio Grande Silvery Minnow Spawning and Recruitment*

Age and body length analyses by Cowley *et al.* (2006) indicate silvery minnows had a maximum longevity of 4-6 years in the late 1800s. Data from minnow rescue in 2006 (Service 2007a) indicates five possible classes (Age 0-4) based on standard length size distribution. The majority of spawning individuals are Age 1 fish (1-year old) with older, larger fish (Age 2+) constituting less than 10% of the spawning population (Platania and Altenbach 1996). Reproductively mature females are typically larger than males. Each female may produce several clutches of eggs during spawning ranging from 2000-3000 (Age 1) to 5000+ eggs (Age 2) per female (Platania and Altenbach 1996). Few adult silvery minnows are captured by late summer, suggesting that spawning adults may either experience high post-spawning mortality or reduced catchability.

Silvery minnows spawn from late April through June at water temperatures greater than 18°C (Medley and Shirey 2013; Platania and Dudley 1999, 2001). Peak egg production occurs in mid to late-May and generally coincides with higher spring discharge produced either by snowmelt or water management operations. Silvery minnows produce numerous semi-buoyant, non-adhesive eggs typical of the genus *Hybognathus* (Platania and Altenbach 1998) that are transported in the lower portion of the water column (Worthington et al 2013). The specific gravity of silvery minnow eggs ranges from 1.012 – 1.00281 as a function of time post-fertilization (Cowley *et al.*

2005). Eggs produced by related species, such as *H. regius* (Raney 1939) and *H. hankinsoni* (Copes 1975), are non-adhesive and considered demersal. More data on the specific gravity of related species of *Hybognathus* may provide useful insights for understanding spawning behavior and site selection among silvery minnow species. Egg hatching time is temperature-dependent, occurring in 24-48 hours at water temperatures of 20-30ºC (Platania 2000). Recently hatched silvery minnow larvae are about 3.7 mm in length. Environmental variables that influence silvery minnow spawning include photoperiod, increased flow, degree days (average temperature multiplied by the number of days), and water turbidity. Additional research should improve our understanding of environmental factors on the timing and duration of silvery minnow spawning.

Nursery habitat consists of shallow inundated surfaces with low water velocities where eggs hatch without downstream displacement, and larval fish can readily find food (Gonzales et al. 2014; Medley and Shirey 2013; Pease *et al.* 2006; Porter and Dean 2007). Shallow water areas provide the productive habitats required by larval fishes to successfully complete their early life history (Dudley and Platania 2007a; Turner *et al.* 2010). The Collaborative Program has focused on creating additional shallow water habitats with appropriate environmental flows in the Middle Rio Grande (Grand *et al.* 2006; Corps 2009).

Platania and Altenbach (1998) discussed the difficulty for explaining the persistence of the silvery minnow in the Rio Grande while other minnow species with semi-buoyant eggs were extirpated from the system. Medley and Shirey (2013) summarize observations that indicate silvery minnows spawn on the floodplain and hypothesize that downstream eggs drift through channelized reaches indicates habitat degradation. Silvery minnows from hatcheries did not demonstrate a strong upstream movement pattern (Archdeacon and Remshardt 2012).

Egg retention from the current into inundated riparian zones favorable for larval fishes provides a mechanism for silvery minnow recruitment in the Middle Rio Grande (Widmer *et al.* 2007, 2010). Egg retention is consistent with the interactions of channel incision and hydrology leading to egg drift, declining recruitment and populations (Porter and Massong 2004b, 2005; Dudley and Platania 2007a, 2007b; Widmer *et al.* 2007, 2010). Larval silvery minnow have been associated with low water velocity habitat including inlets, shelves, and side channels (Pease *et al.* 2006; Turner *et al.* 2010). Higher silvery minnow densities, measured as catch per unit effort (CPUE), appear to be spatially associated with reaches with higher egg retention (Widmer *et al.* 2007).

Rio Grande silvery minnow spawning is closely tied to the annual spring flood (Medley and Shirey 2013). During the ascending limb of the hydrograph, silvery minnows move into flooded riparian areas and backwaters to spawn. Habitat monitoring has documented silvery minnow adults (Gonzales et al 2014; Hatch and Gonzales 2008; SWCA 2008), and eggs (SWCA 2008) on constructed nursery habitat sites. Floodplain habitat use by silvery minnows suggests that nursery habitat is important for population management (Service 2007b; Medley and Shirey 2013).

There has been annual monitoring of silvery minnow egg drift (Table 8) since 2002 (Platania and Dudley 2002, 2015) to evaluate recovery goals. These samples provide information on the magnitude of reproduction carried downstream of nursery habitat in the channelized San Marcial reach (at River Mile (RM) 58.8). The duration of high flows during the April-June spawning season were positively correlated with silvery minnow mean October densities, while extended low-flow periods were negatively correlated with silvery minnow mean October densities (Dudley and Platania 2008). Elevated flows in 7 of the past 10 years (2001-2010) have contributed to silvery minnow recruitment compared with the 2002-2003, 2006 year-classes (Dudley and Platania 2015).

Reclamation has contracted egg entrainment monitoring from 2002 through 2016 (Table 8) as part of RPA elements in the BO (Service 2001, 2003b). After 2002, MRGCD has managed diversions to minimize entrainment during peak egg drift. Higher spring flows since 2003 have inundated riparian areas, providing nursery habitat for spawning and rearing. The availability of nursery habitat probably reduces entrainment of silvery minnow eggs into the current, reducing the number of eggs drifting downstream.

**Table 8. Results of monitoring for silvery minnow eggs at irrigation diversion structures and at San Marcial. Values are absolute number of eggs collected.**

| Date | Albuquerque Main | Peralta Main | Belen Highline | Socorro Main | Totals | San Marcial [d] |
|---|---|---|---|---|---|---|
| 2002 [b] | 0 | 729 | 826 | 28 | 1,583 | 92,000 |
| 2003 [a,b] | 3 | 26 | 48 | - | 77 | 13,292 |
| 2004 [a,b] | 0 | 3 | 3 | - | 6 | 5 |
| 2005 [a,b] | 1 | 1 | 3 | - | 4 | - |
| 2006 [a,b] | 0 | 1 | 8 | 8 | 17 | 7,900 |
| 2007 [a,b] | 0 | 49 | 43 | 2 | 94 | 10,995 |
| 2008 [a,c] | 0 | 1 | 0 | 9 | 10 | 155 |
| 2009 [a,c] | 0 | 12 | 3 | 29 | 44 | 645 |
| 2010 [a,c] | - | 11 | 1 | 0 | 12 | 364 |
| 2011 [a,c] | - | 8 | 4 | 13 | 25 | 96,266 |
| 2012 [a,c] | - | 3 | 82 | 0 | 85 | 12,398 |
| 2013 [a,c] | - | 1 | 0 | 0 | 1 | 1,745 |
| 2014 [a,c] | - | 0 | 0 | 0 | 0 | 9,727 |
| 2015 [a,c] | - | 3 | 0 | 0 | 3 | 6,356 |
| 2016 [a,c] | - | 4 | 0 | 0 | 4 | 481 |

[a] *Diversions managed to minimize entrainment of silvery minnow eggs.*
[b] *Porter and Dean 2007.*
[c] *Data provided to Reclamation by the Service. Monitoring for the Albuquerque Main was discontinued after 2009.*
[d] *Estimated number of eggs collected from Platania and Dudley 2002-2016.*

### *Rio Grande Silvery Minnow Population Trends 1994-2015*

Long-term monitoring of fish populations is fundamental for evaluating how management affects riverine fish communities and silvery minnow populations. Fish community surveys have been conducted since 1993 (with the exception of 1998) in the Rio Grande of New Mexico between Angostura Diversion Dam (RM 209.7) and Elephant Butte Reservoir (RM 58.8). Survey methodology consists of single-pass seine samples (Dudley and Platania 2015) with results reported as count data, such as catch per unit effort (CPUE) or catch per area sampled. Although the statistical properties of these indices (e.g., measures of bias, capture or detection probabilities, and variance) are unknown, these surveys document silvery minnow density (fish per 100 m²) variability over time and space.

The 2001 and 2003 Biological Opinions (Service 2001, 2003) included several Reasonable and

Prudent Alternative elements for maintaining minimal wetted silvery minnow habitat in the Angostura, Isleta, and San Acacia reaches. It also provided for a one-time increase in flows (spawning spike) between April 15 and June 15 of each year to cue spawning if needed (Service 2001, 2003b). The "spawning spike" concept was refined to encompass recruitment flows based on the predictions of nursery habitat and silvery minnow population trends following riparian habitat inundation from 2004-2008 (USACE 2007, 2008a). Though recruitment was highly variable both annually and longitudinally, the 2007 fish community monitoring results show June-July YOY recruitment throughout all three reaches.

The status of the silvery minnow in the action area has been documented by annual surveys. Over the period 1993-2015, October counts were conducted in the Angostura, Isleta, and San Acacia reaches (Dudley and Platania 2015). The density of silvery minnows (CPUE) varies several orders of magnitude across the years in response to spring flow and floodplain inundation (Figure 7).

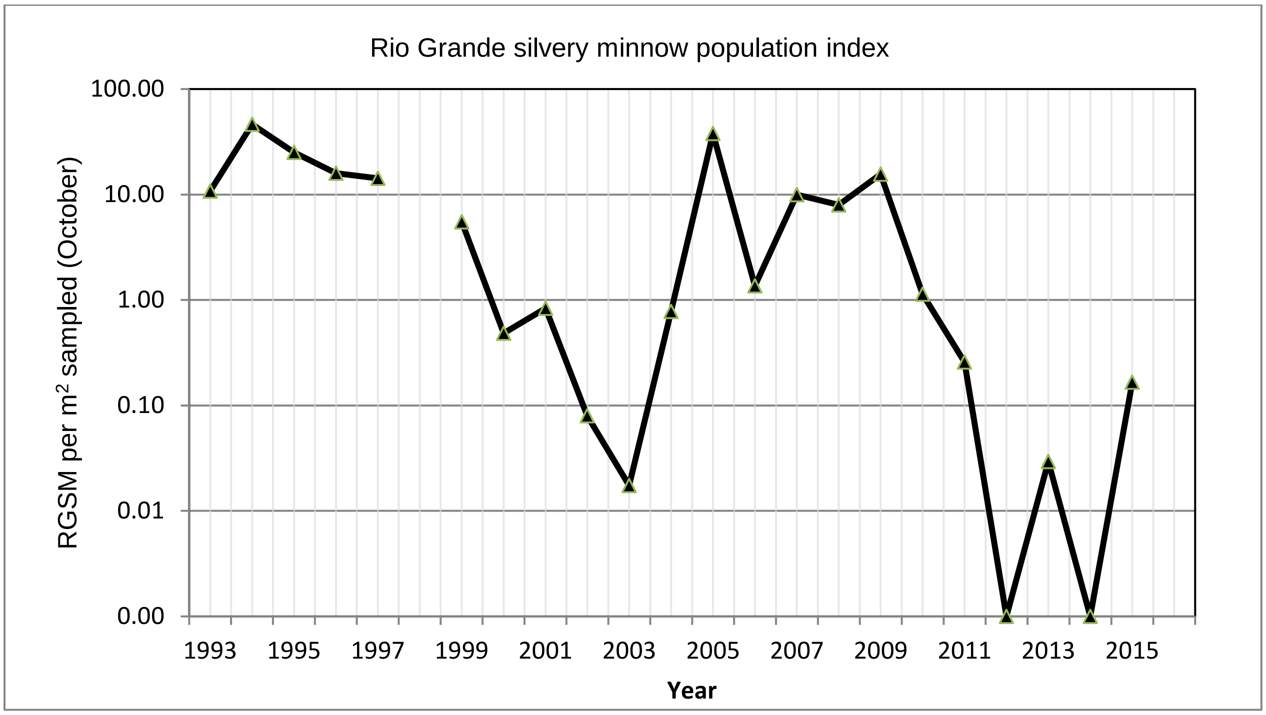



**Figure 7. Rio Grande silvery minnow October population index.**

### 4.3.3 Reasons for Rio Grande Silvery Minnow Decline

Understanding the effects of habitat degradation, connectivity and fragmentation on different fish species' life history patterns provides clues for analyzing future actions (Koster 1955). The range of the Rio Grande silvery minnow has contracted significantly since the 1950s. The proposal to list the silvery minnow as an endangered species discusses many factors that have led to the decline of the species (Service 1993). The silvery minnow has several common factors for extinction prone species including specialized habitat requirements, restricted geographic distribution with limited opportunities for dispersal, and small but demographically-variable populations (Brown and Lomolino 1998).

*Habitat Modification*

Factors currently affecting silvery minnow habitat include loss of habitat due to water impoundment; channel drying; channel straightening and other geomorphic channel alterations; and water pollution (Service 1994; Schmidt et al 2003; Service 2007b). Impoundment of water in the Rio Grande by mainstem dams has affected the flow regime of the river, fragmented habitat, and resulted in geomorphological changes to the channel (Service 1994; Service 2007b). Habitat fragmentation and degradation (resulting from dams) may be a factor in the decline of the silvery minnow, including the sequential decline and loss of fish from upstream to downstream (Platania and Altenbach 1998, Porter and Massong 2004a).

The conversion of riverine habitat into reservoirs creates barriers to silvery minnow movement. Silvery minnows are generally obligate riverine species that have not been documented using limnetic habitat. The unsuitability of reservoir habitat creates barriers to silvery minnow dispersal and does not provide refugial habitat for maintaining populations.

Flows in the Middle Rio Grande are extreme and highly erratic, including episodic flooding and, at times, intermittence (USACE 2007, 2009). Reservoir operations may reduce the size of the flood peaks, extend or decrease the duration of the snowmelt runoff (depending on the size of the runoff), and increase the volume of water entering the Middle Rio Grande valley during normal natural low flow periods (Service 2007b). Managed flow regimes can alter silvery minnow habitat by reducing the frequency and magnitude of overbank flooding, trapping nutrients, altering sediment transport regimes, prolonging summer base flows, and creating reservoir habitats that favor non-native fish species. The changes in hydrology may reduce silvery minnow food supplies, alter its habitat, prevent dispersal, and provide non-native fish with a competitive advantage.

River engineering projects have variable effects on silvery minnow habitat quality and area depending on how they are implemented. Traditional river engineering activities have confined the Rio Grande to a narrower channel and reduced the connectivity with adjacent riparian habitat. Channels have been straightened and deepened, and aquatic plants and snags have been removed to lessen hydraulic resistance. Sediment retention by upstream reservoirs results in channel incision, reducing surface water inundation. Conventional river engineering projects have reduced the retention time of water and organic matter, surface area and physical complexity of the habitat, and refugial habitats.

Channelization of the Middle Rio Grande has resulted from the placement of Kellner jetty jacks along the river to protect levees by retarding flood flows, trapping sediment, and promoting vegetation (Service 1994; Service 2007b). Meanders, oxbows, and other components of silvery minnow habitat have been eliminated in order to pass water as efficiently as possible for agricultural irrigation and downstream deliveries. The loss of low-velocity nursery habitat (inundated riparian vegetation, backwaters, etc.) has likely reduced silvery minnow larval and juvenile recruitment.

*River Diversions and Dewatering*

Dewatering (channel drying) is caused primarily by agricultural water diversion and by periodic drought. For minnows, these actions result in a fragmented range with reduced habitat area and connectivity (Service 1994; Service 2007b). The impacts of water diversion may not be severe in years when an average or above average amount of water is available (Service 1994; Service

2007b). In years of below-average water availability river channel drying may be extensive from Isleta Diversion Dam downstream to Elephant Butte Reservoir (111 mi).

Dewatering is implicated in many studies of silvery minnow range contraction from its historic extent. For example, Trevino-Robinson (1959) documented the early 1950s "cosmopolitan" occurrence of silvery minnows in the Rio Grande downstream of its confluence with the Pecos River where, for "the first time in recorded history," a portion of this reach of river went dry in 1953. Although Trevino-Robinson (1959) could not document any "apparent undesirable or severe after effects" from the drought, silvery minnows have not been documented from this lower portion of the Rio Grande since the mid-1950s (in part, Service 1999). Edwards and Contreras-Balderas (1991) confirm the absence of the silvery minnow from the Rio Grande below Falcon Dam, which is downstream of the Pecos confluence at Amistad Lake.

Drought leading to channel drying has also been implicated in the extirpation of the silvery minnow from upstream reaches of the Rio Grande. Hubbs *et al.* (1977) documented the "inexplicable" absence of silvery minnow from the Rio Grande in Texas between El Paso and its confluence with the Pecos River where Hubbs (1958) had earlier documented the species to occur. However, Chernoff *et al.* (1982) noted that much of this stretch, particularly the Rio Grande between El Paso and the mouth of the Rio Conchos, is at times dry. Sublette *et al.* (1990) documented the former occurrence of the silvery minnow in the Rio Grande from Caballo Reservoir, NM downstream to El Paso, TX, another stretch that is now often dry and from which the silvery minnow has been extirpated. Thus, between 1950 and 1991, the Rio Grande silvery minnow was extirpated from that portion of its historic range lying downstream of Caballo Reservoir to the Gulf of Mexico.

Observations suggest that during periods of such extreme water scarcity, the silvery minnow seeks out cooler pool habitats associated with overhead cover, irrigation return flow, and shallow groundwater (Service 1994; Service 2007b). During periods of no flow, the silvery minnow is thought to have survived in the irrigation ditches and drains, the reaches above the diversions, and in channels maintained by irrigation return flows or leakage from the diversion dams. River drying increases silvery minnow mortality rates due both to decreasing water quality in temporary pools and the eventual disappearance of such pools as water seeps into the substrate.

It has been proposed that the entrainment of silvery minnows (primarily eggs and larvae) in the infrastructure of irrigation systems that derive water directly from the Rio Grande could be a factor contributing to the decline of the species (e.g., Service, 1999). Egg entrainment in irrigation canals has been monitored since 2001 (e.g., Reclamation 2003). These studies show that recent management actions have minimized egg entrapment in irrigation infrastructure.

*Water Quality for Rio Grande Silvery Minnow Habitat*

Water quality in the Middle Rio Grande varies spatially and temporally throughout its course primarily due to inflows of groundwater, as well as surface water discharges and tributary delivery to the river. Factors that are known to cause poor fish habitat include temperature changes, sedimentation, runoff, erosion, organic loading, reduced oxygen content, pesticides, and an array of other toxic and hazardous substances. Both point source pollution (e.g., pollution discharges from a pipe) and non-point source pollution (i.e., diffuse sources) affect Rio Grande water quality.

The expansion of cities and agriculture along the Middle Rio Grande may have adverse effects on river water quality (Service 1994; Service 2007b). During low flow periods, the increased proportion of municipal and agricultural discharge to native flow may allow pollutants to significantly degrade water quality. Agricultural water use appears to reduce nutrient availability in return flows to the river (Van Horn and Dahm 2008). Recent water-quality data have not identified limiting factors for silvery minnows or habitat (NMED 2001, 2009; Service 2004; Marcus *et al.* 2005; Marcus *et al.* 2010).

*Rio Grande Silvery Minnow Population Genetics*

While population size (N) is an important variable for endangered species survivorship, the effective population size (Ne) of an endangered species is also crucial because it describes the genetic diversity of the population (Minckley *et al.* 2003). Genetic diversity determines the ability of species to cope with environmental variability (Gilpin and Soulé 1986). The effective size (and therefore genetic diversity) is reduced by genetic drift and inbreeding. Small effective population size can negatively impact long-term survival because reduced genetic variability can translate into a reduced ability to adapt to environmental changes. These values are poorly understood for most species (Minckley *et al.* 2003). The silvery minnow Ne is moderately low based on different estimators (PBS&J 2011).

Due to the increased efforts in captive propagation, recent studies by the Collaborative Program have focused on the genetic composition of the silvery minnow. Several studies since 2003 have demonstrated a decline in overall mitochondrial mtDNA and gene diversity in the silvery minnow (e.g., Osborne *et al.* 2005; Turner *et al.* 2006). The results are consistent with smaller overall population numbers and/or increasing relatedness of the females. In addition, studies need to be conducted on the genetic effects of stocking hatchery fish. Currently, these fish are artificially spawned in groups, where fish are assumed to form pairs. However, competition between males and gametic competition could produce effective numbers far smaller than those that are assumed. The effect of communal spawning on effective number must be assessed so the genetic consequences of stocking hatchery fish can be accurately measured and a true effective population number can be determined.

Finally, the changes in gene frequency caused by fish culture practices must be assessed (Minckley *et al.* 2003). Osborne *et al.* (2006) reported that genetic heterozygosity in captive-reared fish and wild fish were the same, with a loss only in allelic diversity. They also stated that hatchery-reared fish stocked into the wild will cause a lower effective breeding number and could cause a reduction in fitness of the entire population. However, the effects of domestication and inadvertent selection have not been studied in the silvery minnow. Additional problems may occur due to the increased survival in wild genotypes brought into the hatchery that would have died in the wild. These fish survive due to lack of predation and to increased care, and then are stocked back into the river as brooders and are still considered to be “wild fish.” This is critical because captive-reared fish could affect the natural population’s level of fitness.

*Competition, Predation, Disease*

Accidental or intentional releases of fishes outside of their native ranges (including bait and aquarium sources) have established numerous exotic fish species in the Rio Grande Basin (Sublette *et al.* 1990), representing potential competitors or predators of the silvery minnow. The silvery minnow evolved sympatrically with about 90 other fish species, including those with similar feeding habitats. Competition among fish species often evokes resource partitioning through selective and interactive segregation.

Predation and competition with other fish species has been cited as a factor possibly contributing to the decline of the species (e.g., Service 1999). Predation by piscine and avian predators upon silvery minnows has not been quantified, but probably has a minor role in declining silvery minnow populations (Service 1994; Service 2007b). Swimming performance of silvery minnows may provide a reasonable capability for escaping predators (Bestgen *et al*. 2003). Experiments using brassy minnows (*H. hankinsoni*) exhibited a change in habitat use when predators are present (Schlosser 1988). The turbidity of the Rio Grande serves to lessen the impacts of would-be predators on silvery minnows because the effective predatory strike zone is shortened.

Fish confined to pools during periods of low flow may experience outbreaks of *Ichthyophthirius multifilis* (caused by a protozoan and commonly called "ick") or *Lernaea* (a parasitic copepod, Service 1994; Service 2007b). Ongoing studies are examining the impact of disease and parasites on silvery minnows (Service unpublished data).

## 4.4 Other Threatened and Endangered Rio Grande Species

The New Mexico Meadow Jumping Mouse was historically found along the Rio Grande, but there are no known populations or critical habitat in the project area.

The Northern Aplomado Falcon (*Falco femoralis*) is considered extirpated from New Mexico, with an experimental non-essential population based on the Armendaris Ranch in Socorro County. The Interior Least Tern (*Sternula antillarum athalassos*) is a vagrant along the Rio Grande.

The Mexican Spotted Owl *(Strix occidentalis lucida*, owl*)*, Piping Plover *(Charadrius melodus*, plover*)*, and Chiricahua leopard frog (*Lithobates chiricahuensis*, frog) are federally Endangered or Threatened species of concern that may occur in Bernalillo or Valencia counties (Service 2013), but they are unlikely to occur in the project area (Table 9).

The primary constituent elements for the owl's critical habitat include mixed-conifer forest at elevations above 6,000 feet (Service 2004). The proposed action area does not have the appropriate vegetation for the species with an elevation less than 4,946 feet (NGVD29, Rio Grande at Albuquerque Gage, USGS 2015). The plover overwinters in Texas and breeds along Great Plains rivers and lakes. There is no critical habitat designated along the Rio Grande in New Mexico.

The frog occurs at elevations of 3,281 to 8,890 feet in southeastern Arizona and western New Mexico. The nearest populations to the project area are along the Mogollon Rim in the mountains of west-central New Mexico. The Chiricahua leopard frog inhabits montane and river valley cienegas, springs, pools, streams, and rivers.

The Alamosa springsnail *(Tryonia alamosae)*, Chupadera springsnail *(Pyrgulopsis chupaderae)*, Socorro springsnail *(Pyrgulopsis neomexicana)* and Socorro isopod *(Thermosphaeroma thermophilus)* are endemic to isolated mountain springs in Socorro County, New Mexico. The proposed action area does not extend into Socorro County.

The Pecos sunflower (*Helianthus paradoxus* Heiser) exists within the La Joya Unit of the Ladd S. Gordon Waterfowl Complex downstream of the project area.

**Table 9. Listed species unlikely to occur in the project area.**

| New Mexico Meadow Jumping Mouse | Interior Least Tern | Northern Aplomado Falcon | Mexican Spotted Owl | Piping Plover |
|---|---|---|---|---|
| Occurs at Bosque del Apache NWR. No populations in project area | Vagrant along Rio Grande in New Mexico. | Experimental population in New Mexico. | Occurs in mixed-conifer forest at elevations above 6,000 feet | Breeds along Great Plains rivers and lakes. |
| **Chiricahua Leopard Frog** | **Alamosa Springsnail** | **Chupadera Springsnail** | **Socorro Springsnail** | **Socorro Isopod** |
| Occurs at elevations above 3,281 feet in western New Mexico | Occurs in isolated springs in Socorro County, New Mexico | Occurs in isolated springs in Socorro County, New Mexico | Occurs in isolated springs in Socorro County, New Mexico | Occurs in isolated springs in Socorro County, New Mexico |
| **Pecos Sunflower** | | | | |
| Occurs at La Joya Refuge. No populations in project area | | | | |

# 5 - Analysis of Effects of Proposed Action

This chapter provides an analysis of the effects of Corps' proposed action on listed species and their designated and proposed critical habitat. "Effects of the action" refers to the direct and indirect effects of the proposed action on listed species or critical habitat together with the effects of other activities that are interrelated or interdependent with that action, if any. These effects are considered along with the environmental baseline to determine the overall effect on a species (50 CFR § 402.02). For purposes of this BA, effects on listed species and critical habitat are analyzed individually with respect to the proposed action.

This chapter first addresses the analysis of specific project features or activities on the Rio Grande silvery minnow, the Southwestern Willow Flycatcher, and the Western Yellow-billed Cuckoo, and designated or proposed critical habitat for each species. A detailed description of the proposed action is found in Chapter 2. For ease of review, a brief synopsis of the discretionary activity associated with each component feature of the proposed action is provided in this Chapter as well. This is followed by a section addressing effects on other listed species, and a final summary of all effect determinations (Section 5.5).

## 5.1 Earthen Levee Construction

### 5.1.1 Effects on riparian vegetation

*Vegetation removed due to levee footprint*

The basal extent of the proposed levee was superimposed on geo-referenced aerial photography from 2002 (Callahan and White 2004) and on riparian vegetation coverage mapped in 2012 (Siegle *et al.* 2013). Detailed levee information was imported into ArcGIS for spatial analysis of effects on existing vegetation and changes in floodway area.

Generally, the proposed levee construction footprint would extend beyond the riverward toe of the existing spoil bank throughout the project area, removing approximately 265.8 acres of riparian vegetation in the floodway (Table 10). Vegetation removal and clearing-and-grubbing activities for all proposed construction shall only occur between September 1 and April 15 to avoid disturbance of nesting migratory birds (flycatchers and cuckoos). If needed, vegetation removal outside of that period would only be performed after a survey by a biologist confirms that disturbance to nesting migratory bird species would be avoided.

*Vegetation altered to accommodate the Vegetation Management Zone*

The Corps Engineer Technical Letter 1110-2-583 (30 April 2014) requires that no vegetation other than grasses be allowed to grow on the levee or within 15 feet of either toe of the levee (see Appendix C). During construction, existing vegetation would be removed adjacent to the riverward toe of the proposed levee to create the Vegetation Management Zone. Removal methods may include clearing and grubbing, scraping, or root-plowing and raking. Following construction, a 15-foot-wide zone (totaling 87.5 acres) along the riverward toe of the levee would be permanently maintained to be devoid of all vegetation except grass. Throughout the action area, the 15-foot strip landward (drainward) of the spoil bank is a maintenance road and is unvegetated or supports very sparse grasses and weeds.

**Table 10. Summary of existing habitat, affected riparian vegetation, and affected flycatcher and cuckoo habitat in the proposed action. Cuckoo habitat acreage includes overlapping flycatcher habitat.**

| Riparian Floodplain Vegetation | | | Subset of suitable avian habitat[a] | |
|---|---|---|---|---|
| Native vegetation (27.6%) | Existing | Affected (2.3%) | Cuckoo | Flycatcher |
| C/CW1 (cottonwood/coyote willow) | 61.3 | 12.0 | 12.0 | 3.8 |
| C/CW2 | 242.7 | 48.8 | | |
| C/CW3 | 76.9 | 3.7 | 3.7 | 1.2 |
| C/CW4 | 639.0 | 14.6 | | |
| C/CW5 (shrub) | 197.3 | 9.0 | | 4.3 |
| C/CW6 (meadow) | 29.7 | | | |
| Tree willow-C/CW3/5 | 103.7 | 2.6 | 1.8 | 0.8 |
| Marsh (6) | 204.3 | | | |
| Native vegetation subtotal | 1555.0 | 68.9 | 17.4 | 10.1 |
| | | | Subset of moderately suitable habitat [a] | |
| Mixed gallery forest / shrubs (1-5 ) (68.8%) | Existing | Affected (2.8%) | Cuckoo | Flycatcher |
| C/CW with Russian olive | 2316.0 | 61.2 | 60.3 | 19.0 |
| C/CW with salt cedar | 934.1 | 42.8 | 42.8 | 2.7 |
| Mixed invasive forest | 341.6 | 15.5 | 11.3 | 9.8 |
| Russian olive dominated forest | 96.7 | 6.5 | 1.0 | 2.9 |
| Salt cedar dominated forest | 186.4 | 6.1 | | |
| Mixed gallery forest subtotal | 3874.8 | 167.3 | 115.3 | 34.4 |
| Other classifications | Existing | Affected | | |
| Open area (herbaceous vegetation or bare) | 159.1 | 28.8 | | |
| Roads / canals | 44.2 | 0.8 | | |
| Other subtotal | 203.3 | 29.6 | 0.0 | 0.0 |
| Total Area | 5633.1 | -265.8 | 132.8 | 44.5 |
| Vegetation management zone | | +87.5 | | |
| Net active floodway area loss | | -178.3 | | |

*a. Flycatcher gallery forest habitat is considered suitable for cuckoos.*

**Table 11. Affected vegetation (acres) for the recommended plan levee area.**

| Levee Unit | Levee length (mi) | Suitable flycatcher habitat (acres) | Moderately Suitable flycatcher habitat (acres) | Suitable cuckoo habitat (acres) |
|---|---|---|---|---|
| Mountain View | 4.35 | 0.0 | 0.4 | 13.2 |
| Isleta West | 3.18 | 0.0 | 2.0 | 4.6 |
| Belen East / West | 40.27 | 1.0 | 41.1 | 115.0 |
| Total | 47.8 | 1.0 | 43.5 | 132.8 |

*Summary of affected vegetation*

The construction footprint of the levee beyond the existing spoil bank totals 265.8 acres, of which 87.5 acres would be replanted and managed as the Vegetation Management Zone. Table 10 summarizes the area of extent and type of vegetation affected by the proposed earthen levee, as well as the vegetation types that would be converted to grassland on the levee and within the Vegetation Management Zone. Approximately 0.65 acres of wetland pond (PUBFh) with cattails adjacent to the levee outside the floodway on Isleta Pueblo may be partially filled to support wet meadow or sedges for the Vegetation Management Zone. Approximately 71.3 acres of existing vegetation would be converted to herbaceous vegetation (grass/ sedges; Hink and Ohmart structure 6) for Vegetation Management Zone. There would be 15.7 acres of open herbaceous area in the Vegetation Management Zone that would be re-seeded with grass.

Following construction, the Corps' operation and maintenance manual would require the local sponsor to maintain the Vegetation Management Zone (the levee itself and the 15-foot-wide strip adjacent to each toe) to preclude the establishment of all vegetation except grass. The Vegetation Management Zone (87.5 acres) in the active floodway would be periodically mowed, when dry. If required, spot-application of approved herbicides would be used to prevent colonization by invasive weed species.

*Mitigative Vegetation Establishment*

All areas disturbed by construction activities, except the crown of the engineered levee, would be re-vegetated following construction. These areas include staging and access areas, levees side-slopes, the Vegetation Management Zone, and additional locations within the floodway. Approximately 87.5 acres would be planted and maintained as grassland within the riverside corridor of the Vegetation Management Zone.

The Corps would mitigate with appropriate levels of native shrubs and trees (up to 30% tree canopy cover) on or in close proximity to each phase of levee construction. The mitigation plan measures include vegetation management of 265.8 acres (C/CW1-4), removal of invasive plants species, planting variable densities of shrubs and trees, terrace lowering and willow swales, and other riparian ecosystem measures. The 265.8 acres would incorporate mitigation for the flycatcher and cuckoo. Table 10 identifies flycatcher habitat as10.1 acres of suitable and 34.4 acres of moderately suitable (total 44.5 acres) and 132.8 acres of affected cuckoo habitat. The 44.5 acres of terrace/swales would mitigate for the loss of flycatcher habitat, while the 128 acres of native riparian vegetation and 158 acres of mixed gallery forest would be mitigated with vegetation management. The Corps is coordinating with MRGCD, Reclamation, the Pueblo of Isleta, and Valle de Oro National Wildlife Refuge on possible locations for mitigating riparian habitat.

*Placement of Buried Riprap*

Riprap would be used for erosion protection along the riverward slope and toe of the engineered levee. In most of this area, riprap would be buried at depths at the toe of the levee. Excavation for the placement of buried riprap would be limited to 500 linear feet at a given time. Should groundwater be present in a trench when it is excavated to bury riprap, pumps would be used to temporarily dewater the trench before placing riprap. Based on previous experience in dewatering construction sites, normal water levels in and adjacent to the trench should resume within 12 hours following the cessation of pumping. To assure that pumping would not stress riparian vegetation adjacent to the temporarily dewatered trench, this project includes a requirement to monitor groundwater elevation and oxygen content during construction activities. The Corps believes that the short-term and relatively minor lowering of the local water table for placement of buried riprap would not measurably affect adjacent riparian and aquatic resources.

#### 5.1.2 Southwestern Willow Flycatcher

Most of the flycatcher territories in the southern end of the Belen reach have not been proximally located to the proposed levee footprint. The location of these isolated, territorial birds has changed from year-to-year throughout this approximately 30-mile-long reach. Relatively few flycatchers (3-15 pairs) have nested recently (2011-2015) along the edge of the river in the project area (Table 6). The relatively small number of nests occurring within 0.25 miles of the proposed levee footprint indicates the direct effects will be small and avoidable through the construction schedule. The largest aggregation of flycatcher nests in the Belen reach is more than a mile downstream of the project area. A smaller cluster of nests occurs within 0.25 miles of the Belen West levee alignment. Traffic and construction noise effects on flycatcher breeding behavior and nesting success have not been quantified for effects determinations. Conservation measures for grubbing and construction will address changes in nest locations for the life of the project.

While all woody riparian habitat may have some general value to the flycatcher, not all tree and shrub stands possess the pertinent characteristics (e.g., stature, density, cover) identified as primary constituent elements (PCEs) of critical habitat (Service 2005, Service 2011). Considering these PCEs, along with the known distribution of breeding flycatchers in 2006 through 2014, Reclamation has determined the flycatcher habitat suitability of all riparian vegetation in the action area (Ahlers *et al.* 2010). The “Suitable” and “Moderately suitable” classifications included vegetation types that included all or most of the PCEs for flycatcher habitat. Most of the flycatcher habitat occurs in the Belen East and West reach (Table 11). Other categories also mapped included “Unsuitable” habitat and “Non-habitat” (the latter including upland, grassland, and un-vegetated areas).

Estimates of flycatcher habitat suitability of vegetation affected by the proposed action from the South Diversion Channel to Hwy 346 were based on Siegle *et al*. (2013) and Hatten *et al*. (2007). Approximately 52% of the vegetation altered or removed by the proposed action is composed of mixed gallery forest with invasive trees (167.3 acres) or other habitat types unsuitable for breeding flycatchers (Table 10). Throughout the action area, approximately 44.5 acres of Suitable or Moderately Suitable flycatcher habitat would be altered or removed. The proposed action includes 44.5 acres of dense riparian shrub plantings which, along with natural germination, would develop into, at least, Moderately Suitable flycatcher habitat.

All riparian habitat affected by the proposed action occurs in a narrow strip immediately adjacent to the riverward toe of the existing spoil bank. Geo-referenced locations of flycatchers associated with surveys conducted by Reclamation (see references in Section 6.1) indicate that breeding birds have a propensity to establish territories along or near the bank of the active channel, ranging from 50 to 300 feet from the spoil bank alignment.

Proposed mitigation (Appendix D) would reduce the density of non-native vegetation (measure A) and increase native riparian vegetation (measure B), which should increase the area of suitable flycatcher habitat in the project area. Implementation of measure D would increase the quality and resilience of the riparian vegetation mitigation measures by improving connectivity with groundwater and floodplain inundation.

Given these considerations, with the incorporation of the proposed mitigation measures (Appendix D) and the Conservation Measures (see section 2.2.8), earthen levee construction may affect, but would not likely adversely affect the flycatcher, and would not likely adversely affect designated or critical habitat for the species.

#### 5.1.3 Western Yellow-billed Cuckoo

All riparian habitat affected by the proposed action occurs in a narrow strip immediately adjacent to the riverward toe of the existing spoil bank. This habitat may be valuable for the cuckoo; however, it has not shown to be used for breeding as no detections or territories have occurred within or near the proposed action area during Reclamation's cuckoo surveys from 2009-2015. The mitigation to compensate for adverse effects to 44.5 acres of flycatcher habitat would also produce high- and moderate-value habitat for the cuckoo. The removal of invasive plants species, increased planting densities of shrubs and trees, terrace lowering and willow swales, and other riparian ecosystem measures would mitigate for the other 132.8 acres of cuckoo habitat by creating a mosaic of vegetation.

Suitable habitat for the cuckoo includes a broader range of riparian vegetation than the flycatcher. The PCEs for cuckoo habitat include riparian woodlands, adequate prey base, and dynamic river processes. Table 10 classifies vegetation into high or moderate value for cuckoos. The variable size of cuckoo territories (25-200+ acres) and nesting patterns allow cuckoos to opportunistically follow their food supply. The effects of construction and other disturbances are difficult to quantify because of the territory size and locations away from the existing spoil bank. Traffic and construction noise effects on cuckoo breeding behavior and nesting success have not been quantified for effects determinations. The acreage of affected high- and moderate-value cuckoo habitat (132.8 acres) represents about 4% of the total floodway area.

Proposed mitigation (Appendix D) would reduce the density of non-native vegetation (measure A) and increase native riparian vegetation (measure B), which should increase the area of suitable cuckoo habitat in the project area. Implementation of measure D would increase the quality and resilience of the riparian vegetation mitigation measures by improving connectivity with groundwater and floodplain inundation.

Given these considerations, with the incorporation of the proposed mitigation measures (Appendix D) and the Conservation Measures (see section 2.2.8), and plantings described in the previous section, the Corps' action may affect, but would likely not adversely affect, the Yellow-billed Cuckoo from vegetation removal and alteration. Given the extent of available higher quality habitat within the action area, proposed critical habitat would not likely be adversely modified as a result of these activities.

#### 5.1.4 Rio Grande Silvery Minnow

The areas affected by the levee footprint and establishment of the Vegetation Management Zone are within the Rio Grande floodway but are infrequently inundated by river flows. All vegetation removal activities would occur on dry ground and therefore these activities may affect but are not likely to adversely affect silvery minnow. Levee construction at the Atrisco Drain outfall (Isleta West Unit) may occur up to the water's edge in the drain. Silt curtains (Conservation Measure 11) may be deployed to provide a buffer zone adjacent to construction to minimize disturbance to silvery minnows in the drain. The proposed action may affect, likely to adversely affect the silvery minnow in a small area of the construction zone.

The critical habitat PCEs elements hydrologic regime, instream habitat, and fine sediments for substrate, water temperature, or water conditions would not be adversely affected by levee construction. Removal of riparian vegetation for replacing the spoil banks is a modification of critical habitat, temporarily removing cover for young silvery minnows if the floodplain is inundated (10% chance event) to the toe of the levee prior to the establishment of herbaceous vegetation. Riprap at the toe of the levee would be buried under the Vegetation Management Zone (Appendix C). The rolling berms in the Vegetation Management Zone would create slackwater habitat. Establishment of the Vegetation Management Zone would preclude the establishment of any native woody riparian vegetation, but would not preclude inundation during periods of higher flows. When inundated, silvery minnows can still use these areas for foraging, refugial and spawning habitat. Therefore, the proposed action may affect, likely to adversely affect silvery minnow critical habitat.

### 5.2 Altered Floodplain Inundation

The existing spoil bank has been predicted to fail after several days of a 7000-cfs discharge (USGS Central Ave gage). Currently, spoil bank failure would periodically result in inundation throughout the historical floodplain on either or both sides of the river. There are approximately 13,495 acres outside the floodway that may be affected by a spoil bank breach. Flow conditions within the 7,247 acre floodway up to the breaching or failure discharge would be the same with or without the proposed action.

The native riparian plant and animal species are adapted to the scour and deposition processes inherent in Southwestern sand-bed river systems. Affected plant communities outside the baseline floodway area include: rural and suburban yards; agricultural fields and edges; upland Chihuahuan desert scrub; and wetland and riparian communities. These plant communities may be subjected to substrate scouring or extensive sediment deposition, with additional stress resulting from extended inundation, depending on the tolerance of plant species within each community.

The alteration of floodplain inundation due to the proposed action would be of an extremely limited duration. Historically, spoil banks have failed, but were repaired as soon as equipment can reenter the area of the breach. This pattern would continue in the without-project condition.

Breached or damaged spoil banks would be quickly repaired or rebuilt by MRGCD along the existing alignment.

### 5.2.1 Effects of Floodplain Inundation

The principal effect of the proposed action is that discharges higher than 7000 cfs would be safely contained within the 7,247 acre floodway. The differential extents of inundation are first described below, followed by changes in water depth and velocity specific to the minnow, flycatcher, and cuckoo.

With-project water depths within the proposed action area were reviewed to evaluate potential effects to nesting birds from changes in hydrologic characteristics. After construction of a new levee in the proposed action area, the water surface of the 1%-chance event was similar to the without-project conditions within most of the proposed action area.

*1%-Chance-Event Floodplain*

The 1%-chance flood event would be approximately 18,900 cfs (USGS Central Ave gage; Table 3), with the depth of inundation for the 1%-chance event ranging up to 8 feet. Without the proposed action, damages to ecological resources from 1.0%-chance flood events are expected to occur both within the current floodway and across all property on the historical floodplain outside the floodway (spoil banks).

With the proposed action, all flow for the 1%-chance event is estimated to inundate approximately 7,247 acres of the floodway (between the spoil banks). Flooding and potential ecological damages would be eliminated from approximately 13,495 acres of the floodplain on both sides of the river. Within the floodway, however, potentially adverse impacts to riparian and aquatic communities would still occur following levee construction. Currently, the 1%-chance flood event has the potential to scour the substrate and remove, or otherwise damage, vegetation within the Rio Grande floodway.

Because of the rarity of the 1%-chance event, quantitative data on ecological impacts are not available for the Southwestern United States. Potential impacts likely include the physical destruction of vegetation from high flow velocities, soil erosion, and/or sediment deposition; the temporary displacement of non-aquatic animals; and the death (primarily through drowning) of animals that cannot escape floodwaters. Qualitatively, ecological effects within the floodway following construction of a new levee would be as extensive and similar to the without-project condition. Although inundation, scouring and sediment accretion are natural processes of sand-bed rivers such as the Rio Grande, the recovery of plant and animal communities following the 1%-chance flood would be slow.

*10% Chance-Event Floodplain*

The more probable 10%-chance unregulated flood event is approximately 10,300 cfs (USGS Central Ave gage; Table 3), with the depth ranging up to 2 feet. Without the proposed action, damages are expected to result in spoil bank failure and extensive inundation—between 469 up to 13,495 acres of the valley depending on the side of the river and extent of a levee breach. Because spring runoff floods would be regulated by upstream reservoirs, this event would more likely result from rainstorm activity, and, therefore, would be of short duration. Therefore, resultant ecological damage from scouring, deposition, and inundation would be significantly less than for the 1%-chance event.

With the proposed action, all flow for the 10%-chance event would be contained to the floodway (7,247 acres) and eliminate ecological damages from approximately 13,495 acres of the floodplain on both sides of the river. The magnitude of the 10%-chance flood event is within the range of unregulated snowmelt and thunderstorm flows recorded in the Middle Rio Grande over the past 100 years, and is well within the flow regime to which native riparian species (cottonwood, willow) have adapted. The with- versus without-project differential in depths and velocities of the 10%-chance events are nominal; therefore, the extent of adverse effects would be similarly small.

Retaining flood flows within the floodway would be expected to slightly increase both scouring and sediment accretion. These dynamic processes have the potential to support the regeneration of new riparian habitat patches. The net result would be a continually changing mosaic of suitable riparian floodplain habitat for the flycatcher, cuckoo, and the silvery minnow.

#### 5.2.2 Southwestern Willow Flycatcher

The average flycatcher nest height ranges from 4.6 feet (1.40 m. Graber *et al.* 2007) to 10.7 feet (3.27 m, Ahlers and Moore 2009). The height of denser vegetation and substrate influence nest height (Ahlers and Moore 2009; Paxton *et al.* 2007). Assuming that future flycatcher nests within the project area are a minimum of 4 feet above the ground surface, the probability of inundating eggs or nestlings is only somewhat likely in a 1%-chance event for both with- and without-project conditions. The average maximum water depth for with- and without project conditions for a 1%-chance event is approximately 3 to 5 feet throughout most of the project area. Implementation of mitigation measure D would improve floodplain inundation for about 44.5 acres of riparian habitat. Therefore, the slightly increased floodplain inundation between the constructed levees may affect, but not likely to adversely affect the flycatcher and may affect, but not likely to adversely affect flycatcher designated or proposed critical habitat.

#### 5.2.3 Western Yellow-billed Cuckoo

Cuckoo nests have a lower probability of being inundated than flycatcher nests because they have a greater range of nest height 4-42 feet (1.3 to 13 m at each nest), and a faster breeding cycle (17 days). The average maximum water depths for with- and without project conditions for a 1%-chance event is approximately 3 to 5 feet (0.9-1.5 m) throughout most of the project area. However, even without-project conditions for a 1%-chance event would have similar results. Implementation of mitigation measure D would improve floodplain inundation for about 44.5 acres of riparian habitat. Therefore, the slightly increased floodplain inundation between the constructed levees may affect, but not likely to adversely affect the cuckoo and may affect, but not likely to adversely affect cuckoo designated or proposed critical habitat.

#### 5.2.4 Rio Grande Silvery Minnow

Without the project, floodplain inundation in 2005 has resulted in vertical accretion on the islands and floodplain (Bauer 2007; Makar and Aubuchon 2012). The floodplain and river channel are in equilibrium with the sediment through the project area. A breach of the spoil bank during flood flows, under future without-project conditions, would discharge silvery minnows and other fish into the adjacent drains or onto the floodplain. A few silvery minnows that find their way into a drain may return to the river. Many fish would likely be stranded, and eventually die on the floodplain outside the existing spoil banks.

Although periodic floodplain inundation outside of the existing floodway has the potential for providing allochthonous material to the Rio Grande, historic and existing land uses outside the floodway also present potential threats to water quality. Following a spoil bank breach, floodwaters would likely be of low quality and could result in the introduction of potential contaminants (sewage, petroleum products) to the river, and, therefore, may not be considered beneficial to aquatic habitat and organisms.

The proposed construction would reduce the risk of silvery minnow stranding outside of the floodway due to a spoil bank breach during a flood event. Conversely, retaining higher flows in the floodway would contribute to scouring and re-distribution of sediment creating complex aquatic and floodplain habitat appropriate for all life history stages. Implementation of mitigation measure D would improve floodplain inundation for up to 44.5 acres of nursery habitat for the silvery minnow. Therefore, the proposed action may affect but is not likely to adversely affect silvery minnow. It would not affect the hydrologic regime, instream habitat, fine sediments for substrate, water temperature or water conditions. Therefore the proposed action may affect but is not likely to adversely affect designated critical habitat.

## 5.3 Change in Floodway Area Due to Physical Footprint of Levee

The basal extent of the proposed levee and associated features was superimposed on geo-referenced aerial photography from 2012. The location of the riverward toe of the proposed levee relative to the current riverward toe of the spoil bank was estimated throughout the reach. The differential extent of the proposed levee was calculated and formed the basis for the evaluation of potential changes to the floodway area. Table 10 summarizes the expected changes to the existing floodway and floodplain areas. Throughout the entire length of the proposed levee, the net change in area as a result of levee construction would be a net loss of approximately 265.8 acres and 265.8 acres of habitat mitigation (Table 12). This net loss of active floodway area, and the distance of the levee alignment from the active channel would have no direct effect on aquatic habitat within the proposed action area.

**Table 12 Comparison of affected habitat and habitat mitigation for the recommended plan.**

| Recommended Plan<br>Levee length 47.8 miles | Southwestern Willow Flycatcher | Western Yellow-billed Cuckoo | Rio Grande silvery minnow |
|---|---:|---:|---:|
| Net active floodway loss | 178.3 acres | 178.3 acres | 178.3 acres |
| Net riparian habitat loss | 265.8 acres | 265.8 acres | 265.8 acres |
| Species critical habitat loss | 44.5 acres | 132.8 acres | 65.2 acres |
| Recommended Plan Mitigation | | | |
| Vegetation management (Measures A & B) | 265.8 acres | 265.8 acres | 265.8 acres |
| Vegetation management zone (Measure C) | 0 acres | 87.5 acres | 87.5 acres |
| Floodplain features (Measure D) | up to 44.5 acres | up to 44.5 acres | up to 44.5 acres |
| Pond / wetland features (Measure E) | 2.58 acres | 2.58 acres | 2.58 acres |
| **Total proposed habitat mitigation** | **265.8 acres** | **265.8 acres** | **265.8 acres** |

### 5.3.1 Southwestern Willow Flycatcher

Throughout the entire length of the proposed levee, the net change to riparian habitat area as a result of levee construction would be a net loss of approximately 265.8 acres ( Table 10). Approximately 87.5 acres of the proposed action construction footprint would be planted with grasses as part of the Vegetation Management Zone. Under adaptive management, mitigation measure D would increase the quality and resilience of the riparian vegetation for about 44.5 acres within the floodway. Considering the net loss in active floodway area, and the distance that the levee alignment is set back from the channel, construction of the levee along the proposed alignment may affect, but would not likely adversely affect the flycatcher. Considering the loss of 44.5 acres of suitable flycatcher habitat with mitigation of 44.5 acres of terraces and swales, and mitigation for the loss of unsuitable flycatcher habitat (44.5 acres), the proposed action may affect, likely to adversely affect designated flycatcher critical habitat.

### 5.3.2 Western Yellow-billed Cuckoo

The net change to riparian habitat area as a result of levee construction would be a net loss of approximately 265.8 acres (Table 10). Approximately 87.5 acres of the proposed action construction footprint would be planted with grasses as part of the Vegetation Management Zone. Under adaptive management, mitigation measure D would increase the quality and resilience of the riparian vegetation for about 44.5 acres within the floodway. Considering the net loss in active floodway area, and the distance that the levee alignment is set back from the channel, construction of the levee along the proposed alignment may affect, but would not likely adversely affect the cuckoo. Considering the net loss in riparian habitat area (265.8 acres) including 132.8 acres of suitable cuckoo habitat, with planned mitigation of approximately265.8 acres, the proposed action may affect, likely to adversely affect designated cuckoo critical habitat.

### 5.3.3 Rio Grande Silvery Minnow

The net change to active floodway area as a result of levee construction would be a net loss of approximately 65.2 acres (Table 10) of critical habitat that extends to the toe of the spoil piles. The 265.8 acres of riparian habitat mitigation may provide suitable floodplain habitat, and the herbaceous plant cover on the levee and vegetation management zone may also be suitable at appropriate flows. Inundated floodplain habitat normally provides foraging, spawning, and nursery habitat for the silvery minnow, and improve critical habitat constituent elements (instream habitat, substrate). Hydraulic modeling indicates that even during the 1%-chance flow (29,900 cfs) there will be refugial areas in the floodway providing lower velocity habitat for silvery minnows. The proposed terrace lowering under adaptive management for flycatcher habitat would increase available spawning and rearing habitat at more frequent spring flows by lowering the floodplain surface. The proposed action may affect but is not likely to adversely affect the Rio Grande silvery minnow. The proposed action would not affect the hydrologic regime (i), instream habitat (ii), fine sediments for substrate (iii), water temperature (iv), or water conditions (v). Therefore the change to the floodway footprint may affect, likely to adversely affect critical habitat for the silvery minnow.

## 5.4 Other Threatened and Endangered Species

There is no critical habitat for the New Mexico Meadow Jumping Mouse in the proposed action area. The entire proposed action area is considered unoccupied by the Service. The implementation of the proposed action would not affect the mouse, and would not affect designated critical habitat for the species.

The Interior Least Tern is a vagrant in the proposed action area, occasionally present along the Rio Grande in central and southern New Mexico. Its principal foraging and resting areas would be along the river channel on un-vegetated sandy substrate.

Northern Aplomado Falcons are known to nest on the Armendaris Ranch, almost 100 miles downstream of the proposed action area, and inhabit desert grasslands, rarely visiting riparian areas. Given the distance to the nearest nesting area, the relatively rare occurrence of falcons in the action area, the low disturbance factor of the potential construction activities, the implementation of the proposed action would not affect the Northern Aplomado Falcon.

The nearest stand of Pecos sunflower occurs outside the proposed action area at La Joya State Waterfowl Management Area. The implementation of the proposed action would not affect the Pecos sunflower, and would not affect designated critical habitat for the species.

The Mexican Spotted owl *(Strix occidentalis lucida)*, Piping Plover *(Charadrius melodus)*, and Chiricahua leopard frog (*Lithobates chiricahuensis*), Alamosa springsnail *(Tryonia alamosae)*, Chupadera springsnail *(Pyrgulopsis chupaderae)*, Socorro springsnail *(Pyrgulopsis neomexicana)* and Socorro isopod *(Thermosphaeroma thermophilus)* occur outside the proposed action area. The proposed action would not affect these species.

## 5.5 Summary of Effects, and Endangered Species Act Consultation

The following along with Table 13 summarizes the findings in the sections above and the Corps' determination of effects for the proposed action:

- May affect, but not likely to adversely affect, the Southwestern Willow Flycatcher.
- May affect, likely to adversely affect, designated and proposed critical habitat for the Southwestern Willow Flycatcher.
- May affect, but not likely to adversely affect, the Western Yellow-billed Cuckoo.
- May affect, likely to adversely affect, designated or proposed critical habitat for the Western Yellow-billed Cuckoo.
- May affect, likely to adversely affect, the Rio Grande silvery minnow.
- May affect, likely to adversely affect, designated critical habitat for the Rio Grande silvery minnow.
- Would have no effect on the New Mexico Meadow Jumping Mouse.

- Would have no effect on designated New Mexico Meadow Jumping Mouse critical habitat.
- Would not affect the Interior Least Tern, Northern Aplomado Falcon, and Pecos sunflower.

### 5.6 Reinitiation of Consultation

During the relatively long construction period (up to 20 years) for the proposed action, changes in design, construction methods, or the condition of ecological resources could alter the determinations of effects to listed species that are made by the Corps or Service at the present time. Therefore, this Section 7 consultation is being conducted programmatically to adapt proposed activities to changed conditions. The Corps, in conjunction with other concerned agencies, will monitor the condition of listed species, hydrology, and ecological resources in the action area throughout the construction period.

The criteria for reinitiation of formal consultation are contained in 50 CFR §402.16:

> "Reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in the biological opinion; or (d) If a new species is listed or critical habitat designated that may be affected by the identified action."

Should any of these conditions arise, the Corps would reinitiate Section 7 consultation by providing the Service with a supplemental BA tiered to this Programmatic BA.

**Table 13 Summary of effects analysis for the proposed action on federally endangered species.**

| Feature or effect of the proposed action | Southwestern Willow Flycatcher | | Western Yellow-billed Cuckoo | | Rio Grande silvery minnow | |
|---|---|---|---|---|---|---|
| | Species | Critical habitat | Species | Critical habitat | Species | Critical habitat |
| Earthen Levee Construction | May affect, not likely adversely | May affect, likely adversely | May affect, not likely adversely | May affect, likely adversely | May affect, likely adversely | May affect, likely adversely |
| Altered Floodplain Inundation | May affect, not likely adversely | May affect, not likely adversely | May affect, not likely adversely | May affect, not likely adversely | May affect, not likely adversely | May affect, not likely adversely |
| Change Floodway Area | May affect, not likely adversely | May affect, likely adversely | May affect, not likely adversely | May affect, likely adversely | May affect, not likely adversely | May affect, likely adversely |
| **Overall** | **May affect, not likely adversely** | **May affect, likely adversely** | **May affect, not likely adversely** | **May affect, likely adversely** | **May affect, likely adversely** | **May affect, likely adversely** |

| Feature or effect of the proposed action | New Mexico Meadow Jumping Mouse | | Pecos sunflower | | Interior Least Tern | | Northern Aplomado Falcon | |
|---|---|---|---|---|---|---|---|---|
| | Species | Critical habitat | Species | Critical habitat | Species | Critical habitat | Species | Critical habitat |
| Earthen Levee Construction | No effect | No effect | No effect | No effect | No effect | No effect | No effect | No effect |
| Altered Floodplain Inundation | No effect | No effect | No effect | No effect | No effect | No effect | No effect | No effect |
| **Overall** | **No effect** | | **No effect** | | **No effect** | | **No effect** | |

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## **9.2** Final Biological Opinion for the Programmatic Biological Assessment of U.S. Army Corps of Engineers Middle Rio Grande Flood Protection, Bernalillo to Belen, New Mexico: Mountain View, Isleta and Belen Units

Consultation with the USFWS is complete. The Final Biological Opinion was received on August 29, 2018.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Mexico Ecological Services Field Office
2105 Osuna Road NE
Albuquerque, New Mexico 87113
Telephone 505-346-2525 Fax 505-346-2542
www.fws.gov/southwest/es/newmexico/

August 29, 2018

Consultation Number 02ENNM00-2014-F-0302

George MacDonell, Chief
Environmental Resources Section, Albuquerque District
U.S. Army Corps of Engineers
4101 Jefferson Plaza NE
Albuquerque, New Mexico 87109-3435

Dear Mr. MacDonell:

Thank you for your January 6, 2017 request for formal consultation with the U.S. Fish and Wildlife Service (Service; or *in cite*, USFWS) pursuant to section 7(a)(2) of the Endangered Species Act of 1973 (16 USC 1531-1544, as amended; ESA). On February 8, 2018, you revised the proposed action and reinitiated formal consultation with the Service. You requested formal consultation on the effects of the U.S. Army Corps of Engineers (Corps; or *in cite,* USACE) proposed action of construction, operation, and maintenance of the Rio Grande Floodway, Mountain View, Isleta, and Belen Levee Units, in Bernalillo and Valencia Counties, New Mexico (i.e., the Levee Project). Corps proposes to excavate an older, earthen levee (known as a spoil bank) and construct a new 47.8-mile (77-kilometer) engineered levee to better protect nearby communities from large floods in the Middle Rio Grande (MRG) Valley. Corps' Levee Project is divided into four levee segments, some along both sides of the river, with construction occurring within those segments at a rate of approximately two and a half miles per year, over a period of 19 years, beginning in 2019 until the year 2038. With the proposed operations and maintenance, Corps expects the engineered levee to have a functional life of approximately 50 years. Therefore, the effects of the Levee Project are assumed to occur from 2019 through 2088.

In your programmatic Biological Assessment (BA; USACE 2018a), Corps determined that the Levee Project will have "no effect" on: 1) endangered New Mexico Meadow Jumping Mouse (*Zapus hudsonius luteus*) and its critical habitat; 2) threatened Pecos Sunflower (*Helianthus paradoxus*) and its critical habitat; 3) the experimental, non-essential population of northern aplomado falcon (*Falco femoralis*); or 4) endangered least tern (*Sternula antillarum*). We appreciate your consideration of these species; however, the ESA does not require consultation by federal agencies on proposed activities that have no effects to any listed species or critical habitat.

In your February 8, 2018, cover letter and BA (Table 13), you determined that the Levee Project "may affect, and is likely to adversely affect", the endangered Rio Grande Silvery Minnow (*Hybognathus amarus*; silvery minnow) and its designated critical habitat, the designated critical habitat of the endangered Southwestern Willow Flycatcher (*Empidonax traillii extimus*; flycatcher), and the proposed critical habitat of the threatened, western distinct population segment of Yellow-billed Cuckoo (*Coccyzus americanus*; cuckoo). We concur with this determination. You also determined that the Levee Project "may affect, but is not likely to adversely affect", the flycatcher and cuckoo. The Service does not concur with your findings that the Levee Project "may affect, but is not likely to adversely affect" the flycatcher and cuckoo, so we have considered effects to these species in the attached Biological Opinion.

In this BO, we analyzed the status of the silvery minnow, flycatcher, and cuckoo, the environmental baseline, effects of the Levee Project, and cumulative effects. We found that there were no interrelated or interdependent effects of the proposed action. Based on our analyses, we found that the Levee Project, as proposed, will not jeopardize the silvery minnow, the flycatcher, or the cuckoo. We also found that the Levee Project will not destroy or adversely modify designated critical habitat for the silvery minnow or flycatcher, or that of the proposed critical habitat of the cuckoo.

This BO relies on the revised regulatory definition of "destruction or adverse modification" of designated or proposed critical habitat from 50 Code of Federal Regulations (CFR) 402.02. As of February 11, 2016, the definition of "destruction or adverse modification" has been revised to align it with the conservation purposes of the ESA of 1976, as amended, and the ESA's definition of "critical habitat" (81 FR 7214). Specifically, the rule states: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." The revised definition continues to focus on the role that critical habitat plays for the conservation of listed species and acknowledges that the development of physical and biological features may be necessary to enable the critical habitat to support species recovery.

A complete administrative record of this consultation is on file at the New Mexico Ecological Services Field Office at the above address. If you have any questions about this consultation, please feel free to contact me or Dave Campbell of this office at (505) 761-4745.

Sincerely,

Susan S. Millsap
Field Supervisor

Enclosure

cc:

Director, Department of Natural Resources, Pueblo of Isleta, Isleta, New Mexico (electronic copy)

Director, New Mexico Department of Game and Fish, Santa Fe, New Mexico (electronic copy)

Wildlife Biologist, Bureau of Indian Affairs, Albuquerque, New Mexico (electronic copy)

# Biological Opinion on the Effects of the U.S. Army Corps of Engineers' Mountain View, Isleta, and Belen Levee Units for Middle Rio Grande Flood Protection, Bernalillo County to Belen, New Mexico

Consultation Number 02ENNM00-2014-F-0302

August 29, 2018

Susan S. Millsap
NMESFO Field Supervisor

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Appendices A, B, and 1-5 attached separately

## HISTORY OF COORDINATION AND CONSULTATION ON THE LEVEE PROJECT

- In 1974, Corps initiated a water resources study on flood potential of the Rio Grande between Bernalillo and Belen, New Mexico. Service and Corps staffs participated in numerous meetings, field trips, resulting in a final Fish and Wildlife Coordination Act (FWCA) Report (USFWS 1978) that described methods of compensation for impacts.

- In 1986, Public Law 99-662 authorized the Corps' Middle Rio Grande Flood Protection Project with the establishment of 75 acres (30.5 hectares [ha]) of wetlands and acquisition of 200 acres (81 ha) of riparian habitat to mitigate for fish, wildlife, and habitat impacts.

- In 1996, the Service (USFWS 1996b) recommended Corps conduct ESA consultation on the recently listed as endangered silvery minnow and flycatcher (USFWS 1994, 1995).

- In 1997, Corps provided a BA (USACE 1997) to the Service on effects of constructing the Belen East and West Units and the Service provided a draft BO to Corps.

- In 2000, Corps (USACE 2000) informed the Service that it needed to reformulate project alternatives to include the Mountain View and Isleta Units and concluded consultation.

- In 2013, Corps requested the Service provide an updated FWCA Report on the Middle Rio Grande Flood Protection Bernalillo to Belen, New Mexico, Mountain View, Isleta, and Belen Units General Reevaluation Report.

- During 2017, Corps provided to the Service several BAs (USACE 2017a,b,c,d).

- In May 2017, the Service discussed a draft analytical framework for evaluation of effects to listed species and critical habitats.

- In August 2017, Corps provided a draft Habitat Mitigation, Monitoring, and Adaptive Management Plan (HMMAMP; USACE 2017e).

- In November 2017, Corps provided a final BA (USACE 2017d) and received a final Service FWCA Report (USFWS 2017a).

- On November 22, 2017, the Service initiated formal consultation with Corps.

- In February 2018, the proposed action was revised and Final revised versions of the BA and HMMAMP were provided (USACE 2018a, b).

- On March 19, 2018, the Service (USFWS 2018) reinitiated formal consultation with Corps based on the revised BA and HMMAMP.

- On April 9, 2018, the Service and Corps discussed incidental take estimates and ongoing modeling efforts.

- On July 9, 2018, the Service received additional information associated with the proposed action including reductions in the number of silvery minnows proposed to be monitored as well as a revised footprint associated with the proposed action (USACE 2018c).

- On July 17, 2018, Service provided a draft of the Reasonable and Prudent Measures (RPMs) to Corps.

- On July 25, 2018, Corps agreed to the Service's request for an extension of consultation.

- On August 2, 2018, Corps provided comments on the draft RPMs to the Service.

- On August 14, 2018, the Service provided a copy of the draft BO to the Corps.

- On August 16, 2018, Corps and Service staffs discussed the draft BO.

- On August 24, 2018, the Service provided the draft BO to the Corps.

This BO is based on information provided in the February 8, 2018, revised BA (USACE 2018a), the revised HMMAMP (USACE 2018b), Corps hydrology and hydraulics analysis report (USACE 2015), the Service's final FWCA Report (USFWS 2017), Corps draft Supplemental Environmental Impact Statement (USACE et al. 2007, USACE 2017g-o), Tetra Tech (2013) and other correspondences, meetings, telephone conversations, and additional sources of information that are incorporated by reference as part of this BO and its administrative record.

## DESCRIPTION OF PROPOSED ACTION

*General Description of Activities, Conservation Measures, Timeframe, and Action Area*

The general description of the proposed activities, the action area, and timeframe of proposed activities are provided by the Corps (USACE 2017g-o, 2018a, b, c; Porter 2018a-k) as amended. The Levee Project consists of implementing the Middle Rio Grande Flood Control Project by excavating the existing, earthen levees (i.e., spoil banks) and replacing them with engineered levees for approximately 76 kilometers (km) (47.8 miles (mi)) along one or both sides of the Middle Rio Grande Valley (MRG) Valley from the South Diversion Channel at the southern end of the City of Albuquerque in Bernalillo County to the Bosque Bridge (NM State Highway 346) near the town of Bosque, New Mexico.

Specific locations of many of the proposed activities or other studies in the MRG may use either River Mile (RMs) or memorialized cross sections (transects across the river that have used since the 1960s to monitor changes in rates of aggradation and degradation that are termed Ag/Deg lines). These cross sections are often used to describe the elevation, pattern, and profile of the floodway (including the river channel and associated overbank areas) at various locations approximately every 500 feet apart upstream and downstream in the MRG (see Varyu 2013a,b, for RM and Ag/Deg line locations and descriptions).

The Action Area includes all areas of construction, operation, maintenance, and any activities associated with the Levee Project that occur within the floodway (e.g., overbanks and channel) between southern Albuquerque (near RM 177) to near New Mexico Highway 346 near Bosque, NM, (near RM 142) that are directly or indirectly affected through December 31, 2088 (Figure 1) (USACE 2017g-o, 2018a,b,c). Specifically this includes: All areas immediately proximal (~¼ mile) to the spoil banks, spoil storage and borrow areas; the engineered levees and the Vegetation Management Zone; all areas along any Levee Project associated transportation routes; areas affected by project noise or vibrations; and, areas affected by various monitoring efforts that are proposed.

The need to protect human life and welfare within the floodplain is one of the reasons for structural flood control measures, which include the proposed engineered levees that are used to limit the area over which the Rio Grande can flood (USACE 2012b). The Levee Project creates a physical barrier (a longitudinal earthen dam parallel to the river) that defines a floodable area (termed the "floodway"). The Levee Project differs from the existing spoil banks because spoil banks can breach during certain floods (USACE 2017g, USACE 2018a) whereas the Levee Project engineered levees will not (USACE 2017g, USACE 2018a).

In their selection of the Levee Project, Corps evaluated the economic benefits based on a without-Project scenario where a 1% or 10% chance flood event (USACE 2017k) would undermine the spoil banks and flood onto 13,495 acres of the outlying floodplain and cause economic damages (USACE 2017g, 2018a). Corps compares a scenario without the spoil banks to a scenario with the Levee Project (with engineered levees) to evaluate the feasibility of the levee design for protection and economic benefits to affected communities. The current spoil banks might be expected to protect against limited floods (Berry et al. 1997: 22) but would fail at floods greater than 4,000 cubic feet per second (cfs) to 10,300 cfs (with estimates varying widely based on a number of conditions, see Berry et al. 1997; USACE 1997, 2015, 2017g,k,o, 2018a). Corps found that if the 10 percent chance flood event of 7,510 cfs as measured at the Rio Grande at Albuquerque gage (ABQ gage) occurred for a long duration (that is, greater than four days), it would likely result in spoil bank failure (USACE 2017o). Corps also found that if the 10 percent chance flood event of 10,300 cfs, measured at the ABQ gage, occurred for a short duration (less than four days), it would likely result in spoil bank failure (USACE 2017o). The proposed Levee Project would more than likely contain these floods, as well as a one percent chance flood event of up to 18,391 cfs for a short duration and up to 7,735 cfs within the floodway for a long duration (USACE 2017o: Tables 12 & 13). The engineered Levee Project would extend the capacity to safely pass a one percent chance flood event within the floodway until further sediment deposition in the floodway reduces that flood capacity (Gronewold 2018) over time.

The floodway within the Action Area contains approximately 5,633 acres of overbank habitat and 1,766 acres of river channel habitat (i.e., approximately 1,208 acres active channel and 558 acres of islands as of 2008) totaling 7,399 acres of floodway within the area bounded by the existing spoil banks or high ground (USACE 2018a). With regular operations and maintenance, Corps considers the functional life of flood control structures (i.e., engineered levees) to be 50 years following 18 years of construction. Therefore, if the levee construction begins in 2019 and ends in 2038, then the effects of the Levee Project action are assumed to cease by 2088 (see Construction Schedule in USACE 2018a).

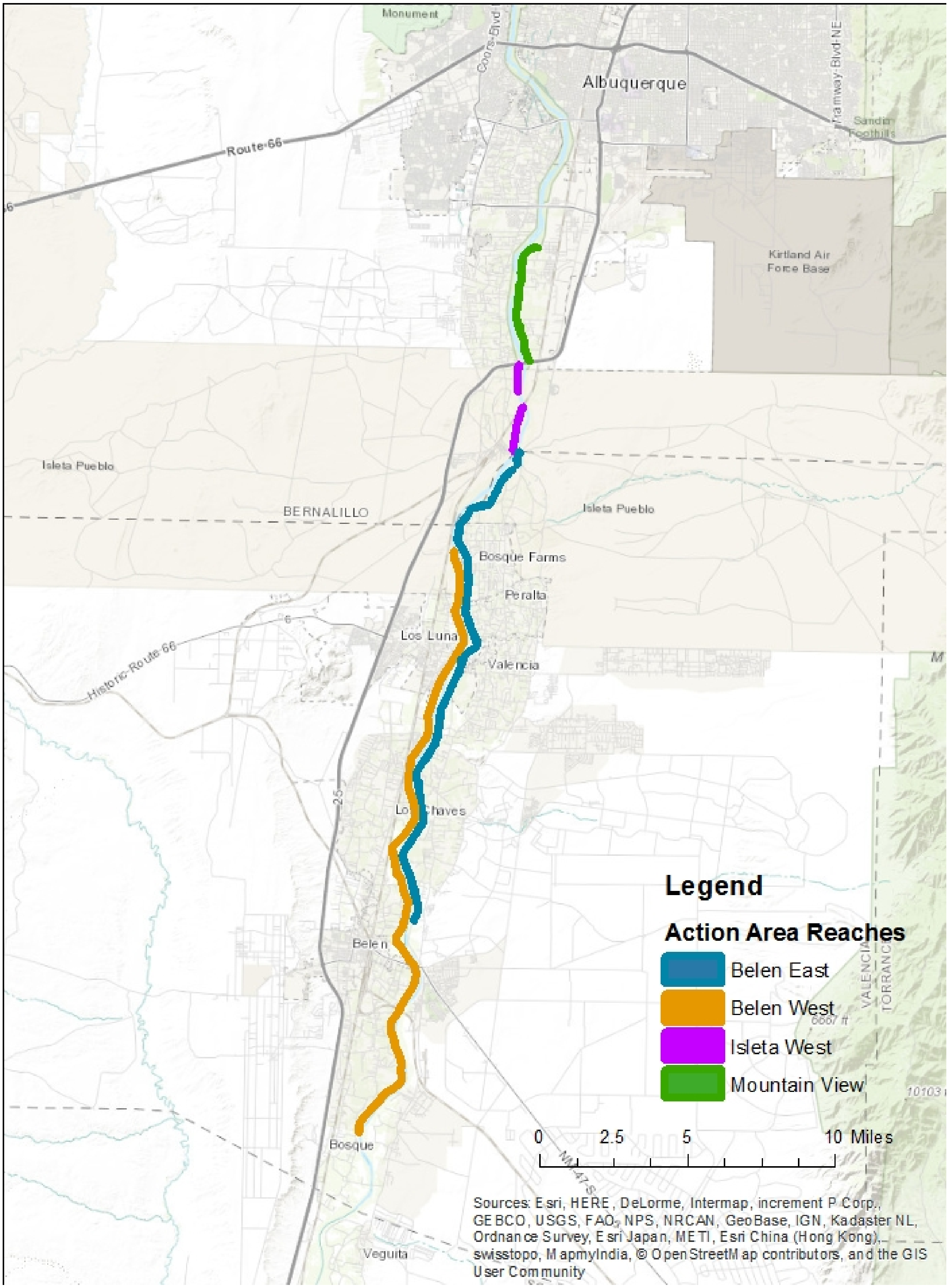

Figure 1. Map of the Action Area and Levee Project Units. (Source: USACE 2017).

Depending on the timing or season of construction or presence of a species of concern, construction of levee portions within a given unit may not be contiguous (and allow for gaps in the levee during construction). Construction of concrete or rock structures may also occur prior to, or after, earthwork has been completed in a particular levee unit. In addition, Corps proposes to construct or enhance 110.2 acres of habitat restoration or mitigation (HR Sites) by lowering the elevations of banks, terraces, or removing earth to form excavated swales (in areas that are yet to be determined, but within the floodway) to offset impacts to federally-listed species (See Conservation Measures described, below). Corps also proposes to maintain 220.8 acres of existing suitable or moderately suitable flycatcher or cuckoo habitat by selectively thinning of non-native vegetation, and/or by planting native plants to increase density. Corps proposes to monitor habitat areas and species response to activities (USACE 2018a, b; Porter 2018k).

The Middle Rio Grande Conservancy District (District) is the local Levee Project sponsor and the District will maintain and operate the levee after the Levee Project construction is completed by the Corps (USACE 2012; and see long-term maintenance described below). The District is not an ESA applicant to this consultation. Therefore, any adverse effects of the District's operations and maintenance activities on the silvery minnow, flycatcher, cuckoo or their critical habitat, are not exempted from the provisions of section 9 as a result of this BO. Corps is consulting with the Service on their provision of the Operations and Maintenance Manual (O&M Manual) that will be provided to the District. In this BO the Service describes measures, that when incorporated into the O&M Manual and implemented, will result in maintenance activities that are not likely to adversely affect listed species or that are not likely to destroy or adversely modify critical habitats. The District and the Pueblo of Isleta have agreements for maintenance of levees on Pueblo lands.

The Levee Project includes construction of four levee units: Mountain View, Isleta West, Belen East, and Belen West (Figure 1). Table 1, below, summarizes the location and construction activities by each levee unit.

<u>Mountain View Unit</u> (east side of Rio Grande)
Approximately 7.1 km (4.4 mi) of spoil bank will be excavated and reused as an engineered levee. The Mountain View Unit begins at the southern embankment of the outlet of the South Diversion channel and extends along the current spoil bank alignment to Interstate 25 (I-25). The west side of the floodway is already protected by an engineered levee. The Mountain View Levee Unit will affect public access from Valle de Oro National Wildlife Refuge to and from the Rio Grande. A portion of the floodway is part of the Rio Grande Valley State Park. A concrete box culvert crossing will occur on the riverside channel north of I-25.

<u>Isleta West Unit</u>
The Isleta West Unit (5.1 km [3.2 mi]) starts at I-25 and extends downstream past the railroad crossing to State Highway 147 Bridge. Levee construction is restricted to the west side of the Rio Grande. The Isleta West has a wetland abutting the levee immediately upstream of the railroad crossing. The wetlands north of the railroad crossing near RM 171 may be affected by proposed levee dewatering activities. The proposed levee may affect a concrete box culvert where a conveyance channel crosses near the wetlands and north of the railroad bridge. The proposed levee actions occur on the Isleta Pueblo and may affect natural resources described in the Isleta Pueblo Riverine Management Plan (Pueblo of Isleta 2005).

Table 1. Spoil excavation and disposal quantities, levee fill and riprap needed, levee unit name, lengths, and areas of new levees to be constructed for the Levee Project.

| Levee Unit Name and quantities | New Levee Length km (mi) | Spoil Bank Excavation (cubic yards) | Total Spoil Disposal (cubic yards) | Levee Fill Needed (cubic yards) | Levee Riprap (cubic yards) |
|---|---|---|---|---|---|
| Mountain View | 7.1 (4.4) | 309,273 | 30,927 | 54,268 | 6,889 |
| Isleta West | 5.1 (3.2) | 139,563 | 13,956 | 17,333 | 5,921 |
| Belen East | 29.1 (18.1) | 1,237,529 | 123,753 | 119,992 | 37,042 |
| Belen West | 35.6 (22.1) | 1,262,433 | 126,243 | 228,269 | 20,296 |
| Project Total | 76.9 (47.8) | 2,948,798 | 310,094 | 419,862 | 70,148 |

Belen East Unit

The Belen East Unit (18.13 miles) starts at the Highway 147 Bridge, extending downstream to approximately 1.7 miles upstream of the Highway 304 Bridge. This unit includes the Highway 147 and Highway 6 Bridge crossings. There are eight irrigation canals or other channels that will be crossed by the proposed levee (USACE 2017l). The Whitfield Wildlife Conservation Area abuts the project area east of Belen.

Belen West Unit

The Belen West Unit (22.1 miles) starts at the irrigation wasteway downstream of Isleta Marsh. The proposed levee will extend downstream through Los Lunas and Belen, with the downstream terminus 2 miles upstream of the State Highway 346 Bridge near Bosque, New Mexico. This unit includes bridge crossings at Highway 6, 309, and the railroad south of Belen. There are six irrigation canals or other channels that will be crossed by the proposed levee (USACE 2017l). There are also 4 utility crossings between Highways 309 and 346. The town of Belen manages a fishing pond adjacent to the proposed levee may be affected by levee construction and dewatering activities (USACE 2017l). The upper portion of this unit is on the Pueblo of Isleta and may have impacts per the Pueblo Riverine Management Plan (Pueblo of Isleta 2005).

*Engineered Levee Construction*

A new, engineered earthen levee will generally follow the alignment of the spoil bank throughout the Action Area; however, the new levee base will move towards the river (Dodge et al. 2007; USACE 2017k: 31). The construction of the proposed levee will entail removing the existing spoil bank with heavy machinery, and processing the material removed to obtain suitable fill material for the new levee construction, and placing fill in layers along with various structural features (e.g., trenches, blankets, seepage pipes, see USACE 2017g-n). The spoil bank would be removed and replaced one mile at a time. Selected materials required for construction (that is, riprap, drains, and bentonite) will be acquired or borrowed at approved sites.

Generally, the base width of the proposed levee is wider than the width of the existing spoil bank (Figure 2). The new levees, bridge buttresses, and turnarounds will physically reduce the area of the floodway area by 180.3 acres with another 85.5 acres adjacent to the levee (on the riverside) managed for herbaceous vegetation only, for a total of 265.8 acres total floodway encroachment (USACE 2018a,c; Porter 2018h).

Corps proposes to position the landward toe of the proposed levee to be as close as practicable (minimum 20 ft) to the riverside drain. The proposed levee will be trapezoidal in cross-section with a 15-foot-wide crest (Figure 2; see also USACE 2017a: Appendix C, 35% design sheets). Overall levee height (bottom to top) will range from 4 to 14 feet. Side slopes will vary between 1 vertical to 2.5 horizontal and 1 vertical to 3 horizontal, depending on the height of the levee. Perforated pipe toe drains, filter blankets, and discharge pipes will be installed into the riverside drains approximately every 90 feet. Pipe risers will be installed for those sections where levee heights are greater than 5 feet. In addition, an inspection trench with a drain or a 2-foot-wide bentonite slurry trench will extend from 2 feet below the levee embankment crest to 5 feet into the foundation of levee to protect levee integrity from seepage during long-duration floods. Where irrigation or stormwater returns into the MRG may occur, concrete box culverts (with grills or flap gates) will be constructed through the levee and riprap materials will be added to protect that area of the culvert crossing the levee. These culvert crossings will occur at the Atrisco Riverside Drain (Isleta West Unit near RM 171), the 240 Wasteway (Belen West Unit near RM 165), the Lower Belen Wasteway (Belen West Unit near RM 157), and the Peralta Main Canal (Belen East Unit near RM 155). The culverts will be gated to prevent floods (and likely fish) from entering these canals while allowing for irrigation flows to return to the MRG.

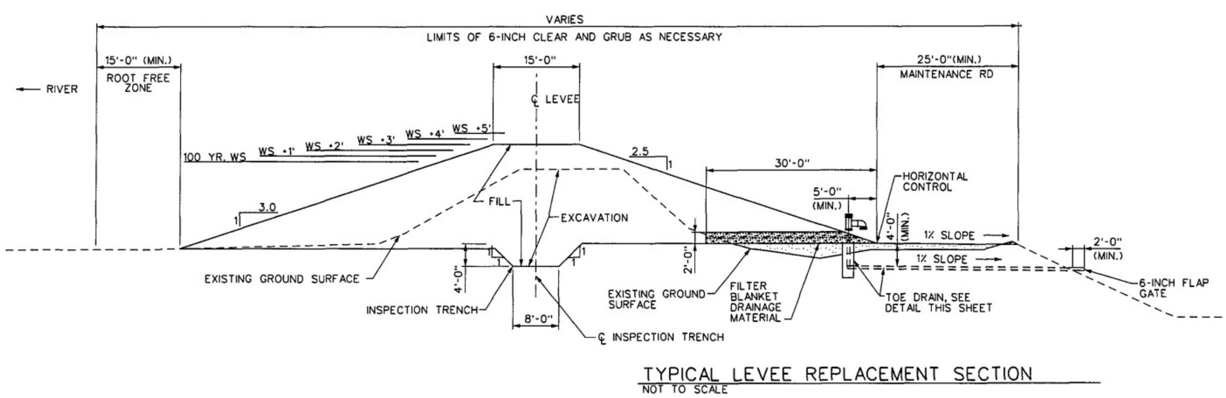


Figure 2. Typical levee cross-section (Source: USACE 2017a: Appendix C).

In areas at risk of scour, riprap (caged or loose stone used to form a structural foundation) will be used to protect the integrity of the slope of the engineered levee from near the crest to toe, and will be buried to a depth of 3 feet beneath the levee toe. Rock sizes used for riprap will vary from 0.75 to 3.5 feet in diameter and coloration will vary from dark colored basalt to grey metamorphic rock. The volume of riprap on levee slopes and around the box culverts will be approximately 70,148 cubic yards (Table 1). In addition, sheet piling may be used to protect the ends of the levees from scouring. Some Kellner jetty jacks will remain where currently located in the floodway to provide erosion protection and sediment deposition for the new levees (USACE 2018a:8). Where erosion protection and sediment deposition is not needed, an estimated 315 jetty jacks will be removed from within the floodway (Porter 2018b).

Vehicle turnarounds and ramps, both riverside and landside, particularly to and from the levee crest maintenance road, will also be located sporadically along the levee, preferably at areas already disturbed or used for spoil bank maintenance activities. Specific locations for ramps and turnarounds will be determined after coordination with the District, landowners, and others parties currently using the spoil bank road for access.

The existing haul roads adjacent to and between the existing spoil bank and the riverside drains will be used for the equipment and staging during construction of the levee. Surplus spoil material will be stockpiled nearby during construction of a given levee segment. Short-term stockpiles will be located within the disturbed construction footprint of a given segment. Long-term stockpiles will only be located at staging areas or previously disturbed sites outside of the floodway. In certain reaches, where a terrace (waterside earthen bench of elevation higher than certain flood levels) is present, the Corps may stage equipment on either the landside or riverward terraces near levees with various environmental safeguards (USACE 2018a).

*Vegetation Management Zone*

Following construction, disturbed soils including the levee side slopes will be seeded with native grass species to prevent wind and water erosion. Corps (USACE 2014) requires that no vegetation, other than approved grass species, be allowed to grow on or near the levee to protect levee integrity and to provide access to the levees for surveillance, inspection, maintenance, monitoring, and flood-fighting. Therefore, a "root-free zone" within 15 feet of the riverward and landside toes of the levee will be maintained in perpetuity to assure that the roots of woody vegetation will not penetrate and weaken the levee structure. During construction, existing vegetation adjacent to the riverside and landside levee toes will be removed by hand, using saws, with mechanical equipment (tree shears), heavy equipment (root ripping, wood chipping, tillage), or by low-drift herbicide application (in areas that are too narrow for heavy equipment), during fall, winter, or spring. Vegetation management zones will be regularly mowed, during fall, winter, or spring each year, or any time when grass reaches a height of 12 inches (or will be mowed sooner, if such mowing is important to the maintenance of a particular grass species).

*Long-term Levee Operation and Maintenance (O&M)*

Upon completion of each functional segment of the new levee, that portion of the project will be turned over to the project sponsor, the District, for O&M. Corps will provide the District with a manual describing the duties necessary for proper O&M of the levee segment, and the entire project.  Levee O&M activities include maintaining the Vegetation Management Zone free of woody plants, mowing grasses as necessary, and implementing levee O&M plans.  Levee O&M plans describe the frequency and type of in-place levee repairs, erosion repairs, lost riprap replacement, rodent burrow elimination, and other emergency action plans or routine repairs of the levee structures.  Routine maintenance will also include periodic assessments and inspections, maintenance road clearing and repair, and cleaning of the levee seepage infrastructure.

*Corps Conservation Measures, Monitoring, and Reporting Activities*

The Corps enumerated 15 Conservation Measures (CMs) in their BA (USACE 2018a) and also described other monitoring, reporting, and mitigation measures in their BA, in their HMMAMP (USACE 2018b), and elsewhere (Porter 2018a,b,k;  USACE 2018c).  The CM's have been proposed to avoid, minimize, or offset adverse effects to listed species or their habitats.  The Service refined and consolidated the list of Corps CMs, monitoring, and reporting activities that affect the flycatcher, cuckoo, and silvery minnow, below, and will thereafter refer to them by their CM number in this BO.  The beneficial effects (and any additional impacts) from implementing the CMs are taken into consideration for both jeopardy and incidental take assessments in this BO.

CM 1:  Corps implementation of flycatcher and cuckoo protocol surveys.

Beginning with the breeding season prior to the initiation of construction of each segment (i.e., Fiscal Year [FY] 2020 through FY 2038), qualified Corps staff will conduct (or fund qualified contractors to conduct) flycatcher and cuckoo protocol surveys along the floodway from South Diversion Channel to Highway 346 on a rotating basis associated with the construction schedule. Protocol surveys will continue until the completion of construction and will continue for three years following the phased construction of each levee unit.  Information resulting from these protocol surveys will be used to update resource conditions to help avoid direct effects from construction activities.  If surveys detect flycatcher or cuckoo in the Action Area, then CM 2 will go into effect.

CM 2:  Seasonal and geographic buffers to avoid flycatcher and cuckoos during construction.

Corps construction activities may occur throughout the calendar year; however, no construction activities will be performed within 0.25 mile of occupied flycatcher or cuckoo nest sites (generally, late May through September 1).  Traffic associated with construction activities will continue along the construction alignment adjacent to any occupied flycatcher or cuckoo nest sites.  Small vehicles (e.g., pickup trucks and SUVs) will travel along the top of the spoil bank (and later, the engineered levee) throughout the year.  All construction equipment and large trucks will be restricted to the maintenance roads adjacent to the spoil bank and to the District's infrastructure.  A noise disturbance study is underway to better understand construction noise impacts to flycatchers and cuckoos and adjustments to the buffer distance may take place in the future as appropriate and as a result of the study.

CM 3:  Monitor silvery minnow presence at inundated habitat restoration and mitigation sites during spring runoff.

Monitoring proposed includes the one-time monitoring of the presence (or absence) of adult silvery minnows at each habitat restoration or mitigation site, (once they are excavated) during their inundation by spring runoff to document, silvery minnow use (Porter 2018k). Corps also proposed to monitor silvery minnows affected by construction noise (see CM 19, below).

CM 4: Best Management Practices (BMPs) for minimization of noise impacts to listed species.

Corps will limit all construction equipment and large truck engine noise levels to 60 decibels. Corps will initiate a Noise Study to evaluate the silvery minnow behavioral and physical responses to noise in a laboratory and field setting (Porter 2018c,k). Depending on the results of this Noise Study, the Corps will deploy BMPs (e.g., bubble barriers) to reduce the adverse effects of noise to silvery minnow. Bubble barriers reduce the transmission of noise underwater and move fish away from adverse noise effects. Other BMPs may be determined by the Noise Study, for example, timing construction activities (where feasible) to avoid sensitive life stages from known adverse effects.

CM 5: Corps adherence to the Pueblo of Isleta Riverine Management Plan.

Construction activities that occur on Isleta Pueblo land will adhere to any requirements described in the Isleta Pueblo Riverine Management Plan (Pueblo of Isleta 2005). In the plan, the Pueblo of Isleta exercises its sovereignty over Pueblo lands and resources. The Pueblo describes their adoption of Water Quality Standards to ensure that they are fully incorporated into discharge permits for those activities that affect their water resources. The plan prescribes appropriate measures and strategies to sustain existing flycatcher populations and habitat and promote a comprehensive, integrated, and adaptive resource management approach.

CM 6: Corps vegetation removal activities and management in Vegetation Management Zone.

Corps will conduct vegetation clearing-and-grubbing activities and remove woody vegetation from the vegetation management zone (15 feet riverside of the levee and variable distances from the landside of the levee) outside of the breeding season for flycatchers and cuckoos, and only between September 1 and April 15, each year (as needed).

CM 7: Corps construction work below the Ordinary High Water Mark (OHWM) during low-flow.

Corps construction activities will be performed below the elevation of the OHWM only during low-flow periods to minimize direct impacts to silvery minnows by not working in the water. Corps will place no erodible fill materials below the elevation of the OHWM to make sure to ensure water quality for silvery minnows and to reduce the risks of fire in the Bosque.

CM 8: Corps use and storage of petroleum related chemicals during construction.

Fuels, lubricants, hydraulic fluids and other petrochemicals will be stored outside the 1%-chance floodplain, if practical. Staging and fueling areas will be located outside of the floodway, landward of the existing spoil bank, and at least 100 feet from any surface water channel. All storage areas will include spill prevention and containment features. This will be completed to maintain water quality for silvery minnows, their habitat, and other environmental purposes.

CM 9: Daily inspection of construction equipment for leaks, spill containment, and spill removal.

Construction equipment will be inspected daily to ensure that no leaks or discharges of lubricants, hydraulic fluids, or fuels will occur in the aquatic or riparian ecosystem. Any petroleum or chemical spills will be contained and removed, including any contaminated soil. This will be completed to maintain water quality for silvery minnows, and avoid increased fire risk for riparian vegetation providing habitat for flycatchers and cuckoos.

CM 10: Corps assurance of good quality fills materials.

Corps will only use uncontaminated earth or crushed rock for backfills to ensure avoidance of introducing exotic species of vegetation which could theoretically decrease habitat suitability for flycatchers and cuckoos. This will also maintain water quality for silvery minnows and their feeding habitat.

CM 11: Corps BMPs for water quality protection.

Corps will deploy silt curtains, cofferdams, dikes, straw bales, and other suitable erosion control measures to prevent sediment-laden runoff or contaminants from entering any watercourse. This will be completed to maintain water quality for silvery minnows and their habitat.

CM 12: Corps performance standards for vegetation establishment and monitoring survival.

Corps will use herbaceous, nitrogen-fixing ground cover to stabilize levee slopes, reduce erosion, and suppress establishment of woody vegetation. Corps contracts will include warranties with performance standards for the establishment of vegetation. Grass seeding by broadcasting or crimp and drill (along with a nontoxic, water retaining (hydro-mulch) gel or fiber) will occur during late summer (July through September). For seeding, requirements will specify that planted areas will exhibit vigorous growth after a one-year establishment period. Requirements typically will include stem density or percent cover measures that the Corps Contracting Officer will use to verify that performance standards have been met. Any additional planting activities to meet the performance standard will be performed at the contractor's expense. The stem density or percent cover criteria included in each contract will vary depending on location-specific soil and moisture conditions, as well as the specified seed mix. For woody plantings (trees and shrubs), the performance standard will require at least 85% survival of planted material at the end of the third growing season following planting. If survival is less than this criterion, the contractor will install additional plantings to assure at least 85% living trees or shrubs. The success of mitigated re-vegetation measures will be based on the acceptable development of vegetation and its likelihood of continued development into a mature stand. Monitoring will be conducted by the Corps once each year during the summer growing season for five years following planting. Monitoring requirements beyond five years (to be determined during consultation and coordination) would be conducted by the project sponsor.

CM 13: Corps water quality monitoring.

Corps will monitor water quality during construction activities to ensure compliance with State of New Mexico water quality standards for turbidity, oxygen, pH, temperature, and dissolved solids. Should water quality drop below State of New Mexico standards, Corps and its contractors will stop work until water quality issues are resolved. This CM will be completed to maintain water quality for silvery minnows and their habitat.

CM 14: Corps provision of Annual Reports to the Service.

Corps will provide to the Service an Annual Report on the progress of Corps Levee Project related activities (list below) during the construction period from FY 2020 through FY 2038. Copies of these Annual Reports will also be furnished to the project sponsors, and to pertinent Federal and local resource agencies. The contents of the Annual Reports will include:

- A summary of construction activities performed during the preceding year;
- A description of construction activities anticipated in the upcoming year;
- A description of refinements in design or construction activities, if any;
- A description and evaluation of Conservation Measures employed;
- A summary of the results of species-specific surveys;
- A description and evaluation of compliance with Reasonable and Prudent Measures (including the associated Terms and Conditions), a summary of listed species takes and acres of impacts to critical habitats that occurred incidental to the Proposed Action that were authorized by the Incidental Take Statement; and,
- The annual status and success of all habitat restoration and mitigation site activities, including re-vegetation measures, any areas excavated, any maintenance of these sites, and the results of habitat or species-related monitoring activities at these sites.

CM 15: Corps excavation of floodplain habitat features to offset listed species habitat losses.

Corps will plan and construct habitat restoration sites by reducing or excavating high terrace or bank elevations, deepening or establishing side channels, swales, or other habitat restoration or enhancement activities. These habitat restoration sites will be created within the Action Area, focusing on the 26 miles in the Belen East and West Units. Improved habitat features will generally range from 5 to 25 acres in size (USACE 2018a,c). The total floodway area excavated or enhanced will be 110.2 acres to offset impacts to silvery minnow, flycatcher, and cuckoo habitat (USACE 2018c). Corps has proposed measures that will ensure no net loss of overbank flow habitat between current and future conditions as a result of the proposed action (USACE 2018c). However, models for accounting of the areas and amounts of levee fill impacts, sediment deposition impacts, and habitat restoration or mitigation site (termed HR sites) offsets with regard to the inundation level of floods have yet been computed. Once these models are complete, they will be reviewed and refined by an independent review.

Of the Corps proposed 110.2 acres of habitat restoration sites, 45 acres will be habitats designed for flycatchers and 65.2 acres will be habitats designed for silvery minnows. Depending on location or design, some of these floodway excavations will maintain habitat features for more than one species.  For example, terraces within 1 foot to groundwater would create additional areas of overbank habitat, which would provide additional areas for silvery minnows as well as conditions for natural recruitment of native species (such as willows (*Salix* sp.) for example) for flycatchers and cuckoos.  Some of the habitat restoration sites will be designed and constructed to produce dense riparian shrub habitat features, or mixed canopies containing cottonwoods (*Populus* spp.), or nearby surface water.  However, Corps construction activity is constrained to areas where excavation depth is at least 1 foot above the site's groundwater elevation and therefore, will occur within 300 feet of the river (USACE 2018c).  Corps excavation activities will be scheduled outside of spring runoff or outside the migratory bird breeding season (generally, that breeding season occurs from mid-April through August).  Corps staff will work directly with Service staff to develop and locate habitat restoration sites along with site monitoring and management plans that will maintain the 110.2 acres of physical features of these species' habitat for the duration of the Proposed Action.

The Corps will also preserve 220.8 acres of existing flycatcher or cuckoo habitat within the Action Area via maintaining riparian vegetation conditions as suitable or moderately suitable habitat for flycatcher or cuckoo (or both) by selectively thinning non-native riparian vegetation and/or adding to native riparian plant density through direct planting or other management activities.  Suitable and/or moderately suitable habitat for flycatchers and cuckoos is considered areas with at least 50% cover with vegetation structure and composition to accommodate nesting activity.

CM 16:  Corps collection and evaluation of hydrologic information for habitat restoration sites.

The hydrology at each habitat site will be determined (USACE 2018b) by collecting and evaluating the flood frequency, flood duration, depth, velocity, wetted area, and groundwater depth.  This data will then be summarized and evaluated for any constructed side channels, bank terracing, willow swales, wetlands, or other habitat restoration sites.  When complete, these summaries will inform adaptive management actions and proposed habitat restoration designs to maximize and expedite success.  These hydraulic analyses may also inform the accounting models for no net loss of floodable areas.

CM 17:  Selection criteria for Habitat Restoration Sites to offset listed species habitat losses.

Corps will conduct a spatial analysis that will combine vegetation mapping (i.e. Siegle et al. 2013) with geological layers to screen preliminary sites based on lower habitat value (coverage of invasive vegetation and proximity to habitat of higher value), suitable soils (percent silt and clay), and hydrology or drainage patterns for selection of silvery minnow, flycatcher, and cuckoo habitat restoration sites.

CM 18:  Determination of avian utilization and vegetation characteristics of re-vegetated areas.

Corps will use photography to document re-vegetated areas at permanently established photo points.  Vegetation mapping (i.e. Siegle et al. 2013) will also be used to evaluate habitat restoration success, and identify areas which may need management via exotic species removal or additional planting of native vegetation to promote occupancy.  By using these tools, the

Corps will be able to efficiently identify and implement restoration techniques that will benefit the flycatcher and cuckoo by maintaining or creating habitat in areas that will be successful in achieving that goal.

CM 19: Qualified biologists will conduct Construction Monitoring for silvery minnows.

Corps will use or contract qualified biologists to conduct construction monitoring of silvery minnows (USACE 2018c; Porter 2018k). Corps will conduct fish surveys at a total of nine sites (two sites near the river channel and seven sites in riverside drains ahead of construction (Porter 2018k; and see Appendix 5). Information resulting from these surveys will be used to update resource conditions, avoid direct effects from construction noise activities, and to revise the determination of effects of the proposed action, if needed (USACE 2018a,b). Silvery minnow monitoring will occur three times at these nine sites: 1) One event of monitoring will occur prior to construction to refine the estimate of incidental take. 2) One event of monitoring will occur just prior to construction or during the deployment of bubble barriers. 3) One event of monitoring will occur after the deployment of bubble barriers (to determine their effectiveness) or after the construction activity leaves the proximity of these nine affected sites. Data from these surveys will also be used to refine BMPs by understanding silvery minnow exposure and the effect thresholds developed by the Noise Study.

CM 20: Corps post-project monitoring plans.

Section 2039(3)(b) of Water Resources Development Action of 2007 (Public Law 110-114) describes the monitoring requirements for environmental restoration components of the Proposed Action (USACE 2017f). The monitoring plans will include the rationale for monitoring, including key project specific parameters to be measured (USACE 2018b). This will include all the parameters related to achieving the desired outcomes or making a decision about the next phase of the project, the intended use(s) of the information obtained and the nature of the monitoring.

Riparian habitat monitoring shall occur prior to construction, during construction and at 1, 2, 5, 10, and 20-year intervals following completion of the Proposed Action unit to document changes in habitat value. The focus in early years will be on vegetation establishment with subsequent years (5 to 20) evaluate habitat value and vegetative succession.

*Interrelated and Interdependent Effects of the Proposed Action*

Effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. The Service reviewed the BA (USACE 2018a) and draft Supplemental Environmental Impact Statement (USACE 2017g-o) for any potential interrelated and interdependent activities. We found that while floods within the MRG floodway may have beneficial or adverse effects to listed species and their habitats (Crawford et al. 1993; USFWS 2002; Poff et al. 2010; USFWS 2016; Dudley et al. 2017b), ascribing those effects depends on the magnitude, duration, timing, frequency and management of the floods themselves (USFWS

2016) and not necessarily to the floodway or the Levee Project. Additionally, Cochiti Lake discharges currently occur at flows less than safe channel capacity due to seepage and stability issues associated with the existing spoil banks (USACE 2017g:16, 106; USACE 2017l:F-11; USACE 2018a; Gronewold 2018). However, safe channel capacity is not expected to increase solely as a result of the Levee Project. Therefore, as flood discharges and safe channel capacity changes are not actions described in the BA (USACE 2013b, 2014a), then the effects of various floods within the floodway are not interrelated or interdependent effects of the Levee Project.

## STATUS OF THE SPECIES

*Status of the Silvery Minnow*

The silvery minnow was federally listed as endangered under the ESA in 1994 (USFWS 1994). When listed, the silvery minnow was known to occur only in the Rio Grande in a 280-km (174-mi) stretch of river that runs from Cochiti Dam to the headwaters of Elephant Butte Reservoir (Bestgen and Platania 1991; USFWS 1994; Dudley and Platania 2002). This includes a small portion of the lower Jemez River, a tributary to the MRG north of Albuquerque (USFWS 2010a). Its current habitat in the MRG is limited to about five percent of its historical range and is split by four dams into four reaches (Cochiti, Angostura, Isleta, and San Acacia; Figure 3).

In 2008, silvery minnows were introduced into the Rio Grande near Big Bend, Texas, as a nonessential, experimental population under section 10(j) of the ESA (USFWS 2008). Surveys through 2012 found the silvery minnow from near Presidio downstream through the Lower Canyon in the Big Bend area (Edwards and Garrett 2013). This indicated not only survival of the introduced population, but also both upstream and downstream dispersion. However, reproduction and recruitment may be limited as optimal conditions do not appear to occur with regularity, and further evaluation and stocking efforts are needed (Edwards and Garrett 2013).

The silvery minnow is reported to live from two to three years (Horwitz et al. 2017). The majority of spawning activity in the wild generally occurs by Age 1 silvery minnows over a six-week period in late spring to early summer (that is, late April, May, to June) in association with spring runoff when water temperatures are generally between 17 and 23° Celsius (C) (Dudley et al. 2016a). Silvery minnows are pelagic spawners that produce thousands of semi-buoyant, non-adhesive eggs that passively drift laterally onto shelves, side channels, inlets, and downstream while the embryo hatches and larvae develop (Platania and Altenbach 1998; Fluder et al. 2007). Drifting eggs and larvae are an adaption considered beneficial because it allows silvery minnow to widely disperse and rapidly recolonize downstream reaches impacted during periods of natural drought (Dudley and Platania 1997; Archdeacon et al. 2018a). Silvery minnow larvae are more abundant in shallow habitats with little or no flow velocity and relatively higher water temperatures as found in flooded overbanks (Pease et al. 2006).

Waters that are moving with slow to moderate velocities and shallow depths are also more favorable habitats for all life stages of silvery minnow (Dudley and Platania 1997; Bovee et al. 2008; Stone 2008; Braun et al. 2015). The preference for a narrower range of physical habitat conditions (often at the edges of the channel than found near the main stem of flows) by silvery minnows means that individuals often persist in a smaller subset of areas within the river system (Tetra Tech 2014). These conditions most commonly occur in side channels, backwaters, and shallow areas that are not directly associated with higher velocities occurring in the main stem.

However, main channel habitats that include areas that are shallow with slow-velocity water may also occur along shoreline where the edges are not eroded (Dudley and Platania 2007) or along the leeside of islands in the main channel (Magana 2012).

Available information suggest that many silvery minnow eggs and larvae are observed with the occurrence of certain abiotic conditions such as increased snowmelt runoff, and perhaps optimal photoperiod and water temperatures during May and June that may favor silvery minnow recruitment (Platania and Dudley 2001, 2003; Dudley et al. 2016a,b). There may be multiple silvery minnow spawning events, perhaps concurrent with multiple runoff events; however, multiple cohorts and recruitment from late-summer or fall spawning events have not been documented. There may also be circadian rhythms, including the timing of available foods (phenology), and genetic relationships that affect silvery minnow reproductive timing (Krabbenhoft et al. 2014; Vadadi-Fulop et al. 2014).

Silvery minnows in the MRG are a mixture of wild fish, fish of hatchery origin and the progeny of hatchery-reared or wild fish (Atkins 2016). Since 2002, approximately 2.5 million hatchery-raised silvery minnows have been augmented (stocked) into the MRG (Archdeacon 2016). The U.S. Bureau of Reclamation (Reclamation, or *in cite*, USBR) and the Service routinely stocks hatchery-reared silvery minnows into the MRG to partially offset losses through water management actions, to increase abundance and distribution, and to prevent silvery minnow extinction. Such augmentation has sustained the silvery minnow population throughout the MRG as evidenced by the higher proportion of hatchery-reared silvery minnows in the river during years of low recruitment and based on genetic indices (Osborne et al 2012). Additionally, silvery minnow rescue activities also take place in the MRG (Archdeacon 2016). During intermittency and river drying, a rescue crew collects and relocates silvery minnow from isolated pools within disconnected reaches. Due to the extreme variation in the silvery minnow population, augmentation of hatchery-reared fish to spawn in the wild, and rescue of silvery minnows are management actions that have and will continue to be taken to prevent extinction of this species (USFWS 2010, 2016; USBR 2015) and were actions considered in this BO.

Nearly monthly seining efforts have been systematically conducted for over 23 years to estimate catch-per-unit effort (CPUE) and monitor the status and trends of the silvery minnow in response to environmental phenomena and management actions as part of the Rio Grande Silvery Minnow Population Monitoring Program (Silvery Minnow PMP) (Dudley et al. 2018). The Silvery Minnow PMP uses a statistical model that considers the variability associated with CPUE in aquatic habitats to estimate the index of October's fish density (Hubert et al. 2016). Silvery minnow densities are estimated in the fall (October) because this is a good representation of the status of the adult silvery minnows surviving annually that may spawn the following spring. The results of the Silvery Minnow PMP provide the best available scientific information upon which to evaluate and measure the long-term demographic trends of silvery minnow in the MRG (Hubert et al. 2016) and were used to evaluate the effects from the environmental baseline and the proposed action in this BO (Appendix 1).

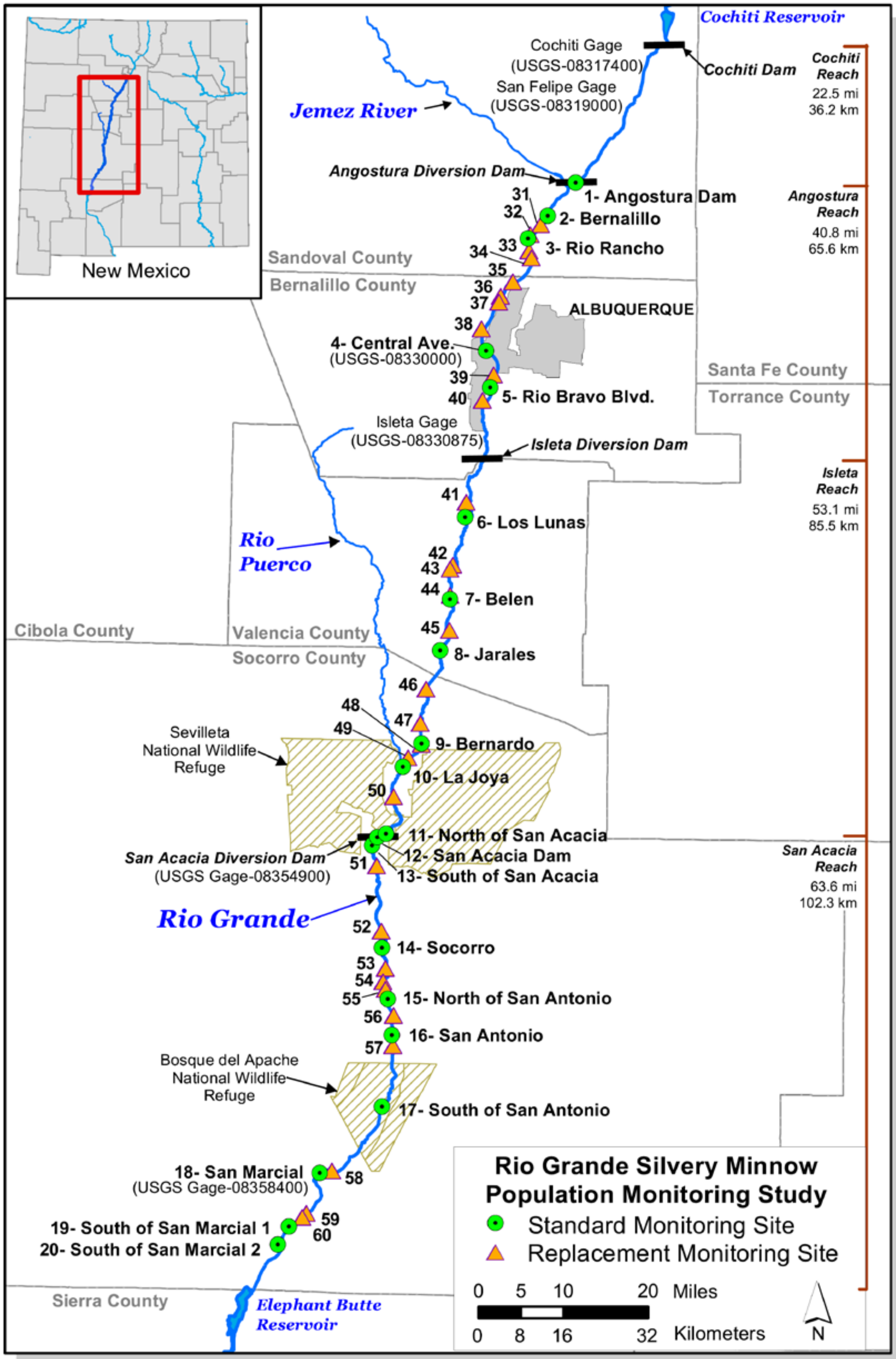


Figure 3. Map of the Cochiti, Angostura, Isleta, and San Acacia Reaches in the MRG and fish collection locations for the Rio Grande Silvery Minnow Population Monitoring Program (Source: Dudley et al. 2018).

Silvery minnow estimated fall densities are highly correlated with hydrologic conditions, particularly the magnitude, timing, and duration of the spring runoff (Dudley and Platania 2009; Dudley et al. 2018). Prolonged and elevated spring runoff result in flooding of the floodway (including those low elevation shelves and terraces near the channel or in portions of overbanks) thus forming of a variety of depths, velocities, and water temperatures in those inundated habitats. High spring runoff flooding of the MRG along with the delayed onset of low flows appear to ensure successful recruitment of silvery minnow (Dudley et al. 2018). Increases in spring runoff can result in the increase of abundance of Age 0 and subsequent adults (Age 1 and older). Reduced flows in spring and summer can result in declines in the estimated fall densities and distribution of silvery minnows (Dudley et al. 2018; Archdeacon 2016; USFWS 2016). Declines in silvery minnow genetic diversity (including declines in mitochondrial DNA and microsatellite diversity) coincide with low spring runoff or extensive drying in the MRG (Turner and Osborne 2007; Osborne et al. 2012). Decreased spring runoff can result in decreased hydrologic connectivity and result in variation in the amount and locations of suitable inundated habitat for silvery minnow eggs, larvae, juveniles, and adults.

*Climate Change, Spring Runoff, and Silvery Minnow Status*

There is a general downward trend in spring runoff volume and an altered timing of spring runoff in the MRG (USBR 2016; Krabbenhoft et al. 2014; Stone et al. 2017). Changes to climate have resulted in winter warming in the Southwest that has advanced of the timing of spring snowmelt runoff including in the MRG (Stewart et al. 2004; Regonda et al. 2005; Enquist et al. 2008; Rauscher et al. 2008; Bui 2011; Pinson 2013; USBR 2016). The monthly fraction and timing of spring runoff in the MRG during the last five decades has advanced in time such that snowmelt runoff flows sometimes arrives up to four weeks earlier than had occurred historically (Stewart et al. 2004; Regonda et al. 2005; Bui 2011; Krabbenhoft 2012). This advance in runoff timing also results in less flow available downstream during summer. Krabbenhoft (2012) suggested that the silvery minnow has adapted to match the timing of their release of eggs and subsequent larvae with necessary food resources in their nursery areas (Pease et al. 2006; Turner et al. 2010). However, the breadth of the silvery minnow's genetic capacity for adaptation to earlier spring runoff events is likely limited (Krabbenhoft 2012). Silvery minnow may not have the genetic capacity to adapt to an even earlier (15- to 25-day) advance in spring runoff and therefore, fewer eggs and larvae will arrive in the nursery areas at the right time. By the 2080s, when a spring runoff may be 15- to 25-days earlier, the abundance of silvery minnows is likely be lower than the current range observed with the runoff advances in the last five decades.

Because spring runoff is critical to the status of the silvery minnow, we reviewed the factors associated with elevated or poor spring runoff events and their timing. The annual flow volume varies significantly from year to year, depending on the amounts of snowmelt runoff, water extraction or consumptive use, various hydrological alterations, land cover changes, the operations of flood, irrigation, and water management infrastructure, alterations in the patterns and amounts of precipitation, evaporation rates, and increasing temperatures due to climatic conditions including multi-decadal droughts (Crawford et al. 1993; Ackerly 1999; Albert 2004; Julien et al. 2005; USACE et al. 2007; Furniss et al. 2010; Swanson 2012; USBR 2015, 2016; USFWS 2016; Stone et al. 2017). Reclamation (USBR 2016) has used greenhouse gas emission scenarios and along with climate projections containing temperature and precipitation data to develop and downscale a set of hydrologic projections that capture the variability in the MRG including current water management and maintenance operations (Llewellyn and Hastings 2015;

USBR 2016). These data include 48 years of simulations of flows at various MRG gages under a variety of emission-based, climate scenarios (including Warm and Wet (WW), Hot and Dry (HD), and a Central Tendency (CT)) into the 2080s.

We used these climate data along with relationship models of simulated silvery minnow density (described below and in Appendix 2 and in Appendix 3) to describe the likely status of the silvery minnow into the future. In this way, we modeled the effects of water management and other actions along with the likely effects of climate change on the magnitude and duration of spring runoff and floodway inundation to consistently evaluate the effects in the environmental baseline along with those attributable to the Levee Project, below. We used the CT and HD climate scenarios to estimate the average mean daily flows, the frequency of low flows, and average change in volume simulated at the ABQ Gage. Based on these analyses, we anticipate that the frequency of estimated silvery minnow densities in the fall less than 1.0 fish per 100 m2 (which is considered a self-sustaining population size; see USFWS 2016) would increase from 17 times to 19 (using a CT scenario) and to 25 times (using a HD scenario) by the 2080s. We anticipate that the frequency of estimated silvery minnow densities in the fall that are greater than 5.0 fish per 100 m2 (which is considered a recovered population in the MRG; see USFWS 2010) would decrease from 22 times historically to 17 (under a CT scenario) to 12 times (under a HD scenario) by the 2080s. We expect the reduced spring runoff duration and volume could result in an overall reduction of 2.3 fish per 100 m2 under a CT scenario by the 2080s. Under a HD scenario, we anticipate a reduction of 5.1 fish per 100 m2 in the fall estimated silvery minnow densities by the 2080s.

*Threats to Silvery Minnow*

Threats to silvery minnow are described by the Service (USFWS 2003, 2010, 2018). Two additional threats of interest in this BO are the effects on silvery minnow dispersal and distribution by habitat fragmentation and by non-native fish competition and predation. Silvery minnow are capable of long distance movement (some can swim up to 125 km (77 mi) in about 73 hours), and that these movements have been documented in the MRG (Platania et al. 2003; Bestgen et al. 2010; Archdeacon and Remshardt 2012a,b). Dams are barriers that prevent upstream movements of silvery minnow to both spawn and access habitat necessary for survival and recovery. The existence of barriers to silvery minnow movements adversely affects survival and recovery by restricting access to suitable habitat. Dams contribute to fragmentation of suitable habitat having negative effects on silvery minnow genetics. The genetic consequences of dams blocking silvery minnow movements are described in more detail by Alo and Turner (2005).

Competition and predation by nonnative species is considered to have contributed to the decline of the silvery minnow throughout its historical range (USFWS 2010a). In the MRG, the impact from predation by nonnative fish is considered low because few of the nonnative species are predators of silvery minnow (Remshardt 2012c) and consistently turbid conditions may provide cover to silvery minnow from predation. Nonnative species competing for resources necessary for survival of silvery minnow may be of greater concern. Species such as the common carp (*Cyprinus carpio)* and white sucker (*Catostomus commersonii)* spawn earlier than silvery minnow and, as a result, could dominate nursery habitat that the silvery minnow use (Hoagstrom et al. 2010). In the MRG, the fish community within irrigation facilities (including in upstream portions of ditches and the downstream portions of drainage outfalls) is dominated by non-native fish, which can adversely affect silvery minnows by competition and predation (Lang et al. 1994; Cowley et al. 2007; Wesche et al. 2010; SWCA 2016; Dudley et al. 2016a). The dominance of nonnative species which are better adapted than native species to reduced flows could lead to competitive displacement in the MRG (Bestgen and Platania 1991) or in other aquatic habitats such as found in irrigation facilities.

*Silvery Minnow Status Summary*

Even with managed stocking of hatchery-reared fish, the status of the silvery minnow remains endangered based on the current and future hydrology, alterations of the magnitude, duration, and timing of spring runoff, and other indicators of habitat availability (USFWS 2018). The physical conditions produced by prolonged and elevated spring runoff events result in the inundation of newly flooded shelves, side channels, shoreline, inlets, island edges, pools, backwaters, and bare or vegetated areas forming shallow, low-velocity habitats with increased nutrients, food, cover, and relatively warmer temperatures. These conditions are essential for the successful recruitment of many freshwater fish species (Welcomme 1979; Junk et al. 1989; Copp 1992; Dutterer et al. 2013) including silvery minnow in the MRG (Dudley and Platania 1997; Valett et al. 2005; Pease et al. 2006; Porter and Massong 2006; Dudley and Platania 2007; Turner et al. 2010, Hoagstrom and Turner 2013; Dudley and Platania 2015a, b; Dudley et al. 2017b). Using the anticipated duration, magnitude, and timing of spring runoff expected into the 2080s, the status of silvery minnow in the MRG is expected to decline from an average historical average in fall of 9 fish per 100 m2 by 2.3 (up to 5.1) fish per 100 m2, using the CT climate scenarios.

It is important to note that these modeling efforts have a high degree of variance (~300%; Appendix 3) around the averages of the densities of fish and the spring runoff flows estimated into the future. This high degree of variance likely reflects the silvery minnow's population response to the wide variability of spring runoff and base flow in the MRG over the last two decades (Dudley et al. 2018). The intent of the modeling efforts was to determine a status of the species that reflected the effects of water management and related actions in the environmental baseline, as well as to consider the potential effects of climate change into the future, so that we could consistently evaluate and isolate the future effects of the proposed action in this BO.

*Status of Silvery Minnow Critical Habitat*

Critical habitat for the silvery minnow was designated in 2003 (USFWS 2003a). Designated critical habitat extends 252 km (157 mi) from the Cochiti Dam downstream to RM 62.1, just north of Elephant Butte Reservoir, which equates to approximately 11,630 hectares (ha) (28,738 acres). The silvery minnow has been extirpated upstream of Cochiti Reservoir (USFWS 2003a). The width of the critical habitat is defined as the area bound by existing levees; or, where no levees are present, as 91 m (300 ft) of riparian zone adjacent to each side of the bankfull stage of the river channel. Contrary to Corps' assertions (USACE 2018c), the physical and biological features of silvery minnow critical habitat include both the inundated aquatic habitat as well as nearby overbank floodplain habitat within the floodway that extend laterally to the "toe" of the existing spoil banks or levees (USFWS 2003). The Pueblo lands of Santo Domingo, Santa Ana, Sandia, and Isleta were excluded from the final silvery minnow critical habitat designation

(USFWS 2003a). The primary constituent elements (PCEs) of the silvery minnow critical habitat are those elements of the physical or biological features in an area that provide for life-history processes and are essential to the conservation of the silvery minnow (USFWS 2003).

Generally, the quality and quantity of surface waters and substrate (and geomorphology) contributes to the status of silvery minnow critical habitat. There are five US Geological Survey (USGS) stream gages that have measured surface water discharges that reflect the volumes of water flowing into, though, and out of the Action Area. These included the USGS Gage at: the Rio Grande at Albuquerque, NM (ABQ Gage; USGS 08330000), the Rio Grande at Isleta Lakes, NM (USGS 08330875), the Rio Grande at Bosque Farms, NM (Bosque Farms Gage; USGS 08331160), the Rio Grande at Bosque, NM (USGS 08331510), and the Rio Grande at Bernardo, NM (Bernardo Gage; USGS 08332010).

The substrate and geomorphology of the MRG has been characterized by a number of researchers over time (Crawford et al. 1993; MEI 2002, 2006, 2008; Tetra Tech 2004; USACE et al. 2007; Massong et al. 2010; USACE 2010, 2015; Makar and Aubuchon 2012; Tetra Tech 2013; Varyu 2013a,b; and Bui et al. 2016). The characteristics of river channel width, depth, width, velocity, and suspended sediment load were found to vary with discharge (Leopold et al. 1953). Sediment supply and transport including the bed-material characteristics along the MRG directly affects the vertical and lateral stability of the river including the channel planform. During spring runoff and flood flows, water, and sediment are transported, redistributed, and deposited within the MRG floodway in the Action Area. The flux of water, sediment, and other materials in a flood are of great importance to inundated floodway habitats (Stone et al. 2017).

<u>Status of Critical Habitat Element 1: A Hydrologic Regime of Sufficient Flowing Water</u>
Element 1 is defined as "A hydrologic regime that provides sufficient flowing water with low to moderate currents capable of forming and maintaining a diversity of aquatic habitats, such as, but not limited to the following: Backwaters (a body of water connected to the main channel, but with no appreciable flow), shallow side channels, pools (that portion of the river that is deep with relatively little velocity compared to the rest of the channel), eddies (a pool with water moving opposite to that in the river channel), and runs (flowing water in the river channel without obstructions) of varying depth and velocity—all of which are necessary for each of the particular silvery minnow life-history stages in appropriate seasons (e.g., the silvery minnow requires habitat with sufficient flows from early spring (March) to early summer (June) to trigger spawning, flows in the summer (June) and fall (October) that do not increase prolonged periods of low or no flow, and a relatively constant winter flow (November through February) (USFWS 2003)."

Spring floods, low flows, winter flows, geology, topography, vegetation, and various engineering structures have all shaped the morphology of the floodway including its size, shape, and other characteristics (Crawford et al. 1993; Berry et al. 1997; Dodge et al. 2007; USACE et al 2007; Makar and Aubuchon 2012). All these factors have affected the function and have defined the extent of silvery minnow critical habitat. We evaluated the hydrologic regime to provide sufficient flows by season (spring runoff, base flows in summer/fall, and winter flows) below.

Hydrologic alterations of the MRG at the ABQ Gage were evaluated by Wesche et al. (2005), The Cadmus Group (2011), and Stone et al. (2017). Generally, mean monthly flows have increased during winter months (i.e., November, December, January, and February), while flows have generally decreased during other months (except in June) compared to reference conditions. Flows have increased during June and during minimum flow events due to augmentation of San Juan Chama Project water and other water management practices (USBR 2015). The average, annual, maximum mean daily flow and instantaneous peak flows have decreased (by an average of 30%) over time with some of the strongest impacts to peak flows attributed to Cochiti Dam operations (USACE 1997, 2015; USACE et al. 2007; Swanson 2012; Stone et al. 2017). This type of alteration to critical habitat has likely reduced the abundance and distribution of fish adapted to turbid, fluctuating flow regimes (such as silvery minnow), together with physical changes brought about by levees, channelization, and flood control dams, have eliminated many productive backwater habitats (Pringle et al. 2000; Swanson 2002; USEPA 2015).

Annual variation in fish recruitment is influenced by flood flows and the amount of inundation (DiCenzo and Duval, 2002; Janac et al. 2010; Dutterer et al. 2013; Dudley et al. 2016b). The amount and areas of inundation of the channel and overbank within the MRG was described for different flows by USACE (2010). Generally, the surface area of the channel and the overbanks within the inundated floodway increased with increasing discharges measured at the ABQ Gage. Estimated density of silvery minnows in the MRG during the fall was significantly correlated with amounts of inundated channel and overbank as well as average top wetted widths measured during May through June (USFWS 2016). Based on USACE (2010), peak flows of 7,000 cfs and a five-day flow of 6,936 was greatest (of the years reviewed) during 1993. During 1993 and 2005 the highest amounts of floodway inundation occurred and resulted in an estimated fall density of over 35 fish per 100 $m^2$. These recent, long-duration floods in the MRG indicated that the maximum area inundated within silvery minnow critical habitat was still functioning to allow for its recovery (that is, 35 fish per 100 $m^2$ exceeds 5 fish per 100 $m^2$; USFWS 2010).

Reduced flows limit fish movements, available habitat, or degrade water quality that may decrease silvery minnow survival (Stalnaker 1981; Fisher et al. 1982; Balcombe et al. 2005; Heggenes et al. 1996; Rogers et al. 2005; Dudley et al. 2008; Hatch et al. 2008; Durham and Wilde 2009; Dutterer et al. 2013 Archdeacon 2016). Extensive fish kills, including silvery minnows, have occurred in sections where the river has dried (Archdeacon 2016). From 1996 to 2017, an average of 47 km (29 mi) of the MRG has dried, mostly in the San Acacia Reach. Reductions in volume in the MRG by drought, water extraction, evaporation, or consumption affect silvery minnows by decreasing summer and fall low flows, thereby altering silvery minnow critical habitat, and affecting the fishes' metabolism, increasing stress, and negatively affecting their survival and distribution (Archdeacon 2016; USFWS 2016). As the distribution of silvery minnows was reduced by river drying (or water quality catastrophes), the probability that any additional stochastic events could deplete remaining fish increased and so did their risk of extirpation (Norris et al. 2008; Miller 2012; Dudley et al. 2018).

Critical habitat requires maintaining constant winter flows, which have occurred in the MRG. Typically, water stored upstream is transferred to Elephant Butte outside of the irrigation season and when evaporative and transpiration losses are reduced during winter (USBR 2015).

Status of Critical Habitat Element 2: Length, Depth, and Velocity of Habitats

Element 2 is defined as "The presence of eddies created by debris piles, pools, or backwaters, or other refuge habitat (e.g., connected oxbows or braided channels) within unimpounded stretches of flowing water of sufficient length (i.e., river miles) that provide a variation of habitats with a wide range of depth and velocities (USFWS 2003)."

Spoil banks and levees are effectively lateral dams that reduce the length of a braiding, sinuous river (Dodge et al. 2007). Spoil banks, levees, high ground, canyon walls, and other features have contributed to simplification of the MRG river channel system and to the vertical accretion of sediment within the floodway (Kennedy et al. 2011; Makar and Aubuchon 2012). The existing spoil banks and levees reduced the historical floodplain area in the MRG to a specific, identifiable area (termed "the floodway"), which resulted in reduced floods, reduced sediment transport, and reduced sediment deposition within the historical floodplain. The Rio Grande was once a sediment-rich river system that was naturally aggrading (Crawford et al. 1993; Varyu 2013). During flooding some of the suspended sediment loads would invariably deposit in the floodplain wherever roughness was increased (Acrement et al. 1989; Tetra Tech 2004; Phillips et al. 2006). When the floodable area was reduced into the floodway (Dodge et al. 2007), the amount of sediment deposition within the floodway was enhanced compared to a pristine (that is, without spoil banks or levees) condition (Adair 2016). This enhanced sediment deposition in the floodway (called aggradation in the channel and sediment deposition on the overbanks), has been exacerbated by the lateral confinement by spoil banks and levees (Makar and Aubuchon 2012). Increasing the topographic elevation of the overbanks due to vertical sediment deposition reduces the areas of flood inundation. During low flows, banks, islands, and bare sediment terraces are often colonized by vegetation (Tetra Tech 2004). Riparian vegetation that colonizes banks and bare sediment can exacerbate processes of channel narrowing by encroaching and armoring them. This increased vegetation creates roughness and also promotes sediment deposition within the floodway when exposed to sediment-rich floods (Acrement et al. 1989; Tetra Tech 2004; Phillips et al. 2006).

The silvery minnow requires long, unfragmented river reaches (USFWS 2003; Perkin and Gido 2012). Reaches less than 100 km (62 mi) in length do not appear to support long-term, self-sustaining populations of silvery minnow (Dudley and Platania 2007). Habitat fragmentation may occur in the form of physical barriers such as dams, but also in the form of dry river beds or areas of unsuitable habitat conditions. Reclamation and its partners plan (USBR 2015) to reconnect the four river reaches (Figure 1) within the next 10 years by providing fish passage through three irrigation diversion dams (Angostura, Isleta, and San Acacia). This reconnection will result in a continuous reach that is approximately 277 km (172 mi) long so it will be again be more capable of supporting silvery minnow survival, provide increased opportunities for dispersal and movement, and lead to a self-sustaining population of silvery minnows that can access more critical habitat during low flows or drought (USFWS 2016).

Dams and reservoirs upstream of the Action Area reduce the sediment supplied downstream to the action area (Lagasse 1980; Albert 2004, Julien et al. 2005, Swanson et al. 2012). This reduction in sediment supply affects channel depth and velocity of water in critical habitat. The reduction of sediment supply caused by upstream reservoirs has resulted in a rapid rate of river channel incision (deepening) as well as a coarsening of the river bed substrate types downstream in the action area (Sixta 2004; Massong et al. 2008). We evaluated the specific types of changes in channel depths in the action area by reviewing the USGS stage-discharge ratings at selected stream gages (Appendix 4). The USGS physically measures the elevational level of water in a cross section of the river channel (or stage) and the volume of flow at the gage. Changes in the stage-discharge rating are often due to a change in the streambed (for example, channel incision, or channel aggradation) or the growth of riparian vegetation. Based on our analyses (Appendix 4), over the last 30 years (or for the period of record), the depth of the channel incision at the

ABQ Gage has increased over time at approximately -0.0084 feet per year (note, the negative sign indicates a deepening of the channel). The depth of the channel incision at the Isleta Lakes Gage has increased as much as -0.0264 feet per year. The depth of the channel aggradation at the Bosque Farms Gage has decreased 0.0183 feet per year. The depth of the channel incision at the Bernardo Gage has increased -0.0024 feet per year. Incision is the dominant impact limiting floodplain connectivity in the upper portion of the action area (Stone et al. 2017). This means that deepening of the river channel will result in less opportunity for water to over the banks of river channel and laterally flood onto the overbank areas of the floodway. Channel incision, then, reduces the amount and function of the inundated overbank areas as nursery habitats for the retention of drifting eggs and development of silvery minnow larvae (Dudley et al. 2018).

The area of overbank inundation has decreased, in part, due to a more incised river channel and the reduction of annual peak discharges, resulting in generally drier (that is, less frequently flooded areas) overbanks (Stone et al. 2017). Whether the amounts of floodway inundation are the result of: 1) channel incision due to reductions in sediment supplies; 2) reduced spring runoff volumes due to climatic factors or water extraction; 3) increased sediment deposition because of the lateral confinement of floods by spoil banks and levees; or 4) hydrologic alteration by dams and reservoir operation that favor riparian vegetation colonization and increased roughness; the effects to silvery minnow are a reduction in the slow velocity habitats available during spring runoff and therefore, reduced recruitment. Reduced inundation of the floodway (which includes the near channel environment (e.g., shelves, side channels, and inlets) and the overbanks) results in reduced silvery minnow spawning and nursery habitat (and a diminishment of critical habitat function), which results in decreases in the densities of silvery minnows observed in the fall (USFWS 2016).

Few studies have documented water velocities in areas across the MRG river channel (Dudley et al. 1997; Watts et al. 2002; Remshardt et al. 2003; Bovee et al. 2008; Magana 2012; Braun et al. 2015) or especially in the overbanks during floods, but average channel velocities and other velocity conditions have been modeled (Tetra Tech 2014; Bui et al. 2016; USFWS 2016). As flows increase, average channel velocities also increase. In reaches where the channel is incised, average velocities tend to increase at a greater rate as compared to these in aggraded channels. There is less diversity in velocity profiles in incised reaches and little difference in channel velocities in flows ranging from 100 to 1500 cfs (Remshardt et al. 2003). Bestgen et al. (2010) reported that the mean critical swimming speed of silvery minnows was 1.7 feet per second and none were able to swim in velocities above 3.9 feet per second. Dudley and Platania (1997) reported a majority (97.5 percent) of silvery minnows captured were found in habitats with velocities less than 1.0 feet per second and most of the observed silvery minnow life stages preferred habitats with less than 0.3 feet per second velocities.

<u>Status of Critical Habitat Element 3. Substrates predominantly of sand or silt</u>
Element 3 is defined as “Substrates of predominantly sand or silt (USFWS 2003).”

Historically, the MRG had a 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 a naturally aggrading system (Woodson 1961). The exclusion of upstream sediment supply by upstream reservoirs has led to rapid downstream river channel narrowing and coarsening of the river bed substrates as far as 60 miles downstream (Sixta 2004; Massong et al. 2008).

Silvery minnows prefer sand substrates and may avoid gravel-dominated channel beds (Dudley and Platania 1997; Remshardt et al. 2003; Torres et al. 2008).

Status of Critical Habitat Element 4. Water of sufficient quality

Element 4 is defined as "Water of sufficient quality to maintain natural, daily, and seasonally variable water temperatures in the approximate range of greater than 1 °C (35 °F) and less than 30 °C (85 °F) and reduce degraded conditions (e.g., decreased dissolved oxygen, increased pH) (USFWS 2003)."

The MRG is a warm water river ecosystem. In floodplains that were infrequently flooded, inundation of the overbanks resulted in widespread low dissolved oxygen conditions within the floodwaters (Valett et al. 2005) that were capable of adversely affecting fish. On April 23, 2004, a large fish kill event was reported by Abeyta and Lusk (2004a) near San Marcial, New Mexico, due to low dissolved oxygen that was associated with excess organic matter oxygen demand occurring in a stagnant floodplain pool. Low oxygen content of storm water runoff was associated with silvery minnow mortalities in the North Diversion Channel on June 27, 2004 (Abeya and Lusk 2004a). Minimum oxygen contents are essential to keep silvery minnows and other aquatic organisms alive and to sustain their reproduction, development, vigor, immune capacity, behavior, movement, predator response actions, and survival (Hughes 1973; Kramer 1987; Breitburg 1992; Heath 1995; Portner and Peck 2010; Buhl 2011a, b, c). In the MRG, there are extended periods of low flow, with extremes in habitat characteristics, such as depth, velocity, and cross-sectional area, and water quality parameters, such as elevated temperature, low oxygen saturation, and high suspended sediments which require existing fish, including silvery minnow, communities to have wide environmental tolerances (Crawford et al. 1993).

*Status of Southwestern Willow Flycatcher*

The flycatcher was federally listed as endangered in 1995, without critical habitat (USFWS 1995). The flycatcher is a small, insect-eating generalist, neotropical migrant bird (USFWS 2002). It grows to about 15 centimeters (cm) [5.8 inches (in)] in length. It eats a wide range of invertebrate prey including flying, and ground- and vegetation-dwelling insects of terrestrial and aquatic origins (Drost et al. 2003). The flycatcher spends the winter in locations such as southern Mexico, Central and South America (Paxton et al. 2011).

Flycatchers use riparian habitats that are generally dense, shrubby, moist, and that have abundant flying insects (USFWS 2002). Riparian habitat is used throughout the flycatcher's range for breeding and stop-over habitat during their long-distance migration. Breeding habitat is largely associated with perennial (persistent) streamflow that can support the expanse of vegetation characteristics needed by breeding flycatchers. The hydrologic regime and supply of surface and subsurface water is a driving factor in the long-term maintenance, growth, recycling, and regeneration of flycatcher habitat (USFWS 2002).

At the end of 2007, 1,299 flycatcher breeding territories were estimated to occur throughout southern California, southern Nevada, southern Utah, southern Colorado, Arizona, and New Mexico (USFWS 2014). Some of the flycatcher breeding sites having the highest number of territories are found along the MRG and upper Gila River in New Mexico, and Roosevelt Lake and the San Pedro and Gila River confluence area in central Arizona.

Flycatchers have higher site fidelity (to a local area) than nest fidelity (to a specific nest location) and can move among sites within stream drainages and between drainages (Paxton et al. 2007). Within-drainage movements are more common than between-drainage movements (Paxton et al. 2007). Evidence gathered during studies of banded populations shows that although most male willow flycatchers return to former breeding areas, flycatchers regularly move among sites within and between years (Ellis et al. 2008). Juvenile flycatchers were the group of flycatchers that moved (dispersed) the farthest to new and distant breeding sites from the area where they hatched (Paxton et al. 2007).

The USGS's 10-year flycatcher study in central Arizona (Paxton et al. 2007) is the key movement study that has generated these conclusions, augmented by other flycatcher banding and re-sighting studies (Sedgwick 2004; McLeod et al. 2008). Between 1997 and 2005, of the 1,012 relocated banded flycatchers, 595 (59%) banded flycatchers in Arizona returned to the breeding site of the previous year, while 398 (39%) moved to other breeding areas within the same major drainage, and 19 (2%) moved to a completely different drainage (Paxton et al. 2007). Overall distance moved amongst adults and returning nestlings ranged from 0.03 to 444 km with mean distance moved by adults (9.5 km) being much less than the mean natal dispersal distance (20.5 km) (Paxton et al. 2007). Movement patterns are strongly influenced by reproductive success, and the age class of habitat patches may also be of consideration (Paxton et al. 2007).

*Threats to Flycatcher*

Declining flycatcher numbers have been attributed to loss, modification, and fragmentation of riparian breeding habitat, loss of wintering habitat, and brood parasitism by the brown-headed cowbird (Sogge et al. 1997; McCarthey et al. 1998). Changes to riparian ecosystems such as reductions in water flow, alteration of flood flows, physical modifications to watersheds and streams, and removal of riparian vegetation have occurred as a result of dams and reservoirs, groundwater pumping, channelization of streams for flood control, livestock overgrazing, agriculture developments, urbanization and other modifications.

Fire is also responsible for changes to riparian ecosystems, and is a threat to flycatcher habitat (Paxton et al. 1997), especially in monotypic tamarisk (also referred to as "saltcedar"; *Tamarix* sp.) vegetation (DeLoach 1996) and where water diversions or groundwater pumping desiccates riparian vegetation (Sogge et al. 1997).

Flycatcher nests are sometimes parasitized by brown-headed cowbirds (*Molothrus ater*), which lay their eggs in the flycatcher nests. Feeding sites for cowbirds are enhanced by the presence of livestock and range improvements such as waters and corrals, agriculture, urban areas, golf courses, bird feeders, and trash areas. When these feeding areas are in close proximity to flycatcher breeding habitat, especially coupled with habitat fragmentation, cowbird parasitism of flycatcher nests may increase (Hanna 1928; Mayfield 1977a; Mayfield 1977b; Paxton et al. 2011). An increase in nest parasitism by cowbirds and predation of flycatcher nests affects populations, especially those in smaller numbers and at more isolated locations.

Modification and loss of wintering habitat as well as loss of migratory "stopover" habitat used by flycatchers to replenish energy reserves during their long-distance migration may also contribute to the decline of flycatcher survival and reproduction. The widespread distribution, accumulation, or continued use of agrochemicals and pesticides in North, Central, and South America as well as the legacy of previous chemical use, storage, leaks, spills and atmospheric re-distribution also likely contributed to the decline of the flycatcher.

Recently, a new threat to the flycatcher has been introduced. The U.S. Department of Agriculture facilitated a biocontrol effort to eradicate nonnative tamarisk vegetation by releasing tamarisk leaf beetles (*Diorhabda* spp.) in the southwestern U.S. These beetles act by defoliating tamarisk trees during the growing season, with repeated defoliation over multiple years until the tree is killed. The use of tamarisk beetles was predicted to have large net positive benefits and minimal negative effects. However, tamarisk beetles have dispersed from original release sites in Colorado and Utah much faster than predicted (Paxton et al. 2011) and have the potential to spread widely and defoliate large expanses of tamarisk habitat, which is often utilized by flycatchers. In June 2010, the U.S. Department of Agriculture issued a moratorium on the release of tamarisk beetles in response to concerns over its potential effects on flycatcher critical habitat. The tamarisk beetle however, has become established in multiple watersheds in the southwest, and has continued to expand its range (Tamarisk Coalition 2016). In 2017, there were no confirmed reports of flycatcher nests failing as a result of tamarisk beetle defoliation along the Rio Grande, although that threat is still a major concern within the Rio Grande Recovery Unit.

*Flycatcher Critical Habitat*

Critical habitat was first designated in 1997, but was recently redesignated in 2013 (USFWS 1997, 2013a). San Ildefonso, Santa Clara, and Ohkay Owingeh Pueblo lands are excluded from designated critical habitat (USFWS 2013a). Range wide there are 84,568 ha (208,973 acres) of designated critical habitat.

The PCEs of flycatcher critical habitat are those elements of the physical or biological features in an area that provide for life-history processes and are essential to the conservation of the flycatcher. The PCEs listed in the critical habitat for the flycatcher are:

1. Riparian vegetation. Riparian habitat along a dynamic river or lakeside, in a natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs (that can include Gooddings willow (*Salix gooddingii*), coyote willow (*Salix exigua*), Geyer's willow (*Salix geyeriana*), arroyo willow (*Salix lasiolepis*), red willow (*Salix laevigata*), yewleaf willow (*Salix taxifolia*), pacific willow (*Salix lucida*), boxelder (*Acer negundo*), tamarisk, Russian olive (*Eleagnus angustifolia*), buttonbush (*Cephalanthus* spp.), cottonwood, stinging nettle (*Urtica dioica*), alder (*Alnus* spp.), velvet ash (*Fraxinus velutina*), poison hemlock (*Conium maculatum*), blackberry (*Rubus* spp.), seep willow (*Baccharis salicifolia*), oak (*Quercus* spp.), rose (*Rosa* spp.), sycamore (*Platanus* spp.), false indigo (*Baptisia australis*), Pacific poison ivy (*Toxicodendron diversilobum*), grape (*Vitis* spp.), Virginia creeper (*Parthenocissus quinquefolia*), Siberian elm (*Ulmus pumila*), and walnut (*Juglans* spp.) and some combination of:

    a. Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 2 to 30 m (about 6 to 98 ft). Lower-stature thickets [2 to 4 m (6 to 13 ft) tall] are found at higher elevation riparian forests and tall-stature thickets are found at middle and lower-elevation riparian forests;

b. Areas of dense riparian foliage at least from the ground level up to approximately 4 m (13 ft) above ground or dense foliage only at the shrub or tree level as a low, dense canopy;
c. Sites for nesting that contain a dense (about 50–100 percent) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground);
d. Dense patches of riparian forests that are interspersed with small openings of open water or marsh or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.1 ha (0.25 acres) or as large as 70 ha (175 acres).

2 Insect prey populations. A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, which can include: flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies, moths, and caterpillars (Lepidoptera); and spittlebugs (Homoptera).

For more detailed information on the flycatcher's biology, status of the species and critical habitat, see the Recovery Plan (USFWS 2002), designation of critical habitat (USFWS 2013a), 5-year review (USFWS 2014a), and recent BOs (USFWS 2015, 2016a). See the Environmental Baseline below for more details on the life history and demographics of the flycatcher.

*Status of Yellow-billed Cuckoo*

The cuckoo was listed as threatened in 2014 (USFWS 2014b) and critical habitat was proposed (USFWS 2014c). Currently there is no recovery plan for the cuckoo, and a recent 90-day finding in response to a petition for delisting determined that a 12-month review is warranted (USFWS 2018). The western population of cuckoo is considered a "distinct population segment" (DPS) as opposed to a subspecies (USFWS 2014b). The cuckoo is a neotropical migrant bird that winters in South America and breeds in North America (USFWS 2014b). The cuckoo is typically a secretive and hard-to-detect bird with a distinct vocalization. In the Southwest, the cuckoo usually occurs in association with large areas of mature riparian cottonwood-willow woodlands and dense mesquite associations. However, recent survey efforts in Madrean oak and pine-oak woodland, juniper woodland, and dense Sonoran desert scrub have documented cuckoo breeding in these alternative vegetation types. This DPS is historically known from 12 states including: Washington, Oregon, California, Idaho, Nevada, Utah, Arizona, and parts of Montana, Wyoming, Colorado, New Mexico, and Texas. The estimated cuckoo population was summarized by the Service (USFWS 2013a) and is provided in Table 2. Northwestern Mexico and Arizona are believed to have the largest populations of cuckoos, range wide (Table 2). New Mexico also contains important breeding habitat for cuckoos with approximately 15 percent of the estimated population found in this area.

Table 2. Estimated cuckoo population by geographic location (USFWS 2013a).

| Area | Estimated Number of Territories |
|---|---|
| Arizona | 170-250 |
| California | 40-50 |
| Colorado | < 10 |
| Idaho | 10-20 |
| Nevada | < 10 |
| New Mexico | 100-155 |
| Northwestern Mexico | 330-530 |
| Utah | 10-20 |
| Western Texas | < 10 |
| Wyoming | < 5 |
| **Total** | **680-1025** |

Cuckoos generally arrive at their breeding grounds in mid-June with nesting starting between late June and late July. Nest clutch size is typically between two and four eggs (Halterman et al. 2016). Nesting may continue into September, but along the Rio Grande, nesting activity is typically concluded by mid to late August (Sechrist et al. 2009, 2012; Carstensen et al. 2015; Halterman et al. 2016). Both adults will tend to the nest, eggs, and young. Nest heights range from 1.3 to 13 m (4 to 43 ft) and the nesting cycle is extremely rapid, taking 17 days from egg laying to chicks fledging (Carstensen et al. 2015; Halterman et al. 2016). Cuckoos typically have one brood per year (Ehrlich et al. 1988); however, in circumstances where an abundance of prey is available; cuckoos can have up to three broods (Halterman et al. 2016). Fledglings are dependent on the adults for up to 4 weeks, and have shorter tails and paler coloration. Little is known about cuckoo survivorship or nesting success, but telemetry and banding evidence from the lower Colorado River suggests they could live at least 3 years (Laymon 1998), and that pesticides are suspected of causing reproductive failure (Gaines and Laymon 1984).

Cuckoo nest site fidelity information is limited. Where banding studies have taken place, returning cuckoos one or more years after initial capture were typically recaptured within 24 m (80 feet) to 80 kilometers (50 miles) from their original banding location (McNeil et al. 2013, Halterman 2009, Halterman et al. 2016). Breeding pairs of banded cuckoos along the Lower Colorado River were found occupying the same territory for up to three years (Laymon 1998, Halterman et al. 2016).

*Threats to Cuckoo*

Cuckoos now breed in small isolated populations. These populations are increasingly at risk to further declines as a result of increased predation rates, lack of abundance of prey, migratory obstacles (i.e. weather events, collision with structures, etc.), conversion of habitat from native to exotic vegetation, defoliation of saltcedar caused by tamarisk leaf beetles, increased fire risk, and climate change (Thompson 1961, McGill 1979, Wilcove et al. 1986).

Fire is an imminent threat to cuckoo breeding habitat (USFWS 2014c). Although fires occurred to some extent in riparian habitats historically, many native riparian plants are neither fire-adapted nor fire-regenerated. Thus, fires in riparian habitats are typically catastrophic, causing immediate and drastic changes in plant density and species composition. Busch (1995) documented that the current frequency and size of fires in riparian habitats is greater than historical levels because reduced floods have allowed buildup of fuels, and because of the expansion and dominance of the highly flammable tamarisk. Tamarisk and arrowweed (*Pluchea sericea*) tend to recover more rapidly from fire than do cottonwood and willow.

The historic breeding range of the cuckoo included areas as from Canada to Mexico and from the Continental Divide to the Pacific Coast (Laymon and Halterman 1987). Similar to the flycatcher, declining cuckoo numbers have been attributed to loss, modification, and fragmentation of riparian breeding habitat (78 FR 61621). Changes to riparian ecosystems such as reductions in water flow, alteration of flood flows, physical modifications to watersheds and streams, and removal of riparian vegetation have occurred as a result of dams and reservoirs, groundwater pumping, channelization of streams for flood control, livestock overgrazing, agriculture developments, urbanization and other modifications.

*Cuckoo Proposed Critical Habitat*

The PCEs of cuckoo proposed critical habitat are those elements of the physical or biological features in an area that provide for life-history processes and are essential to the conservation of the cuckoo. The PCEs listed in the 2014 proposed rule for the cuckoo (USFWS 2014c) are:

1. Riparian woodlands. Riparian woodlands with mixed willow-cottonwood vegetation, mesquite-thorn-forest vegetation, or a combination of these that contain habitat for nesting and foraging in contiguous or nearly contiguous patches that are greater than 100 m (325 ft) in width and 81 ha (200 acres) or more in extent. These habitat patches contain one or more nesting groves, which are generally willow-dominated, have above average canopy closure (greater than 70 percent), and have a cooler, more humid environment than the surrounding riparian and upland habitats;

2. Adequate prey base. Presence of a prey base consisting of large insect fauna (for example, cicadas, caterpillars, katydids, grasshoppers, large beetles, dragonflies) and tree frogs for adults and young in breeding areas during the nesting season and in post-breeding dispersal areas; and

3. Dynamic riverine processes. River systems that are dynamic and provide hydrologic processes that encourage sediment movement and deposits that allow seedling germination and promote plant growth, maintenance, health, and vigor (e.g., lower gradient streams and broad floodplains, elevated subsurface groundwater table, and perennial rivers and streams). This allows habitat to regenerate at regular intervals, leading to riparian vegetation with variously-aged patches, both young and old.

There are currently 546,335 acres being proposed for designation as critical habitat in Arizona, California, Colorado, Idaho, Nevada, New Mexico, Texas, Utah, and Wyoming (USFWS 2014c). For more detailed information on the biology, status of the species and critical habitat, see the final listing and proposed designation of critical habitat rules (USFWS 2014b, 2014c), and recent BOs (USFWS 2015, 2016a,b). See the Environmental Baseline below for more details on the life history and demographics of the cuckoo in the Action Area specifically.

*Climate Change as Related to Flycatchers, Cuckoos and Associated Habitats*

One of the hydrological consequences of droughts and climate change has been a shift of the timing of snowmelt runoff events to earlier in the season in snowmelt-dominated regions (Frederick and Gleick 1999; Poff et al. 2002) including in the Action Area (USBR 2016). The timing of spring streamflow in the MRG during the last 5 decades has advanced so that peak flow can now arrive up to 1 to 4 weeks earlier, resulting in less flows in the summer (Stewart et al. 2004; Bui 2011; Krabbenhoft 2012). Earlier peak runoff has substantial impacts on water resources management including irrigation operations, geomorphology, recreation, flood control, and instream flow for fish (USBR 2016).

NMOSE (2006), listed the following impacts of climate change in New Mexico:

- Warming trends in the southwest are expected to continue to be greater than global averages by about 50 percent;
- Modeling suggests that even moderate increases in precipitation would not offset the negative impacts to the water supply caused by increased temperature;
- Increased temperatures will increase growing seasons, resulting in increased plant and human use of decreasing water supplies;
- There will likely be alterations in the arrival of snow, acceleration of spring snow melt, increased variation in the proportion of rain, all contributing to rapid and earlier seasonal runoff events; and
- The intensity, frequency, and duration of drought may increase.

The impacts associated with climate change are expected to exacerbate effects associated with hydrology, geomorphology, vegetation changes, and others as described in the above paragraph. Flycatchers may be more vulnerable to future climate change owing to its climate-associated genotypes and genes important to thermal tolerance (Ruegg et al. 2018). For flycatchers and cuckoos, warming temperatures and decreases in the amount of water mean an unquantified amount of native vegetation converted to exotic vegetation when less water is available that would help native vegetation outcompete exotic stands. Additionally, nesting sites in saltcedar stands may not provide adequate cover for nestling survival in hotter climates (Friggens et al. 2012). It would also mean decreases in foliage cover in times of drought, which would lead to nests being more exposed to the elements of the weather or less conspicuous for predators, which would theoretically result in increases in predation. Foraging opportunities would also be more limited with less water available for prey base (Sedgewick 2000).

## ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area. Included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the Action Area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress.

*Status of the Silvery Minnow in the Action Area*

We reviewed the status of the silvery minnow in the Action Area by querying the Silvery Minnow PMP data collected during 1993 to 2016 (Dudley et al. 2015b, 2016b, 2017b, 2017c; Table 3, and see Appendix 1). During 1993-2016, 136,687 silvery minnows were captured at 20 sampling stations in the MRG. Of these, 39,661 silvery minnows (or ~29% of the total collected from the MRG) were collected at eight stations that were in or just above or below the Action Area. Two of the fish monitoring stations were later abandoned and as a result, we did not consider data collected at those two stations (918 fish) in our analysis. We summarized these data by river sub reaches that we termed “georeaches” in this BO (see Table 4 for GeoReach name, length, and location, below). Using data from the six, long-term monitoring stations (composed of two stations per georeach, in GeoReaches 3, 5, and 6) we summarized the status of silvery minnow in the Action Area over 23 years in July and October (Table 3; and see Appendix 1). We found that 4.6% (6,319), 13.3% (18,194), and 10.4% (14,230) of the silvery minnows were collected from GeoReaches 3, 5, and 6, respectively. We assumed that the percentage of silvery minnows caught (38,743 or 28.3%) during the Silvery Minnow PMP in the Action Area contributed proportionally, or approximately one-third, to the overall population of silvery minnows in the MRG. We based this assumption on the review by Hubert et al (2016) that stated that the use of CPUE indices (that is, the effort standardized catch of silvery minnows) provides a reasonable indication of the status and trends of abundance of RGSM in the MRG.

During 1993-2016, the average silvery minnow densities in the Action Area in October were significantly related to spring runoff magnitude and duration as measured at the ABQ Gage (Appendix 2). When poor snowmelt runoff occurred (averaging ~1,000 cfs mean daily flow at the ABQ Gage during May and June) lower silvery minnow densities (~0.3 fish per 100 m2) were captured in the Action Area in October. Seasonally, the highest catches of silvery minnows occurred in summer months and lower catches occurred in the fall or in winter just prior to the following year’s spring runoff. The average, Total Catch per Pooled Effort (TCPE; of 74.8 fish per 100 m2) of silvery minnows in GeoReach 5 was significantly greater (using a Friedman ANOVA by ranks test; chi square = 15.75, n=21, df=2, p=0.0004) than the average TCPE (9.2 fish per 100 m2) of silvery minnows captured in GeoReach 3. Since GeoReach 3 often receives more spring runoff than GeoReach 5 (due to agricultural diversion: USBR 2015), we suspect that the amount of floodway inundation may have influenced the catch of silvery minnows in GeoReach 5 (Table 3). Given the wide variation in silvery minnow catch rates, we used the $85^{th}$ percentile TCPE densities of Age 0 and Age 1 silvery minnow (from Table 3) for estimating the number of fish, by season, which included those that were affected in the environmental baseline and for estimating some of the effects of the proposed action, below.

We also simulated the expected densities of Age 0 and Age 1 silvery minnows in the fall using the duration of spring runoff at the ABQ Gage for 96 years from 1951 and projected through 2063 (based on USBR 2016 forecast flows under a CT climate scenario) (Appendix 3). The historic and projected flows include all water operations as part of the environmental baseline (USBR 2015). Based on those flows, our simulated values of the average TCPE for Age 0 plus Age 1 silvery minnows was within 83 percent of the observed values (average October TCPE in Table 3) from six stations of the 23 years of Silvery Minnow PMP (Appendix 3). That is, the average error in our simulated silvery minnow estimates was approximately 17 percent. Using these simulations, we extrapolated an estimated number of silvery minnows in the fall by multiplying the estimated density times by one-fifth the maximum width of the Action Area in each spring times its length (33.2 mi). We reduced the densities by one-fifth to reflect the reduction of water from spring to summer and associated mortalities due to water operations and related activities. Using these simulations, we projected the number of Age 0 silvery minnows in the Action Area would decrease by 21 percent under a CT climate scenario (Appendix 3).

As a result of these modeling efforts, we estimated that a self-sustaining population (described in USFWS 2016 as survival) density of approximately 1 fish/100 $m^2$ times the Action Area size would equal approximately 5,000 silvery minnows. We also estimated that a recovered population (described in USFWS 2010) density of 5 fish per 100 $m^2$ would equal approximately 20,000 silvery minnows in the Action Area. We evaluated the effects of the proposed action, in addition to the effects in the environmental baseline, as affecting silvery minnow survival when the proposed activity reduced the estimated population below 5,000 silvery minnows or reduced the estimated density below 1 fish/100 $m^2$ (Appendix 3). We evaluated the effects of the proposed action, in addition to the effects in the environmental baseline, as affecting silvery minnow recovery when the proposed activity reduced the estimated population below 20,000 silvery minnows or reduces the estimated density below 5 fish/100 $m^2$ (Appendix 3). We also used these simulated Age 0 silvery minnows and densities in the Action Area to evaluate the effects to the silvery minnow by projected changes to its critical habitat (that is, by reductions in the maximum wetted width of spring floods and to historical and expected changes to channel depths by aggradation or incision phenomena; Appendix 3), together with the effects of the environmental baseline, along with the effects of the proposed action (described below).

Irrigation systems (canals, riverside drains, waste ways, or drainage outfalls) in the Action Area provide a significant proportion (515 mi) of flowing waters in the Isleta Reach (53.1 mi; Lang et al. 1994). However, portions of the irrigation system do provide some silvery minnow habitat. The upper portions of the irrigation system may provide less suitable habitat for silvery minnows and they occur there mainly through entrainment of a smaller proportion of silvery minnow eggs or larvae (Dudley et al. 2016a). Those silvery minnows caught in upper portions of irrigation water supply canals were likely derived from eggs (or larvae) taken into the canal during water diversion and will most likely perish there (Dudley et al. 2016a). The downstream portions of these irrigation systems (that is the drainage outfalls into the MRG channel) do provide some suitable habitat or refugia to silvery minnows and other nonnative or predatory fishes during low flows (Lang et al. 1994; Cowley et al. 2007; Wesche et al. 2010; SWCA 2016). Based on these studies, the frequency of occurrence or percent of silvery minnows of the total fish caught from within or near irrigation systems (and mostly in the drainage outfalls) averaged 25 percent (ranging from 0.02 to 65 percent) compared with the catch or density of silvery minnows in nearby river sites (Lang et al. 1994; Cowley et al. 2007; Wesche et al. 2010; SWCA 2016).

Table 3. Average total catch per pooled effort (TCPE) of Age 0 or Age 1 Rio Grande Silvery Minnow caught in July or October in three river sub reaches in Action Area (see Appendix 1).

| Year | Mo. | Reach 3 Age 0 /100 $m^2$ | Reach 3 Age 1 /100 $m^2$ | Reach 5 Age 0 /100 $m^2$ | Reach 5 Age 1 /100 $m^2$ | Reach 6 Age 0 /100 $m^2$ | Reach 6 Age 1 /100 $m^2$ |
|---|---|---|---|---|---|---|---|
| **1993** | Jul | 2.34 | 0.00 | 8.60 | 0.00 | 8.95 | 0.00 |
| **1993** | Oct | 0.56 | 0.00 | 3.78 | 0.00 | 1.27 | 0.00 |
| **1994** | Jul | 0.28 | 0.37 | 9.80 | 0.36 | 2.37 | 0.00 |
| **1994** | Oct | 0.00 | 0.00 | 0.91 | 0.18 | 0.00 | 0.00 |
| **1995** | Oct | 0.50 | 0.40 | 58.68 | 0.67 | 3.32 | 0.00 |
| **1996** | Oct | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **1997** | Oct | 0.89 | 1.19 | 7.33 | 2.23 | 0.71 | 0.00 |
| **1999** | Oct | 0.00 | 0.00 | 0.76 | 0.00 | 0.00 | 0.00 |
| **2000** | Oct | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **2001** | Oct | 0.00 | 0.00 | 1.70 | 0.00 | 0.17 | 0.00 |
| **2002** | Jul | 0.00 | 0.00 | 0.00 | 0.21 | 0.00 | 0.00 |
| **2002** | Oct | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **2003** | Oct | 0.00 | 0.00 | 0.26 | 0.00 | 0.00 | 0.00 |
| **2004** | Jul | 0.41 | 0.00 | 2.23 | 0.00 | 8.90 | 0.00 |
| **2004** | Oct | 0.00 | 0.00 | 0.25 | 0.59 | 0.00 | 0.00 |
| **2005** | Jul | | | 328.65 | 0.00 | 127.27 | 0.00 |
| **2005** | Oct | 4.12 | 0.00 | 66.63 | 0.00 | 146.69 | 0.00 |
| **2006** | Jul | 0.39 | 0.00 | 5.35 | 2.30 | 4.61 | 1.74 |
| **2006** | Oct | 0.49 | 0.49 | 0.00 | 0.53 | 0.20 | 0.39 |
| **2007** | Jul | 19.40 | 0.00 | 18.23 | 0.00 | 45.72 | 0.00 |
| **2007** | Oct | 13.11 | 0.00 | 28.60 | 1.84 | 6.94 | 0.33 |
| **2008** | Jul | 2.14 | 0.53 | 46.78 | 0.30 | 26.09 | 0.82 |
| **2008** | Oct | | | 3.07 | 0.89 | 2.69 | 0.32 |
| **2009** | Oct | 6.32 | 1.05 | 10.31 | 0.26 | 4.92 | 0.00 |
| **2010** | Jul | 0.00 | 0.35 | 2.50 | 0.69 | 13.57 | 0.47 |
| **2010** | Oct | 0.00 | 0.27 | | | | |
| **2011** | Jul | 0.00 | 0.00 | 1.88 | 0.46 | 0.40 | 0.00 |
| **2011** | Oct | 0.61 | 0.00 | 3.30 | 0.00 | 1.51 | 0.00 |
| **2012** | Jul | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **2012** | Oct | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **2013** | Jul | 0.00 | 0.00 | 1.11 | 0.00 | 0.00 | 0.00 |
| **2013** | Oct | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **2014** | Jul | 0.00 | 0.00 | 0.20 | 0.00 | 0.58 | 0.00 |
| **2014** | Oct | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **2015** | Jul | 3.20 | 0.00 | 1.15 | 0.00 | 1.74 | 0.00 |
| **2015** | Oct | 0.18 | 0.18 | 0.57 | 0.00 | 0.21 | 0.00 |
| **2016** | Jul | 12.79 | 0.00 | 63.04 | 0.00 | 15.54 | 0.00 |
| **2016** | Oct | 7.93 | 0.00 | 14.57 | 0.56 | 1.16 | 0.00 |
| **July 85th percentile** | | 7.52 | 0.36 | 31.08 | 0.56 | 20.29 | 0.63 |
| **October 85th percentile** | | 5.66 | 0.46 | 24.39 | 0.65 | 4.44 | 0.00 |

We assumed that the density of silvery minnows in the irrigation outfalls was the same as that within the irrigation systems and, on average, 25 percent of the densities of silvery minnows (Table 3). These population densities were used for the purposes of estimating effects to silvery minnows exposed to the proposed action activities that occur in irrigation facilities.

In the environmental baseline, the Service has authorized or exempted take of silvery minnow for scientific research, recovery activities, and through incidental take statements. The estimated densities that are described in Table 3 reflect the status of the silvery minnow in the Action Area after the activities in the environmental baseline have been considered. For example, under section 10(a)(1)(A) of the ESA, the Service has authorized harassment and capture of up to 35,000 eggs, 15,000 larvae, and 120,000 juvenile and adult silvery minnows in the Action Area. Under section 7(o)(2), the Service has exempted incidental take of up to 76 percent of all life stages of silvery minnows due to the effects of actions of water management, river maintenance, and conservation measures proposed by Reclamation and its partners (USBR 2015). These water management, river maintenance, and other activities included the harm or mortality of up to 40 percent of the silvery minnows (all life stages) in the Action Area (USFWS 2016). These activities also include a variety of water management related activities that harass and harm silvery minnow in the action area including monitoring, captive propagation, salvage, and research (USBR 2015; USFWS 2016). As a result of population declines that occur during low spring runoff, and additional take exempted or authorized in the environmental baseline, the Service restricts activities (USFWS 2017) resulting in take of silvery minnow during periods when: 1) the population status is low (that is, density is less than 0.3 fish per 100 m2); or, 2) when there is an estimated number of adults is low (~20,000 in the MRG or ~5,000 in Action Area); or 3) when take-authorized mortalities (45%) approach the numbers of silvery minnows at any time (as was estimated by modeling described above).

<u>Summary Status of Silvery Minnow in the Action Area</u>
Silvery minnows occupy the Action Area and contribute up to one-third of the overall population in the MRG (as measured by the Silvery Minnow PMP). Densities of Age 0 silvery minnows estimated in the fall were significantly related to the duration, magnitude, and inundation width of the spring flood in the Action Area. The densities of silvery minnows were highest in GeoReach 5 compared with those in GeoReach 3 due to the interaction of spring floods and the amount of inundation in each georeach. Spring runoff inundates GeoReach 5 at lower flood levels and across a wider area than in other sub reaches in the Action Area. Silvery minnows occur in the lower portions of drainage outfalls in the Action Area at about 25 percent of the estimated density found in the river habitat monitored nearby. Nearly 75 percent of the estimated population of silvery minnows in the Action Area is affected by water management and river maintenance activities, with mortalities and augmentation as high as 45 percent of this population (USFWS 2016). An approximate 27 percent reduction in silvery minnow densities (21% by reduced spring flows + 1% by channel deepening + 4.8% by reduced floodway inundation) are likely to occur in the Action Area due to effects of projected warmer temperatures on reduced spring floods, more channel incision, and a reduction in the area of floodway inundation due to sediment deposition impacts from the spoil banks (assuming no breaches) into the foreseeable future. The silvery minnow population can experience wide fluctuations (including through management of the species through augmentation); they are short lived, and can be locally extirpated with consecutive low spring runoff years followed by reduced low flows and river drying during extended droughts. Therefore, silvery minnow remains endangered throughout the Action Area and therefore sensitive to additional impacts.

*Status of Silvery Minnow Critical Habitat within the Action Area*

Approximately 21 percent of critical habitat (33.2 of 157 miles) or ~5,354 acres of channel and overbanks within the floodway occurs in the Action Area. Critical habitat was not designated on the Pueblo of Isleta, which mainly occurs in GeoReach 4. Critical habitat does not include the existing flood control facilities (including the spoil banks themselves; USFWS 2003). Silvery minnows are still present during all or part of the year wherever water occurs and their habitat is suitable within the critical habitat boundaries of the Action Area (USFWS 2003; Remshardt et al. 2003; Bovee et al. 2008; Dudley et al. 2018b). Critical habitat in the Action Area was deemed essential to the conservation of the silvery minnow because the additional loss of any habitat that is currently occupied could increase the likelihood of extinction or severely affect the downstream reaches (USFWS 2003). In the final rule, the Service (USFWS 2003) indicated that channelization, road and bridge construction, reduction of available floodway, removal of materials, excessive sedimentation, and reductions in stream flow, would likely adversely affect critical habitat and those type of activities with a federal nexus should be consulted upon. Below, we reviewed the functional status of the four critical habitat elements in the Action Area.

Status of Critical Habitat Element 1: Hydrologic Regime of Sufficient Flowing Water

The annual, mean daily flow (averaged during 1993-2016) was 1,040 cfs, 801 cfs, and 844 cfs, at the ABQ, Bosque Farms, and Bernardo gages, respectively. The mean daily flow during May and June (averaged during 1993-2016) was 2,226 cfs, 1,723 cfs, and 1,783 at the ABQ, Bosque Farms, and Bernardo gages, respectively. Densities of Age 0 silvery minnows in October were significantly related with the volume of spring runoff, the duration of spring runoff, and the channel area and width of inundated overbanks in the Action Area (Appendix 2). There were significant positive relationships between the fall densities of silvery minnows and spring flows at these three gages (even with the different gages' reduced spring flows due to water removal and loss) within the Action Area.

Spring flows, other floods, geology, topography, vegetation, and various engineering structures have all shaped the morphology of the floodway including its size, shape, and other characteristics (Table 4) in the Action Area (Crawford et al. 1993; Berry et al. 1997; Dodge et al. 2007, USACE et al 2007; Makar and Aubuchon 2012). We reviewed the geomorphological characteristics by floodway sub reaches in the Action Area (Table 4). Generally, the overbanks in GeoReach 5 were flooded the widest under most flows. GeoReach 6 had the narrowest active floodway and was similar to GeoReach 3. While GeoReach 3 was generally wider at base flows (<500 to 1000 cfs), it was the most incised channel indicated by higher average channel velocities (Table 4). GeoReach 4 and GeoReach 5 were shallower reaches as indicated by flood depths, had lower average channel velocities, and had channels more connected to overbanks indicated by wider areas of flooding at lower floods. Note that overbanking occurs when a flood rises out of the channel and spills over its banks onto the nearby riparian floodplain.

Approximately fifty percent of the overbank areas began flooding at 4,000 cfs in GeoReach 4 and 5, while GeoReach 3 and 6 began similarly overbanking at 9,000 cfs. Note that bankfull is when the level of a flood reaches laterally across the floodplain onto the toe of a nearby spoil bank or levee. Nearly 50 percent of GeoReach 5 was flooded to bankfull at 5,000 cfs, while bankfull flooding did not occur in the other reaches until flows were 9,000 cfs or greater. Note that it is at these annual chance exceedance floods (that is, at the 10 percent chance flood event or 10,300 cfs at the ABQ Gage; USACE 2017o) that the inundated areas likely represent the maximum extent of functional wetted width in the Action Area. The maximum extent of floodway inundation provides silvery minnow spawning and nursery habitats as indicated by the maximum wetted width of spring flooding in the Action Area. Those additional riparian areas at greater flood heights contribute to the physical and biological features of critical habitat (USFWS 2003).

We used two models to figure out how many fish have been affected by floodway narrowing due to the levee fills and due to the sediment depositions. We also used the habitat model by Tetra Tech (2014) to determine those 79 spawning and nursery areas, which would therefore likely contain silvery minnow eggs and larvae, and that were immediately near the levee construction activities during May through July. We reviewed the results of the inundation model by Corps (USACE 2010) and the average wetted width models (developed for this BO; Appendices 2 and 3). Both the inundation area of spring floods and the maximum wetted width models were significantly related to the density of Age 0 silvery minnows estimated in the Fall in the Action Area. For both models, when the wetted width or the area of channel and overbank inundation during spring floods was reduced by 30 percent (±10%, 1 std dev) then the estimated number of Age 0 silvery minnows was reduced by approximately 62 percent (±10%, 1 std dev) (Appendix 2). From 2002 to 2012, the average wetted width during spring flooding was reduced by approximately 2.3% (Appendix 5, based on USACE 2018c). Therefore, using the results from these models, we found that the estimated silvery minnow densities in the fall were reduced by approximately (2.3% x 62% ÷ 30 % = 4.8%) 4.8% based solely on the reductions of inundated areas (and wetted widths during spring floods).

This assessment indicated that reduction of inundated floodway areas (and average wetted widths) during spring floods had measurable adverse effects on the function of critical habitat for survival and recovery of silvery minnow in the action area. Hereafter, we use this relationship of a 2.1 percent reduction in silvery minnow densities in the fall for every one percent reduction in the area of floodway inundation in the spring. Notably, even with the reduction of spring flow volumes entering GeoReach 5, it remained functional and wetted widths and inundated areas remained high allowing maintenance of silvery minnow nursery habitat in this reach, and therefore, the more-readily floodable areas in this reach indicated the favorable morphological goals for silvery minnow habitat restoration (Table 4). For each percent of floodway inundated (at lower spring flows) up to 2.1 percent increase in the fall density of silvery minnows in that reach can occur (with all other factors, such as extent of intermittency, remaining same).

Days of zero flow (evaluated using mean daily flows less than 1 cfs) during July through October occurred infrequently at the ABQ gage and occurred at approximately 2.4 percent frequency at the Bosque Farms and Bernardo gages during 1993 to 2016. During 1993 to 2016, periods of intermittency occurred in the Action Area during 17 of 23 years (71%). The average amount of river drying in the Action Area was 13 miles and mostly occurred between Los Lunas and Belen, New Mexico (in GeoReach 5). These frequencies of low flows at the ABQ and Bosque Farms gages are expected to continue into the 2080s and maintain silvery minnow distribution within the Action Area in areas that remain wet due to improved water operations (USBR 2015; USFWS 2016). Low flows and extent of river drying are likely to remain similar to the current condition and will adversely affect up to 39 percent of critical habitat the Action Area into the 2080s.

Table 4. Morphological characteristics (average ± 1 standard deviation for each geomorphic sub reach or GeoReach) averaged using ag/deg line data within the floodway in the Action Area. [Based on results from HEC-RAS models by Corps (USACE 2015) and Bui (2016); ag/deg = aggradation/degradation line (see Varyu 2013b); RM = River Mile (see Varyu 2013b); mi = mile; cfs = cubic feet per second, ft = feet; ft/sec = feet per second; Appendix 4]

| Morphological Characteristics | GeoReach 3 | GeoReach 4 | GeoReach 5 | GeoReach 6 |
|---|---|---|---|---|
| **General Description (nearest larger town)** | South ABQ to Isleta, NM | Isleta to Los Lunas, NM | Los Lunas to Belen, NM | Belen to Bosque, NM |
| **Upstream River Mile (RM; and ag/deg line)** | RM 178.18 (ag/deg 575) | RM 169.38 (ag/deg 656) | RM 160.51 (ag/deg 751) | RM 154.41 (ag/deg 815) |
| **Downstream River Mile (RM; and ag/deg line)** | RM 169.4 (ag/deg 655) | RM 160.6 (ag/deg 750) | RM 154.5 (ag/deg 814) | RM 142.3 (ag/deg 928) |
| **Reach Length (mi)** | 7.2 | 9.3 | 6.0 | 10.7 |
| **Average Spring Flood Width (ft) at <500 cfs** | 369.6 ± 107.9 | 257.6 ± 67.6 | 289.2 ± 96.2 | 212.5 ± 65.3 |
| **Average Spring Flood Width (ft) at <1500 cfs** | 396.0 ± 111.6 | 335.1 ± 114.3 | 384.6 ± 133.7 | 230.9 ± 72.7 |
| **Average Spring Flood Width (ft) at <2500 cfs** | 422.0 ± 123.0 | 393.5 ± 182.1 | 455.1 ± 195.2 | 267.9 ± 99.3 |
| **Average Spring Flood Width (ft) at <3500 cfs** | 508.8 ± 182.7 | 528.4 ± 322.7 | 632.9 ± 331.8 | 368.7 ± 208.5 |
| **Average Spring Flood Width (ft) at <4500 cfs** | 654.3 ± 314.5 | 824.3 ± 624.8 | 921.7 ± 484.6 | 600.7 ± 356.3 |
| **Average Spring Flood Width (ft) at <5500 cfs** | 894.7 ± 409.9 | 1,307.1 ± 678.6 | 1,260.9 ± 488.5 | 994.0 ± 449.4 |
| **Average Spring Flood Width (ft) at >7000 cfs** | 915.2 ± 493.6 | 1,137.4 ± 465.8 | 1,356.3 ± 562.1 | 815.2 ± 274.1 |
| **Average Spring Flood Depth (ft) at <1500 cfs** | 1.8 ± 0.5 | 2.2 ± 0.6 | 2.2 ± 0.4 | 3.1 ± 1.1 |
| **Average Spring Flood Depth (ft) at <3500 cfs** | 3.1 ± 0.6 | 3.9 ± 0.5 | 3.6 ± 0.4 | 5.0 ± 1.2 |
| **Average Spring Flood Depth (ft) at <5500 cfs** | 4.1 ± 0.6 | 4.9 ± 0.5 | 4.6 ± 0.5 | 6.3 ± 1.1 |
| **Average Spring Flood Velocity (ft/sec) at <1500 cfs** | 2.1 ± 0.5 | 2.2 ± 0.6 | 2.2 ± 0.6 | 2.4 ± 0.6 |
| **Average Spring Flood Velocity (ft/sec) at <3500 cfs** | 2.9 ± 0.6 | 3.1 ± 0.9 | 3.0 ± 1.0 | 3.4 ± 0.9 |
| **Average Spring Flood Velocity (ft/sec) at <5500 cfs** | 3.4 ± 0.7 | 3.5 ± 1.2 | 3.4 ± 1.2 | 3.8 ± 1.1 |

Status of Critical Habitat Element 2: Length, Depth, and Velocity of Habitats

Although the Action Area is generally rural, roads, bridges, railroad crossings, and urbanized areas have had long-term physical, chemical, and biological impacts to silvery minnows in the Action Area. There is one diversion dam, six irrigation delivery canals, and nine irrigation drainage outfalls in the Action Area including two riverside drains (SSPA 2001). There are two railroad crossings and five highway bridge crossings in the Action Area. Swanson et al. (2012) indicated that bridge piers create backwaters both upstream and downstream, but velocities between the piers tended to be higher and sometimes create areas with higher velocities that exceed silvery minnow swimming abilities. The Isleta Diversion Dam currently poses a substantial barrier to silvery minnow movements and upstream passage in the Action Area. This segregates the silvery minnow population, prevents upstream movement, or reduces dispersal to meet life history needs. In 2015, Reclamation (USBR 2015) proposed to implement fish passage at Isleta Diversion Dam, which will reduce its impacts to silvery minnows by 2022.

Critical habitat in the Action Area provides a diversity of habitat water depths, especially at higher spring flows, as indicated in Table 4. The overall trend is decreased channel depth caused by aggradation in portions of GeoReach 4 and GeoReach 5 of up to 0.02 feet per year, and increased channel depth (incision) in GeoReach 3 and in GeoReach 6 (Varyu 2013; USACE 2017o; and see our stage-gage depth analysis, above, and in Appendix 4). We simulated the effects of the expected changes in channel depth during spring floods over time on the estimated numbers of Age 0 silvery minnow in the fall to characterize the function of critical habitat depths in the Action Area with conditions as they are now and projecting out for the duration of the project (Appendix 3). These estimates also included the effects of surface water loss due to aggradation of sediment within the channel and increased seepage to groundwater (SSPA 2001). In the Action Area, seepage losses varied from 0.6 cfs per mile to 10.1 cfs per mile (SSPA 2001).

Changes in (simulated) channel incision or aggradation depths had more moderate (~1 to 4 percent) adverse effects to critical habitat in the action area (as compared to changes in wetted width during spring). While the ranges of depth impacts in the individual reaches varied widely (from a gain of 4% due to aggradation to a loss of 10% due to incision), overall gains in the simulated numbers of Age 0 silvery minnows that were estimated in the aggraded reach (GeoReach 5) offset the losses that occurred in incised GeoReachs 3, 4, and 6. This is not to say that changes to channel depth does not have adverse effects to silvery minnow habitat. However, it is the reduction in areas of flooded overbank associated with a deepening channel that had the primary effects to silvery minnow. Note that Stone et al. (2017) indicated that channel incision was the predominant influence limiting floodway inundation in the action area. Their analysis was more holistic. Our analyses evaluated changes to the average wetted width and areas of spring flood inundation and changes to average channel depth independent of each other. However, in both these studies, it was the reductions to the wetted width and extent of inundation during spring floods that had the most severe effects to the abundance of estimated Age 0 silvery minnows in the fall.

Average and variance of modeled hydraulic channel velocities for each sub reach are provided in Table 4. There are few studies on the distribution of velocities within the water column and across the channel that are associated with detections of silvery minnow or their preferred habitats (but see Dudley and Platania 1997; Remshardt and Tashjian 2003; Bovee et al. 2008; Braun et al. 2015). Therefore, we used average daily channel velocities derived from modeling efforts and regression equations (Bui et al. 2016) to evaluate the effects of different flow velocities within the different sub reaches on critical habitat in the Action Area (Table 4). Higher average channel velocities occurred in the narrow GeoReach 6. Channel velocities will be expected to exceed the swimming ability of silvery minnow in 5.4 percent of this reach. Average channel velocities that were modeled at many cross sections within the georeach were generally lower in the aggraded GeoReach 5, with 28.5 percent of those average channel velocities below 1.0 feet per second (which is the velocity preferred by silvery minnows). As would be expected, there were fewer silvery minnows in the narrower GeoReach 6 with the higher velocities when compared to GeoReach 5, which is more connected to overbank flows and has lower average channel velocities. Actions proposed that increase the areas of flooding also result in decreased velocities (Byrne 2017). Widening and connecting more portions of the Action Area to inundation during floods would help to restore the function of critical habitat to maintain channel velocities that support silvery minnow habitat.

Status of Critical Habitat Element 3: Substrates predominantly of sand or silt

The substrate in the Isleta Reach remains predominantly a fine to medium sand (Massong et al. 2008). However, small areas of gravels were observed in those zones of increased velocity associated with a narrower channel or with nearby inlets in the Isleta Reach (Massong et al. 2008). Bed material samples collected downstream of Isleta Diversion Dam indicate an overall median bed material diameter ranging from 0.14 mm to 0.5 mm (Remshardt et al. 2003). The pebble count data in the higher velocity areas indicated a median bed material diameter of approximately 6 mm (USACE et al. 2007). Therefore, substrates predominantly of sand or silt occur in the Action Area, which supports this physical feature of silvery minnow critical habitat.

Status of Critical Habitat Element 4: Water of sufficient quality

Atmospheric conditions, topography, distance from the source, shading, anthropogenic uses, temperature of the incoming water (precipitation, surface runoff, and groundwater), stream discharge, and streambed are factors that influence the thermal regime of rivers (Reale 2014). Water quality in silvery minnow critical habitat is sufficient when the natural, daily, and seasonally variable water temperatures occur in the Action Area in a range of greater than 1 °C (35 °F) and less than 30 °C (85 °F). Water temperatures in the Action Area has been observed to increase (greater than 30 C) during river intermittency and when water was isolated in pools especially in summer (Hubbs 1990; Lusk et al. 2012; Archdeacon 2016). During summer, when flows are low, or in isolated pools, water temperatures sometimes exceed the range required to accommodate species needs in critical habitat in the Action Area. Shading by riparian vegetation along shorelines is widely recognized as providing moderation of water temperature changes (USFWS 2003; Cooper et al. 2014). Zehfuss and Hiebert (2009) described an average of 3 to 5 degrees of cooling water temperature at a well-shaded site near Bernardo, New Mexico. With riparian shading, water temperatures were generally below 30 C during summer. When exposed to higher temperatures, and lack of riparian shading, an undetermined number of silvery minnows will have increased bacterial infestations, altered metabolism, or decreased survival (Balfour 1999; Platania 2000; Buhl 2011a,b,c; Lusk et al. 2012).

Summary Status of Silvery Minnow Critical Habitat in the Action Area

The current status of critical habitat is the result of hydrological alteration through climate and water management, including flood control dams, storage reservoirs, and levees. The value and function of critical habitat to maintain its role in the survival and recovery of silvery minnow is expected to decline within the next 48 years. The cumulative effect of aquatic habitat loss through the channel narrowing process, combined with a hydrologically disconnected floodplain, and reduced spring runoff contributes to a severely degraded environment for the various life stages of the silvery minnow. The channel will likely continue to degrade in GeoReaches 3, 4, and 6, with some increased velocities. The channel will likely continue to aggrade in GeoReach 5 with some decreased velocities. There have been increased water temperatures during low flows and where riparian shading has been reduced. Duration and extent of intermittency and river drying will likely remain similar to levels observed recently based on modified water operations. Within six years, fish passage will allow for movement of silvery minnows upstream and downstream and thereby increase the likelihood of survival and recolonization after local extirpations or during low flows. The greatest impacts to silvery minnow critical habitat were from the reduced extent of floodway inundation during spring flooding due to altered hydrology, droughts, channelization by rectification, jetty jacks, spoil banks, levees, and reduced sediment supply, and sediment deposition in the overbanks.

*Status of Southwestern Willow Flycatchers and Critical Habitat within Action Area*

There are a total of 4467 acres of designated critical habitat within the Action Area. A large portion of this designated critical habitat is lacking PCE's at this current time. The Rio Grande Recovery Unit for the flycatcher encompasses the San Luis Valley as well as the Upper, Middle, and Lower Rio Grande Management Units (USFWS 2002, 2011a, 2011b). Increases in the number of territories have occurred within this Recovery Unit, primarily due to increasing numbers within the MRG Management Unit (Albuquerque to Elephant Butte Reservoir). The Action Area found is entirely within the MRG Management Unit. In 2002, a total of 197 territories were known to occur within the Recovery Unit, mostly along the mainstem Rio Grande (Sogge et al. 2003), representing 17 percent of the territories rangewide. By 2007, this number had increased to an estimated 230 territories (Durst et al. 2008). There were 355 territories detected in the MRG Management Unit in 2016 (Moore and Ahlers 2017). Since 1999, most territories within the MRG Management Unit (75 percent) have been located to the south of the Action Area and within the lower San Marcial Reach near Elephant Butte Reservoir (Moore and Ahlers 2017). In the MRG Management Unit, the numerical recovery goal is 100 territories, which has been far surpassed in most recent years (Moore and Ahlers 2017).

Suitable habitat (habitat composed of vegetation with adequate structure and density to accommodate nesting activity) within the Action Area is estimated to be 1,010 acres based on vegetation mapping completed in 2002 and 2012 (Callahan and White 2004, and Seigle et al. 2013). Habitat consists of a mix of cottonwood gallery, with sparse saltcedar, Russian olive and/or coyote willow understory. Suitable flycatcher habitat within the Action Area is patchy and consists primarily of developing stands of willows and Russian olive on lower terraces and recently established river bars (Moore and Ahlers 2017; Siegle et al. 2013). Flycatcher surveys within the Action Area are conducted by Isleta Pueblo and Reclamation. Based on 2016 and 2017 survey data received by the Service, the flycatcher population is estimated to be 10 territories within the Action Area.

*Status of Yellow-billed Cuckoos and Proposed Critical Habitat within Action Area*

Formal cuckoo surveys conducted by Reclamation within the middle and southern portions of the Action Area were started in 2009. Formal cuckoo surveys were also conducted by Tetra Tech in select areas of suitable habitat at the northern extent of the Action Area in 2017. Within the overall Action Area, 8 total cuckoo detections (of which there were 0 estimated breeding territories) were present in 2017. In 2016, 7 total cuckoo detections (of which there was 1 estimated breeding territory) were observed based on 2016 and 2017 survey data received by the Service). Suitable habitat within the Action Area boundary is estimated to be 1,589.25 acres (USFWS 2018a). There are a total of 8,139 acres of proposed critical habitat within the Action Area.

*Baseline Conditions for Flycatchers, Cuckoos, and Associated Habitats*

<u>Hydrology and Geomorphology</u>
Flycatchers and cuckoos rely on large flashy overbank flows to support critical habitat and food sources (USFWS 2013 and 2014 - proposed CH for both spp.). Flycatcher and cuckoo habitat is created by having substantial flows that encourage sediment movement and deposits that allow seeding germination, plant growth, maintenance, health, and vigor (USFWS 2013 and 2014). This type of environment is referred to as a dynamic riverine process, and it provides nutrients within the soil, supports the amount of groundwater or surface water available to plants, supports the successional age classes of vegetation, and foraging opportunities for both species.

Channel capacity of the river has been reduced for a variety of reasons (i.e. vegetation encroachment, sediment accretion). The reduction in channel capacity calls for more flood control to protect infrastructure and local communities, and until resolved, results in our current condition of reduced flows and less flooding (particularly of a large magnitude) of the riparian forest. These current conditions within the Action Area reduce opportunities for dynamic riverine processes and also lessen the amount of future habitat for both species. Habitat conditions with less overbank flooding or increased depths to groundwater result in vegetation that is stressed and producing less canopy cover (Siegle et al. 2013). Less canopy cover presumably results in changes in microclimate, less humidity, increased susceptibility to heat and weather events, and less concealment from predators which indirectly negatively impacts flycatchers and cuckoos.

The volume of flows and the ability for water to spread over the river banks and onto the floodway is also critical to support plant health and promote new growth. Overbank flows hydrate soils, leach them of salt or other undesirable accumulations, redistribute nutrients, deposit sediments in some areas and scour in others, and provide for river channels to move and change in a dynamic fashion (USFWS 2002). If timed during seed dispersal, this creates an environment suitable for natural establishment of vegetation. Riparian vegetation recruitment is a function of the timing, duration, and rate-of-change of floodplain flows. River stage recession rate, floodplain elevation, scour potential, and seasonality are all important for recruitment and survival of riparian seedlings (Stone et al. 2017). However, the timing of spring flows to coincide with native vegetation dispersal is critical to avoid establishment of saltcedar or other undesirable and invasive vegetation that produce seeds throughout the growing season. Though flycatchers and cuckoos will nest and/or forage in mixed or exotic stands of vegetation, the historic survey effort along the MRG indicate that native vegetation is the preference of the species (Moore and Ahlers 2018, Dillon et al. 2018).

Overall, less water creates a narrower wetted channel and increases the depth to groundwater. These conditions allow for vegetation encroachment within river channels as that is the area with saturated soils to accommodate new growth. Over time this has created narrower channels that become anchored in place with adjacent vegetation and extreme flows or aggressive construction becomes required to allow for channel movement (Figure 4).


Figure 4. Example of Rio Grande planform change over time from RM 101 (looking downstream) (Holste Presentation 2016).

<u>Groundwater and Aggradation within the Floodway</u>

Vertical accumulation of sediment in a floodplain, exacerbated by the lateral confinement of the floodplain, ultimately results in a physical separation of riparian vegetation from groundwater (Dufour et al 2007; USFWS 2012b). This has happened to such an extent within the floodway, that productive pioneer species such as willows or poplars have been replaced by either non-native (e.g., tamarisk) or upland plant species (Friedman and Auble 2000; Dufour et al. 2007; Decamps et al. 2008).

The elevation of the water table in riparian areas within the floodway correlates with the surface water elevation in the channel and the drawdown effects of adjacent drains at even lower elevations (USACE et al. 2007). Groundwater elevation maps along the Action Area show less stable groundwater elevations and decreases in the areal extent of high water table conditions generally during the April to September period (USACE et al. 2007). The net result of the lowered water table is generally a decline in river flow, as well as stress, injury and loss of riparian vegetation. Topography, drainage patterns, soil types, depth to groundwater, groundwater flow direction and gradient, and other factors can affect the transport of water on and beneath the ground surface. These impacts are expected to be exacerbated as the river is expected to aggrade up to 1 ft, over time in the Action Area (USACE 2017o).

The effect of activities that alter groundwater can lead to the reduction of water tables in or below riparian habitats that may support minnows, flycatchers and cuckoos (USFWS 2002). High water tables in floodplains and near river channels sustain extensive growth of riparian vegetation that provide breeding habitat for flycatchers and cuckoos. As the depth to groundwater increase, conditions become more favorable for invasive species to outcompete native vegetation. Long term, the encroachment of vegetation along the bankline adds to the narrowing of the river.

Urban and Non-Native Vegetation Alterations

In New Mexico, floodplain riparian vegetation has likely been impacted more by human activities than any other type of riparian vegetation (Dick-Peddie 1993). Current Rio Grande floodplain vegetation greatly differs in both composition and extent from that described by Van Cleave (1935; cited in Finch et al. 1995). Cottonwood and willow were, and remain, primarily restricted to the floodway. The bosque, though much reduced in extent, is still represented by some individual cottonwood trees of extremely large size. With some notable exceptions, the historic cottonwood and willow forests have been reduced to a narrow band of mid- to old-age forest stands between levees in the floodway. Many cottonwood/willow communities were lost to expanding agriculture, the demand for fuel and wood products, channelization and flood control projects, urbanization, transportation systems, inundation by large impoundments, and the introduction and escape of exotic plants (Finch et al. 1995).

The specific role of tamarisk in floodplain aggradation and channel narrowing is a matter of debate. Tamarisk was not common on the floodplain until the 1930's, after channel narrowing had begun in the Lower Rio Grande (Everitt 1998). Tamarisk has been better equipped to handle floodway conditions over the recent years and has provided some habitat where native species would not be able to naturally regenerate or adapt to the modified conditions. Tamarisk litter is slow to decompose, water-repellent, and builds up over time without overbank flows to flush the litter accumulations (Sugihara et al. 2006). Dense stands of tamarisk can create conditions promoting frequent, high intensity fires extending past the ground surface to the canopy layer (Sugihara et al. 2006, USFWS 2013). Tamarisk is also susceptible to defoliation caused by the introduced saltcedar leaf beetle.

Tamarisk was introduced into the southwestern United States from the eastern Mediterranean region in the early 1900s. This shrub/small tree spread rapidly and became naturalized. By 1961, there were approximately 155,000 acres of saltcedar growing within the state of New Mexico (Robinson 1965). Part of the reason for its proliferation is that tamarisk seeds remain viable for longer periods than native cottonwood and willows, and it is able to sprout and grow vigorously in somewhat drier soils. Russian olive is another Eastern and Central Asian woody species which has become naturalized in the middle Rio Grande valley since 1900. This species occurs in monotypic stands or as a dense understory component in mature cottonwood stands.

Although there are negative impacts from the continued spread of tamarisk along the Rio Grande, the introduced saltcedar leaf beetles are now a threat to flycatcher breeding habitat and cuckoo foraging habitat. In 2012, more than 50 percent of flycatcher nests in the MRG were found in saltcedar-dominated patches. Biocontrol efforts against saltcedar using the saltcedar leaf beetle have created a new challenge to the recovery of the flycatcher. Saltcedar leaf beetles actively impact saltcedar during the flycatcher and cuckoo breeding season. This can cause vegetation mortality containing flycatcher nests and surrounding territory vegetation, resulting in nest failure (Paxton et al. 2011). Vegetation mortality may also reduce prey base for cuckoo foraging habitat.

The U.S. Department of Agriculture began actively releasing saltcedar leaf beetles in Colorado and Utah in 1999. Saltcedar leaf beetles were first reported in the MRG near Santa Ana Pueblo (Tamarisk Coalition 2012). As of 2016, saltcedar leaf beetles have been confirmed throughout the Action Area (Tamarisk Coalition 2016).

Beetle defoliation of saltcedar occurs during the summer at the time of peak breeding for many migratory bird species. By mid-summer, the beetle-infested saltcedar becomes defoliated and is no longer suitable. This results in decreased nesting success and even mortality through nest abandonment, increased nest parasitism and increased predation (Paxton et al. 2011). Beetle-infested saltcedar can take up to 5 years to die. This can result in multiple years of reduced nest success or localized extirpation. It is anticipated that 50 percent of the flycatcher population known to occupy saltcedar habitat could be affected (Service 2014a). Cuckoos also can be found in saltcedar and defoliation could impact the cuckoo prey base (Ahlers et al. 2016).

The spread of saltcedar leaf beetles has historically been monitored and reported by the Tamarisk Coalition (Bosque Ecosystem Monitoring Program 2015; Tamarisk Coalition 2016). Reclamation, BIA, and the BA Partners have also been planning maintenance and restoration activities to allow for natural native vegetation recruitment by creating more favorable geomorphology and hydrologic conditions (USBR 2015).

Urban and Non-Native Vegetation Changes in Flycatchers, Cuckoos and Critical Habitat

Fires and conversion from native to exotic vegetation with subsequent tamarisk beetle defoliation, both provide conditions that decrease canopy cover in flycatcher or cuckoo foraging or nesting areas during the breeding season. Decreased canopy cover makes nests more exposed and therefore more susceptible to weather conditions or predators. Fire can also cause direct loss of MRG riparian forest habitat. The probability of fire is enhanced by the vegetation accumulation on regulated, flood-suppressed rivers (Busch 1995). Fire was virtually unknown in naturally functioning, riparian ecosystems of the Southwest (Busch and Smith 1993). However, fuel accumulations coupled with human-caused ignitions have introduced fire as a major disturbance mechanism in the riparian ecosystem (Stuever 2009). While cottonwood is highly susceptible to fire-induced mortality, saltcedar re-sprout vigorously following fire (Busch and Smith 1993; Busch 1995). Post-fire soils typically have significantly higher salinity than unburned soils areas, which may allow establishment of saltcedar (Busch and Smith 1993).

Historic conversion of riparian habitat to agricultural use has directly impacted the amount of habitat available to the species. However, riparian vegetation that supports flycatcher and cuckoo habitat can also be sustained by agricultural seepage and return flows. For flycatchers and cuckoos, pesticide drift from adjacent agricultural fields can decrease the abundance of large insects and their larva in riparian areas (White 2007). This can be particularly problematic during migration and breeding seasons when high energy demands are required (Service 2002).

Urbanization development and recreation near flycatcher and cuckoo habitat provides the catalyst for a variety of indirect effects, which can adversely affect flycatchers and cuckoos or contribute to habitat loss. Similar to that of irrigation returns, riparian vegetation that supports flycatcher or cuckoo habitat can also be sustained by urban stormwater and wastewater. However, the chemical quality of riparian habitat and insects associated with urban water may affect breeding habitat and may need further research. Continued use of chemicals and certain pesticides as well as a legacy of previous chemical use, spills, and atmospheric re-deposition may also affect flycatchers and cuckoos. Effects of these activities may vary with frequency, intensity, and management actions.

Temporary, short-term impacts to wildlife from noise, dust, and the presence of workers and machinery occur during project construction where activities occur near flycatchers or cuckoos.

Accidental spills of fuels, lubricants, hydraulic fluids and other petrochemicals, although unlikely, could be harmful to aquatic insect prey or riparian habitat vigor.

*Past Federal Actions (projects with a Federal nexus)*

The Service has conducted section 7 consultations that authorized incidental take of silvery minnow, flycatcher, and cuckoo resulting from past projects in the MRG. The projects encompassed activities such as water management, river maintenance, levee-building, and habitat restoration. Examples of such consultations are listed below.

- Consultation Number 02ENNM00-2013-F-0033. Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico. This consultation included hydrology and river maintenance (including habitat restoration) along the Rio Grande from the Colorado/New Mexico state line to Elephant Butte Dam. Associated with this consultation, Reclamation and it BA Partners proposed to implement a large-scale habitat restoration project in the Isleta Reach. The Service anticipates that Reclamation will deliver and develop its Lower Reach Plan for habitat restoration by the end of 2018. The goal of the Lower Reach Plan is to reverse some of the ongoing adverse effects through habitat restoration that will increase floodplain inundation in portions of the Action Area. Other activities to offset adverse effects will include revised reservoir operations to supplement spring peak flows and ease river drying.

- Consultation Number 02ENNM00-2012-F-0015. Biological Opinion for the U.S. Army Corps of Engineers San Acacia Levee Project. This consultation included construction of a new engineered levee within the 100-year floodplain of the Rio Grande from San Acacia Diversion Dam to the Tiffany Basin. The construction adjacent to the northernmost portion of the Action Area was completed during 2017. Further construction is on indefinite delay. Though this project is not within the Action Area specifically, the proposed action is much the same as are the effects analysis below.

- Several past restoration projects have occurred within the Action Area. Strategies of habitat restoration often include clearing and planting of vegetation on islands and floodplains, removal of jetty jacks, bank lowering along the main channel and the creation of side channels, backwaters, and scalloped terraces on floodplains (Tetra Tech 2004, Byrne 2017). In 2002, Corps and Reclamation built the Los Lunas Habitat Restoration Project by removing jetty jacks along 1.1 miles of river bank, lowering 43.2 acres of overbank, and contouring to connect river banks, overbanks, side channels, wetlands, and other features (Tetra Tech 2013; Consultation Number 22420-2002-I-0668). In 2005, the Pueblo of Isleta and Corps proposed to remove sediment and vegetation from below Isleta Diversion Dam, and subsequently planted 22 acres of riparian vegetation, and built 0.4 acres of backwater habitats post construction (Consultation Number 2-22-05-F-0350). In 2009, the New Mexico Interstate Stream Commission (NMISC) built the Isleta Habitat Restoration Sites, Phase I, including various treatments over 24.1 acres (Consultation Number 22420-2009-F-0002). In 2011, Reclamation built the Isleta Habitat Restoration Project, Phase II, including various treatments over 101.1 acres (Consultation Number 22420-2010-F-0060). In 2015, the NMISC and the Service complete habitat restoration that allowed flood inundation of 56 acres of Sevilleta National Wildlife Refuge (Consultation Number 02ENNM00-2015-I-0234). Habitat restoration projects have been conducted in a total of 225 acres, or 3 percent of the total acres of floodway in the Action Area (7,499 acres).

- The Service has issued approximately 65 permits in New Mexico for scientific research and enhancement purposes under ESA section 10(a)(1)(A) authorizing surveys for flycatchers using vocalization tape playback. Nineteen of these permit holders are also authorized to conduct flycatcher nest searches and nest monitoring activities. Applicants for 10(a)(1)(A) permits must also acquire a permit from the NMDGF to monitor flycatcher nests.

- The Service has issued approximately 54 permits in New Mexico for scientific research and enhancement purposes under ESA section 10(a)(1)(A) authorizing presence/absence surveys for cuckoos in the State. Eight permit holders are authorized to either conduct nest searches or telemetry studies.

- The effects of permits associated with silvery minnows have been incorporated in the status of species and baseline section calculations.

## EFFECTS OF THE ACTION

Regulations implementing the ESA (50 CFR 402.02) define the effects of the action as the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, which will be *added to* the environmental baseline. Indirect effects are those that are caused by the Proposed Action and are later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification; interdependent actions are those that have no independent utility apart from the action under consideration. Effects of the action are considered *along with the environmental baseline* and the predicted cumulative effects to determine the overall effects to the species for purposes of preparing a BO on the proposed action (50 CFR 402.02).

The Levee Project would remove approximately 47.8 miles of existing levee (non-engineered spoil bank) adjacent to the floodway and construct wider, engineered levees in its approximate location that are capable of containing at least the 1%-chance flood event (USACE 2018a). The current construction plan has been divided into 4 segments that would be constructed over a 19-year period (2019-2038). The functional life of the project is 50 years (until 2088). Many aspects of the project are not expected to result in effects on the endangered species and their habitats, and those will not be discussed. For example, the proposed action of coordinating with Reclamation for disposing of spoil material or incorporating it within the engineered levee will not be discussed because, though cost efficient, does not impact the listed species as the spoils are proposed to be removed from the floodway anyway. The following sections describe the anticipated effects on minnows, flycatchers, cuckoos and their designated or proposed critical habitat resulting from the proposed action.

*Effects to Rio Grande Silvery Minnow*

Effects to Silvery Minnow by Levee Construction Noise and Disturbance
Noise disturbance during levee construction will likely have adverse effects to silvery minnows. We based this conclusion on the following analysis. Ambient noise in the Action Area is likely low, perhaps 45 dBA, consistent with a rural agricultural setting (USEPA 1974). However, during levee construction, equipment such as handheld tools, chainsaws, or heavy equipment such as chippers, mulchers, compactors, construction equipment, heavy trucks, pumps, water trucks, and other vehicles will be used (USACE 2018a). These activities are known to generate noise and vibrations ranging from 55 to 101 decibels (A-weighted decibels or dBA) at 50 feet from their source (see USEPA 1974; FHWA 2006; WADOT 2012; Broyles et al. 2017). Noise will be generated during construction activities from fall until spring each year for 20 years, in an area of about 2.5 miles per year. Corps has proposed a conservation measure (CM 4; USACE 2018a) that would limit engine noise levels to 60 dBA in all construction equipment and large trucks used. However, even with CM 4 deployed to reduce engine noise, other activities involving the equipment used during construction will generate noise and vibrations of up to 101 dBA (USEPA 1974; FHWA 2006; WADOT 2012). Levee Project noise and vibrations are expected to propagate across air (or through the ground) to water containing silvery minnows within 50 feet at nine locations. The two river sites occur upstream of RM 171 for 650 feet and downstream of RM 155 for 2,100 feet) and the seven irrigation drainage outfall locations are described in Appendix 5. Based on the methods described in WADOT (2012), we estimated that these noise and vibrations would continue to propagate 30 feet or more into the water (Appendix 5) and adversely affect adult and juvenile silvery minnows in those nine locations. Additional exposure of silvery minnow eggs and larvae would occur in those 79 spawning and nursery habitats (based on the Tetra Tech model (2014)) that were adjacent to levee construction activities during May through June.

Evidence is mounting of noise-induced habitat loss, heightened physiological stress, fleeing behaviors, disruption of schooling or movement patterns, changes in distribution, masking of biologically important sound (e.g. during spawning, predator/prey detection), auditory injury, decreased population fitness, and in extreme cases, direct or indirect mortality and reductions in survival in certain fish species (Popper et al. 2014; Faulkner et al. 2018). We identified noise and vibrations as likely to have adverse effects on silvery minnows based on their underwater exposure to noise ranging from 16 to 70 dBA in the water column (Appendix 5). In particular, silvery minnow eggs or larvae that encounter noise during construction during Spring may be adversely affected because they are at the mercy of currents and move slowly, if at all. Data on effects of sound on developing fish eggs and larvae were very limited (Popper et al. 2014). Banner and Hyatt (1973) described 40 percent mortality of fish eggs and larvae at water exposure levels greater than 15 dBA, which will likely be found in the exposed areas (Appendix 5). We assumed that silvery minnow eggs or larvae would be exposed within the 79 habitat locations to construction noise at levels associated with mortality based on Banner and Hyatt (1973). We assumed the density of silvery minnow eggs or larvae was approximately 60 percent greater than the number of Age 0 silvery minnows monitored during July (in Table 3). This assumption is based on the 60 percent average mortality rate between silvery minnow cohorts. That is, the number of silvery minnow eggs or larvae is 60 percent greater than juveniles in July.

There are no species-specific data regarding the effects of sound and vibrations specific to silvery minnow life stages (eggs, larvae, juveniles, and adults), which severely limits the ability to accurately assess these effects and identification of mitigation measures necessary to reduce adverse effects to silvery minnows from the Levee Project. Therefore, Corps proposed a Noise Study to evaluate silvery minnow behavioral response to construction activities (Porter 2018c,e). If silvery minnow life stages are acoustically sensitive, are present and exposed to noise as we have described, then Corps carrying out the Noise Study to determine thresholds of injury and identifying the BMPs necessary to reduce such injury, is appropriate. The Service required Corps to model the exposure from Levee Project noise on silvery minnow life stages using the results of the Noise Study and implement management practices to reduce silvery minnow noise exposures from O&M activities too, as described below.

Until such time as Corps' Noise Study results are available, the Service calculated that as many as 3,223 silvery minnow eggs and larvae will likely occur in within the Action Area (at up to 79 locations based on the Tetra Tech (2014) model of spawning and nursery habitats; and as described and itemized in Appendix 5) and they will be harassed within 50 feet of high river flows wherever the levee construction activities occur near these areas (Appendix 5). Once intensity of noise exposure is sufficient to disrupt development, growth, feeding, or sheltering, then we expect that as many as 1,289 (40 percent based on Banner and Hyatt (1973); and see Appendix A and Appendix 5) of silvery minnow eggs and larvae would be harmed and die.

As the estimated threshold for survival (described in Environmental Baseline, above) was approximately 5,000 juvenile silvery minnows in the Action Area, we do not expect the harm and harassment of 3,223 silvery minnow eggs or larvae over 20 years at 79 locations to significantly affect silvery minnow survival or recovery. Many of the mortalities would be compensatory (60 % will likely die, see mortality rates discussed in Appendix A). Also, while 79 sites could be affected, there were additional spawning and nursery habitat areas that were more distant from Levee Construction noise exposure, and which would not be affected.

For older silvery minnow (juvenile (Age 0) and adult (Age 1+)) life stages exposed in the main stem river, we identified only two areas (upstream of RM 171 for 650 feet and downstream of RM 155 for 2,100 feet) where Levee Project activities would occur within 50 feet of the river's edge. We assumed that an 85$^{th}$ percentile estimated Age 0 and Age 1 silvery minnow density (during Jul or Oct) would occur within 30 feet of the river's edge (Appendix 5) and would be exposed to Levee Project noise and vibrations. We assumed adverse effects occurred within 30 feet using the analysis methods by WADOT (2012) and because we lacked the sufficient engineering information about the magnitude and sources of noise and effects in the BA. We assumed adverse effects occurred within 30 feet using the analysis methods by WADOT (2012) and because we lacked the sufficient engineering information about the magnitude and sources of noise and effects in the BA. We assumed the 85$^{th}$ percentile estimated density because the density of silvery minnows that could occur at a site varies widely based largely on whether a low or high spring runoff would occur prior to sampling over the 20-year project action. The 85$^{th}$ percentile density (Table 3) is well above the average density and is a reasonably high density for estimating take. The 85$^{th}$ percentile density is also likely to be adequately conservative to address the assumptions of the areas of underwater noise exposure. That is, the 85$^{th}$ percentile density is sufficiently high to estimate the number of silvery minnows exposed to underwater noise at a distance greater than our estimates in Appendix 5. We describe these 85$^{th}$ percentile fish densities because we use them in a formula for determination of the estimated incidental take as: (85$^{th}$ percentile density in Table 3) x (area of exposure in Appendix 5) x (mortality factor in Appendix A), which is further described below. The actual incidental take (based on Corps Construction Monitoring) will be used to verify cumulative compliance with the Incidental Take Statement, both annually, and cumulatively, every five years, below.

Using these methods, we estimated that as many as 4,191 juvenile and adult silvery minnows would be exposed to construction noise and harassed (Appendix 5). Incidental to their harassment, we expect as many as 168 minnows may be harmed and subsequently die indirectly due to noise, because they would be harassed and retreat into high velocity habitat where they may die, or they would be subsequently preyed upon, or otherwise flee from suitable feeding or sheltering habitat and die from cumulative stress (see Appendix 5 for locations and enumeration of exposure and response and see Appendix A for the likely mechanisms of harm or mortality). We currently lack methods to evaluate noise and vibration frequencies, fish exposure, life stage sensitivity, and specific behavioral, injury, or mortality thresholds for noise, and the site-specific information and best management practices necessary to mitigate these adverse effects. These estimates of the silvery minnows exposed must be refined by Corps during their Construction Monitoring of silvery minnows in the exposed areas just prior to, or during, exposure to construction noise. We also lacked information about the range of underwater noise exposures other than those we modeled. As part of a Noise Study, Corps has proposed to monitor underwater noise levels at the affected sites in a field portion of the Noise Study. Together, Corps evaluation of the estimated adverse behavioral or injurious effects based on the Noise Study, and the estimate of the areas affected by underwater noise, along with the Construction Monitoring results of the site-specific silvery minnow density just prior to exposure to noise, will be used to determine the actual number of silvery minnows taken as compared to the Incidental Take Statement (ITS), below. The formula that we will use for determination of actual incidental take is: (the maximum density determined by Corps Construction Monitoring) x (area of exposure [provided in Appendix 5]) x (mortality factor [provided in Appendix A]).

As the estimated threshold for survival (described in Environmental Baseline, above) was approximately 5,000 silvery minnows (in the action area in each year), we do not expect the harassment of 4,191 silvery minnows (about 210 each year, on average) or the subsequent harm of 168 silvery minnows (about 9 silvery minnows each year, on average), at nine locations, over 20 years, to significantly affect silvery minnow survival or recovery in the action area or in the MRG. We evaluated the number of silvery minnows harmed to a simulated population of silvery minnows over 48 years (which included the effects in the environmental baseline over a range of spring flows), and the average annual level of Levee Project incidental take due to noise effects by the harm of 168 silvery minnows did not significantly reduce silvery minnow survival or recovery in the action area (Appendix 3). Because the Levee Project activities occur at a pace of about 2.5 miles per year, and most of the nine locations exposed to construction noise were spread out, we considered the use of an average loss of silvery minnows per year as reasonable.

<u>Effects of Monitoring Silvery Minnow for Construction (Construction Monitoring)</u>
Corps proposed that qualified biologists would monitor all construction activities (USACE 2018a). Specifically, Corps proposed that biologists (in possession of a valid 10(a)(1)(A) permit) would conduct surveys of the fish community, including silvery minnows, using flat seines prior to, during, and after construction activities that are within 50 feet of any of the nine, exposed water bodies containing silvery minnows (Appendix 5). These surveys would include the two river sites and seven irrigation facilities that were within 50 feet of levee construction activities and affected by noise (described above). These surveys would provide a site-specific

catch-per-unit-effort (CPUE) density of juvenile (Age 0) and adult (Age 1+) silvery minnows that would occur at those sites prior to, during, and after being affected by construction noise.

This Construction Monitoring will be done: 1) once prior to the onset of construction noise (in any season); 2) once just prior to harassment of fish away from the construction areas and noise, along with potential deployment of bubble barriers; and 3) once monitoring afterwards to establish whether or not the bubble barriers were effective. We used the frequency of the monitoring at construction sites (three times per year during construction) at these nine sites (which varied in length and width; see Appendix 5) times the 85$^{th}$ percentile density in the monitored area to estimate the maximum number of juvenile and adult silvery minnows that would be harassed. We then determined the estimated incidental harm or mortality by: (85$^{th}$ percentile density in the monitored area) x (the area of the nine sites described in Appendix 5) x (mortality factor (based Appendix A)) to reach the estimated actual take due to harm. For Corps proposed Construction Monitoring, we expect as many as 4,966 adult and juvenile silvery minnows would be harassed and 140 of them will be harmed and subsequently die.

The Levee Project activities occur at a pace of about 2.5 miles per year, and most of the nine locations exposed to construction noise were spread over a distance greater than 1.7 miles. Given this logistical information, we considered the use of an average loss of silvery minnows per year as a reasonable exposure scenario for our effects analysis and we also figured that not all silvery minnows would be harassed or harmed all at one time. As the estimated threshold for survival (or recovery) (as described in Environmental Baseline, above) was approximately 5,000 (for survival and ~20,000 for recovery) silvery minnows in the Action Area, we do not expect the harassment of 4,966 silvery minnows and harm of 140 silvery minnows over 20 years to significantly affect silvery minnow survival or recovery. We evaluated the number of silvery minnows harmed (140) to a simulated population of silvery minnows over 48 years (which included the effects in the environmental baseline over a range of spring flows), and the average annual level of the Construction Monitoring incidental take did not significantly reduce silvery minnow survival or recovery in the Action Area (Appendix 3).

<u>Effects to Silvery Minnow from Levee Fills and Sediment Depositions by the Levee Project</u>
Corps (USACE 2018a; USACE 2018c) describes the Levee Project as adding sediment (fill materials) within the footprint of the engineered levee and at ramps and turnarounds (180.3 acres; USACE 2018c). The Service (Appendix 5) and Corps (Aubuchon 2018) evaluated aggradation and degradation processes in both the channel and the overbanks with and without the Levee Project. Based on Corps (Aubuchon 2018) analyses, 30.8 acres of sediment deposition occurs within the floodway (at floods of 5,000 cfs measured at the ABQ Gage) due to the Levee Project. Corps proposed to offset all of the sediment deposition and fills attributable to the Levee Project (USACE 2018c). Corps also proposed to manage or remove sediment to allow an equivalent amount of area to be flooded (at varying flows) as compared to the current condition. Note that Corps also proposed to manage or remove sediment from 45 acres in the overbanks at flycatcher HR sites. Corps also proposed to mitigate sediment deposition by managing, excavating, or enhancing an additional 65.2 acres of HR sites subject to inundation by floods at less than 3,500 cfs as measured at the ABQ Gage (USACE 2018c).

Corps and the Service agreed that additional review of the amounts of these fills and areas of sediment deposition were appropriate and will work with the Service to reach a goal of "no net loss" of floodable areas within the Action Area (USACE 2018c). The Service will also require that methods for accountability for determining this "no net loss" and the methods to determine the duration of these habitat restorations maintain their function for the duration of the Levee Project as determined through the review process. That is, the accountability for maintaining the 45 acres of flycatcher HR sites and the 65.2 acres of silvery minnow HR sites must remain fully functional and floodable for the duration of the project. This includes all floodway habitat affected by floods up to the 10 percent chance event flood of 10,300 cfs at the ABQ Gage. Therefore, since the mitigation offsets for Levee Project fills and sedimentation will result in no net loss of the total wetted areas during 10 percent chance event floods in the Action Area, no long-term adverse effects to silvery minnows or to its critical habitat will occur (other than construction at habitat restoration and mitigation sites, described below). By proposing HR sites for those amounts or areas of levee fills and sediment depositions and maintaining those areas as currently floodable (by the different flood levels) up to 10,300 cfs, the Corps Levee Project does not destroy or adversely modify silvery minnow critical habitat. Restoring impacted habitat is a commonly used reasonable and prudent measure that minimizes the amount or extent of incidental take and can be accomplished consistent with the ESA (50 CFR part 402).

At the State Highway 6 Bridge in Los Lunas, New Mexico, the levee could also encroach into the floodway creating a narrower passage for fish during high flows or affecting planned or existing habitat restoration there. By 2022, this bridge is scheduled to be expanded with additional support piers that will be placed within the floodway. Working with the Federal Highway Administration, the New Mexico Department of Transportation may use areas within the rights-of-way below bridge crossings to mitigate habitat loss by pier placement. During high flows, combined with the current and proposed bridge piers, a narrowed floodway could concentrate flows in the main stem and increase flow velocities, with some above the swimming abilities of silvery minnow. Therefore, the Corps will subsequently minimize levee fills in the habitat restoration within the floodway in this area to reduce the potential for a pinched floodway that would unduly increase average channel velocities during high flows.

<u>Effects to Silvery Minnow from Actions in the Vegetation Management Zone</u>

Near several areas (RM 155, RM 159, RM 160, RM 161, RM 169, RM 171), the Vegetation Management Zone will reduce the riparian canopy cover within 50 feet of the river's edge and other seasonally inundated habitats. This riparian shading supports the physical features of silvery minnow critical habitat, including Element 4 of adequate water temperature. As described above, increases of water temperatures in spring or summer can have adverse effects to silvery minnow survival and development (Platania 2000; Buhl 2011a). There can also be improvements in water temperatures in inundated habitat that foster rapid larval development. We lack adequate scientific- and site-specific information to quantify the effects of the Vegetation Management Zone on the seasonal water temperatures in nearby inundated and channel habitats to silvery minnows. Therefore, the Service will require that Corps conduct a field study of water temperature regimes in areas of silvery minnow habitats affected by the Vegetation Management Zone compared with a control condition over a year with several flood events. If the 90% confidence interval of the daily water temperatures is significantly different at comparable sites with riparian shading and without, then additional analysis of adverse effects to exposed silvery minnow life stages would be necessary.

The results of the water temperature monitoring will be used to compare water temperatures within riparian shading and without riparian shading to the water temperature effect thresholds provided by Platania (2000) or any completed studies conducted by Buhl (2011a,b)). If incidental takes due to elevated water temperatures associated solely with lack of riparian shading are determined to likely occur in areas affected by the loss of riparian shading in the Vegetation Management Zone and would be determined by Corps evaluation to likely have adverse effects to exposed silvery minnow life stages based on comparison to values in the literature, then Corps would likely reinitiate consultation with the Service as part of this BO. No take of silvery minnows was quantified for temperature effects because there was not adequate information available to make meaningful estimates of any temperature-related phenomena associated with the Vegetation Management Zone and therefore, to provide estimates of adverse effects to exposed silvery minnow life stages with certainty.

During O&M of the Vegetation Management Zone, the sponsors will mow grass and perhaps remove woody vegetation using mechanical tools (e.g., mowers, chainsaws, chippers, etc.) that will likely create additional noise impacts. Results from the Corps Noise Study will inform the BMPs necessary to mitigate these impacts. Those noise-related BMPs must be made part of the O&M manual prior to its provision to the project sponsor for implementation.

The Levee Project will install riprap materials along culverts and in areas underground that may be subject to erosion. The introduction of coarse substrates could affect silvery minnow critical habitat (USFWS 2012). However, both the relatively small amount and location of the placement of rip rap (deep underground) in the Action Area reduce the likelihood of adverse effects to silvery minnow and its critical habitat because the rip rap is less likely to be launched into the channel or significantly alter substrate composition based on the rip rap volume.

Additionally, flap gates will be installed in or near the culverts under the levee where irrigation drains cross. Some drains that cross under the spoil banks currently have flap gates, but these sometimes remain tied open. The flap gates installed by the Levee Project will be required to remain closed per the O&M activities, and thereby prevent some fish movements. However, as described above, silvery minnows that are swept into upper portion of the irrigation system will likely perish and not be affected by the closure of the flap gates. Flap gates will also reduce fish movements up into the downstream portion of an irrigation system. However, the Service found that the upper portion of the irrigation drains (those portions upstream of the levee crossing) had little habitat value for silvery minnow (as described above). Therefore, flap gates will further limit the occupancy of silvery minnows in the unsuitable habitat portions of the irrigation facilities upstream of the levee crossings while not affecting the occupied downstream portions.

Effects to Silvery Minnow from HR Construction Noise and HR Site Monitoring

During consultation, Corps proposed habitat restoration and mitigation (HR sites) and described construction impacts during HR site construction after discussion of levee construction impacts. Similarly, Corps construction of HR sites generally follows construction of a portion of the levee within certain unit from upstream to downstream. For these reasons, we discuss the effects of the construction of the 45 acres of flycatcher HR sites and 65.2 acres silvery minnow HR sites by construction noise and monitoring separately in this section (even though these are similar to the analyses described above (and in Appendix 5)).

Corps will construct up to nine, 5-acre flycatcher HR sites (site size varies, but we expect that no more than 1,328 square meters of these HR sites will follow along the edge of the river channel – see Appendix 5). The flycatcher HR sites will likely be constructed closer to the river channel and in areas that flood at flows less than 1,500 cfs as measured at the ABQ Gage. The silvery minnow HR sites will be constructed in areas that flood at flows less than 3,500 cfs (because these sites are being used largely to mitigate the impacts that occur at even higher flood levels). However, the information on how many or the locations of the silvery minnow HR sites is currently unknown. We assumed that there will be an undetermined number of silvery minnow HR sites that total 65.2 acres, and they will be floodable at flows less than 3,500 cfs, which is often much further than 50 feet from the river's edge (recall that this was our distance threshold for determining if there were likely adverse effects of noise to silvery minnows). We also assumed that the Noise Study would be completed prior to construction of the silvery minnow HR sites, and that any necessary BMPs would be deployed, and therefore, we assumed that no harassments or injuries to silvery minnow adults, juveniles, larvae, or eggs would occur at these 65.2 acres during construction.

However, for the construction of the flycatcher HR sites, we estimated the effects of construction noise in those areas exposed near the river channel. We used the area of construction at the nine HR sites and mitigation sites times the 85th percentile density in the nearby river areas to estimate the number of juvenile and adult silvery minnows that would be harassed or harmed by construction noise. We used the same assumptions used above (and described in Appendix 5) to estimate the numbers of adult or juvenile silvery minnows adversely affected by HR construction noise. For HR site construction, we expect as many as 1,815 adult and juvenile silvery minnows will be harassed and none of them will be harmed and subsequently die due to noise (based on the assumption that BMPs from the Noise Study would be deployed) (see Appendix 5). Similar to previous analyses, we do not expect the harassment of 1,815 silvery minnows over 20 years to significantly affect silvery minnow survival or recovery (Appendix 3).

Even with careful planning and design of HR sites, at times, silvery minnows can sometimes be stranded within habitat features that are inadequately sloped or otherwise entrap silvery minnows during a flood or its recession. Often numerous juvenile or even larval fish can be entrapped after a flood. Therefore, the Service is authorizing up to 1,301 silvery minnows to be moved by Corps from stagnant water with an entrapment monitoring protocol (Appendix B). However, based on the stress of being entrapped or during their transport to the nearest perennial water, we expect that as many as 651 will die either just before, during, or after transport into flowing water (based on the size of a single HR site described in Appendix 5 and on the mortality factors described in Appendix A).

Following construction of both the flycatcher and silvery minnow HR sites, Corps proposed to monitor the presence (or absence) of silvery minnow juveniles and adults at each HR site once, during inundation by spring runoff. Because Corps did not submit any Floodway Fisheries Monitoring Sampling and Analysis Plans along with the BA that provided further detail on the activities that would be conducted, the Service assumed and verified the extent of monitoring (Appendix 5 and Porter 2018k). We used the frequency of monitoring proposed at HR sites (once during a year of inundation). We estimated that as many as 1,815 juvenile or adult silvery minnows could be captured or harassed until presence was determined by seining and as many as 88 silvery minnows could subsequently die (Appendix 5) from handling, cumulative stress, crushing injury, other health or disease effects, or enhanced predation (see Appendix A). Similar to previous analyses, we evaluated the number of silvery minnows harmed (88) to a simulated population of silvery minnows over 48 years (which included the effects in the environmental baseline over a range of spring flows), and the average annual level of the HR Site construction

HR Site Monitoring incidental take did not significantly reduce silvery minnow survival or recovery in the Action Area (Appendix 3).

Table 5. Maximum total number of incidental take of silvery minnows associated with the Levee Project by activity types.

| Activity | Area of Takes (m2) | Harassments of silvery minnows | Injury or mortality of silvery minnows |
|---|---|---|---|
| Levee Construction Noise | 32,665 | 7,414 | 1,457 |
| Levee Construction Monitoring | 31,618 | 4,966 | 140 |
| Floodway fills/deposition | (180.3+30.8 = 211.1 acres) = 854,291 | Indeterminate and offset by habitat restoration or mitigation in Action Area | Indeterminate and offset by habitat restoration or mitigation in Action Area |
| HR Site Construction Noise | 29,270 | 1,815 | 0* |
| HR Site Potential Entrapments | 1,328 | 1,301 | 651 |
| HR Site Monitoring | 29,270 | 1,815 | 88 |
| Levee Project Maximum Total | 124,151 | 17,310 | 2,335 |

* Note this assumed the Noise Study was completed and BMPs that reduced noise were deployed.

*Effects to Southwestern Willow Flycatcher*

Noise and Traffic Disturbance

Noise disturbance within the Levee Project is estimated at 0-11 kilohertz (kHz) based on other construction and rock crushing type noise disturbances (Maijala et al. 2017). This amount of noise disturbance would overlap with the vocalization frequency of the endangered Southwestern willow flycatcher which is between roughly 2.7 and 5 kHz (Fernandez-Juricic et al. 2009).

Further studies on noise disturbance specific to a similar project are required as part of RPM 2, Term and Condition 2.4 from the San Acacia Levee Project (Consultation Number 02ENNM00-2012-F-0015) which will refine the buffer distance to something more appropriate. In the interim period until the study is complete, we will be conservative for the species and assume at least some level of impact where communication between individual flycatchers may be limited as a result of the construction traffic associated with the Levee Project.

Disturbance impacts are estimated to affect flycatchers by either having increased stress due to communication issues or the inability to attract a mate as a result of the noise and disturbance in the areas near River Miles 143, 161, 166 and 171. An estimated 10 territories have historically been located within 0.25 mile of the Action Area and located near the River Miles listed above and are expected to be non-fatally impacted in the form of harassment. The following proposed CMs will minimize impacts associated with noise disturbance.

CM 1:  Corps implementation of flycatcher and cuckoo protocol surveys.

Protocol surveys from one year prior and three years post construction will ensure that the Corps is aware of sensitive areas where flycatchers may be present and time to revise construction plans/schedules accordingly and where applicable.

CM 2:  Seasonal and geographic buffers to avoid flycatcher and cuckoos during construction.

The Corps will not have construction activities take place within 0.25 mile of occupied flycatcher territories from late-May to early September.  However, traffic will continue throughout the year and could be within the buffer area of nesting activity.  For heavy machinery, traffic will be restricted to the maintenance roads that would be separated from the active floodway by the large spoil bank or engineered levee that may serve as a noise barrier to an unknown extent.  Small vehicle traffic would occur wherever necessary and may include on top of the spoil bank or engineered levee.

CM 4:  Best Management Practice (BMP) for minimization of noise impacts to listed species.

Corps will limit all construction equipment and large truck engine noise levels to 60 dBA.

CM 6:  Corps vegetation removal activities and management in Vegetation Management Zone.

Corps will conduct vegetation clearing-and-grubbing activities and remove woody vegetation from the vegetation management zone (15 feet riverside of the levee and variable distances from the landside of the levee) during the fall, winter, and spring and will generally avoid avian species nesting season.

<u>Levee and grass only area footprint</u>
The proposed action removes 265.8 acres out of an estimated 7,270 acres of the floodway within the Action Area (USACE 2018c).  Of the 265.8 acres removed by either the levee itself or the grass only area, 230 acres is designated critical habitat.  Within the Action Area, there is a total of 4467 acres of designated critical habitat.

Of the total removed 265.8 acres, 85.5 acres would be permanently managed as grasslands and the remainder would be narrowing of the floodway itself due to the levee encroaching closer to the river.  Of the 265.8 acres of vegetation that will be removed, an estimated total of 44.5 acres is currently suitable (or of high to moderate value as defined by Siegle et al. 2013) for flycatchers, and thus, accommodates flycatcher critical habitat PCEs (derived from most recent available USACE project shapefiles and 2002, 2008, and 2012 habitat suitability ArcGIS shapefiles).  To offset these 44.5 acres of adversely affected habitat, the Corps has proposed to create 45 acres of lowered terraces and willow swales.  Including the 45 acres of lowered terraces and willow swales, a total of 265.8 acres would be conserved through management of existing high to moderate value habitat (USACE 2018c) by selectively removing non-native plants and planting native vegetation to increase density/canopy cover (CM’s 12 and 15).

Removing 44.5 acres of suitable habitat over the 20 years of construction time would minimize the amount of habitat available to accommodate breeding activity.  Also, the total removal of riparian habitat by 265.8 acres reduces the opportunity for suitable habitat to develop in the future in those areas along the engineered levee. That being said, suitable habitat typically grows in areas closer to the river and away from the levee itself, presumably due to hydrological conditions, and will be replaced by the Corps. The replacement of habitat is estimated to take up to 5 years to develop.

Ultimately, the loss of 44.5 acres of suitable habitat (or loss of 230 acres of designated critical habitat) is offset by the proposed 265.8 acres of creation or management of suitable or moderately suitable habitat via terraces, willow swales, and management of existing habitat, as well as the conceptual opportunity for larger flows to be supported by infrastructure within the project area.

<u>Depth to groundwater increases</u>
The depth to groundwater is anticipated to increase as sediment accumulates within the floodway. Generally speaking, within the Rio Grande floodway a certain pattern occurs over time. When a high flow event occurs within the river and the river subsequently overbanks, oftentimes sediments fall out in the lower velocity areas. The lower velocity areas are typically the first to have moist soil exposed again, and the soils are rich with nutrients and moisture to accommodate new vegetative growth. For flycatchers, this is beneficial in the short term as this provides early successional stands of vegetation. However, over the long term, the banks become armored with vegetation and root structures that would become overmature and decadent and incision within the river channel can occur as opposed to overbank flows. This process of having sediments accumulate on the floodway with incision also occurring within the river channel ultimately leads to a floodway where the depth to groundwater increases over time. The levee presence keeps the sediments confined to a narrower area and is just a portion of this process. Other contributing factors including upstream dams, downstream reservoirs, drought conditions, frequency of high river flows, geology and soil composition, and how much (or little) sediments are present within each river reach, all factor into how the process of lateral floodplain detachment unfolds in a certain area.

As indicated within the Corps' Hydrology and Hydraulics report (USACE 2017o), one subreach is anticipated to experience aggradation from the area below the Isleta Diversion Dam to Ag/Deg line 801 by as much as 1 foot over a 50-year period. Using the ArcGIS Software and the Upper Rio Grande Water Operations Model (URGWOM Riparian Model), we looked at the aggrading reach and assumed anywhere the additional foot of aggradation would increase the depth to groundwater past 6.6 feet at 100 cfs flows within the Rio Grande that willows would experience at least some stress from lack of water availability (Table 6). When willows become stressed, we assume this would minimize habitat suitability by decreasing foliage cover within the canopy at the very least. By decreasing foliage cover in the canopy, less habitat would be available for habitat selection and territory establishment. Should territory establishment occur, nesting pairs would have nests more exposed to the elements of weather or more visible to predators. Thus, nest success could suffer and less young would be produced. These parameters selected were the most conservative for the species or the worst-case scenario for water conditions within the Rio Grande.

Table 6. Depth to groundwater for native and nonnative riparian vegetation in the Middle Rio Grande resulting in healthy, stressed, crown dieback or mortality, in feet.

| Riparian species & separation from groundwater effect | Healthy (feet) | Stressed (feet) | Crown dieback (feet) | Mortality (feet) |
|---|---|---|---|---|
| willows | 0 – 6.5 | 6.6 – 7.4 | 7.5 – 9.8 | > 10 |
| cottonwood | 0 – 7.4 | 7.5 – 9.8 | 9.9 – 16.4 | > 16 |
| tamarisk | 0 – 7.4 | 7.5 – 8.2 | > 8.2 | > 100 |
| (Sources: Horton et al. 2001, Parametrix 2008, Caplan et al. 2012) | | | | |

It is important to note that not all areas within the floodway that are considered to be suitable or moderately suitable habitat for flycatchers have vegetation composed of willows (i.e. cottonwoods become stressed when depth to groundwater exceeds 7.4 feet as opposed to 6.5 feet). It is also important to note that the amount of aggradation that may occur and its association with impacts due to the levee was estimated by Aubuchon in 2018. Aubuchon found that an estimated 65.2 acres of sediment accretion would occur within the Action Area and would result in 65.2 acres of decreased overbank flows at 3,500 cfs (USACE 2018c). The Corps has committed to offsetting these losses, pending review, so that there is no net loss of overbank habitat inundated at 3,500 cfs. With the no net loss of overbank flows being proposed, the following analysis may no longer be applicable because there may not be aggradation impacts within the floodway.

Conservatively and with benefit to the species and its habitat, an estimated 16 acres of impacts to critical habitat is anticipated to be impacted by depth to groundwater increases. First, we found that 440.85 acres would have a depth to groundwater increase deeper than 6.6 feet over 50 years when one foot of aggradation was added to the current conditions using the URGWOM Riparian Model. We then attributed 3.5% of the 440.85 acres directly to impacts associated with the Proposed Action as calculated by Aubuchon (2018). The result is 16 acres of critical habitat to be negatively impacted as a result of the depth to groundwater increases anticipated from the aggradation estimated to occur as a result of the engineered levees.

The loss of 16 acres designated critical habitat is offset by the proposed 265.8 acres of creation or management of suitable habitat via terraces, willow swales, and management of existing habitat. This loss is also offset by the Corps assurance that there will be no net loss in overbank habitat inundated at 3,500 cfs. Overbank habitat impacts are estimated to be 65.2 acres (USACE 2018c).

Buried Riprap and dewatering

Riprap will be used at the toe of the levee for erosion protection along the riverside slope. Excavation for the placement of buried riprap is limited to 500 linear feet at a given time. In the event of surface water being present, this water would need to be pumped off the job site temporarily and prior to placing riprap. Should pumping of water be necessary, the trench will refill with water within 12 hours of cessation of pumping and the Corps will assure no stress occurs to riparian vegetation adjacent to the site by monitoring groundwater elevation during construction activities. Construction activities such as this would not occur during the breeding season, and thus, the buried riprap and dewatering aspect of this Levee Project is not anticipated to adversely affect flycatchers or flycatcher critical habitat.

Summary of Effects on Flycatcher

As a result of noise and traffic disturbance, the levee footprint and grass only area and the aggradation of sediment within the floodway, an estimated ten flycatchers will be non-fatally taken in the form of harassment from the noise disturbance specifically, and 246 acres of unoccupied flycatcher critical habitat will be removed (Table 7). These impacts will be fully offset by the conservation measures proposed by the Corps' which include seasonal and geographic restrictions, surveys, monitoring of groundwater, and creation or enhancement of 110.2 acres of lowered terraces and/or swales and 220.8 acres of maintenance of existing suitable or moderately suitable habitat via non-native species selective thinning or adding to native plant density with planting activity. Within the Action Area, there is an estimated 1,108 acres of suitable or moderately suitable habitat currently available (calculated from White and Callahan 2004, Ahlers et al. 2010, and Seigle et al. 2012). With the loss of 44.5 acres of suitable habitat, that would leave 1,063.5 suitable habitat acres for flycatchers. Given flycatchers occupy habitat patches on average of 4.5 acres (USFWS 2002 Appendix D), that would be enough suitable habitat to potentially support 236 potential flycatcher territories in the future.

The total of all floodway within the Action Area is estimated at 7,247 acres currently (including riparian, open areas, river channel, etc). Post construction, the total of all floodway within the Action Area is estimated to be 6,981.2 acres. Though the floodway will be roughly 4% narrower, it will accommodate larger flows as a result of the engineered levee. In 2017, the Corps was concerned about having flows above 6,000 cfs because of potential spoil bank failure (USACE 2018d). With the engineered levee, flows at 14,237 cfs could pass through the floodway at the Bosque Farms gage with an extra 2.18 feet of levee exposed past the elevated water surface elevation (USACE 2017o). By being able to accommodate larger flows from unregulated sources, it will benefit the species by allowing for dynamic environments where sediments can scour and redeposit, and opportunities for new emergent vegetation can take place. These types of dynamic environments support the flycatcher and its habitat. That being said, the primary source of unregulated flows within this Action Area would occur from the Tijeras Arroyo which had a maximum flow of 2,930 cfs in 1988 (USGS 08330600 Peak Streamflow).

Table 7. Estimated flycatcher take and offsetting or conservation measures.

| Corps BA Proposed Activity | Estimated Incidental Take of Flycatcher Territories | Impacts to Flycatcher Critical Habitat (Acres) | Offsetting/Conservation Measure Proposed |
|---|---|---|---|
| Noise and Traffic Disturbance | 10 | 0 | Seasonal & Geographic Restrictions, Surveys (CM 1, 2, 4, and 6) |
| Earthen Levee Footprint and Vegetation Free Zone | 0 | 230 (44.5 of which is considered suitable for nesting activity) | 220.8 Acres vegetation management + 45 of swales/lowered terraces (CM 12 and 15) |
| Levee exacerbated sediment accumulation in floodway | 0 | 16 | 65.2 acres of swales/lowered terraces (CM 15) |
| Buried Riprap and dewatering | 0 | 0 | Monitoring |
| Column Totals | 10 | 246 | 331 |

*Effects to Yellow-billed Cuckoo*

<u>Noise and Traffic Disturbance</u>

Goodwin and Shriver 2010 documented that cuckoos are ten times less likely to be found in noisy (44-57dBA) areas than quiet areas. Areas within 250 meters (0.16 mile) of roads were considered “noisy” within the study (Goodwin and Shriver 2010). It was hypothesized that this was due to the traffic noise frequency (<3 kHz) overlapping with that of the cuckoo and, therefore, making communication more challenging for the species (Figure 5). Therefore, we consider chronic noise pollution an important factor affecting bird population distributions including those of cuckoos in the MRG.

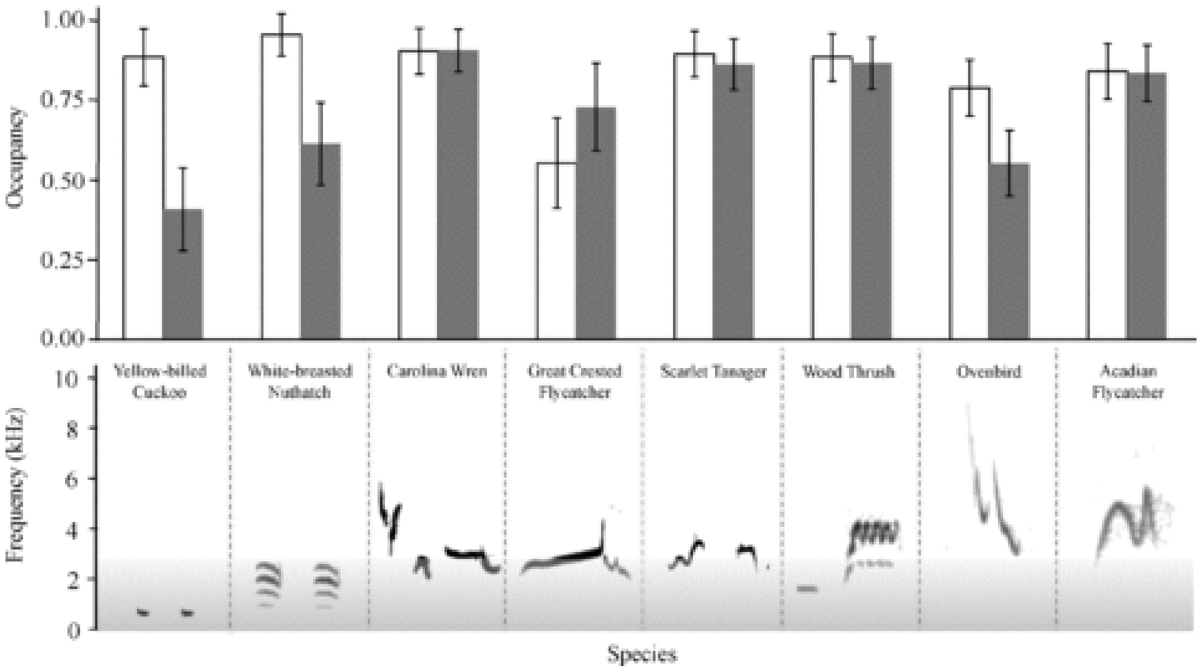


Figure 5. Estimates of bird occupancy in quiet (white bar) and noisy (gray bar) plots, and spectrograms of bird vocalizations or a portion of a vocalization (black) and frequency range of traffic noise (gray) (Goodwin and Shriver 2010).

It is important to note that in Goodwin and Shriver's study, traffic conditions consisted of passenger traffic as opposed to construction traffic. We are making the assumption that this study would still be relevant to this consultation activity. Upon completion of the Corps' noise disturbance study (Consultation Number 02ENNM00-2012-F-0015), the 0.25 mile buffer distance may be modified to something more appropriate, such as whatever distance is required to keep noise disturbance from inhibiting the ability for cuckoos to successfully communicate with one another which will be determined as a result of the noise disturbance study. In the interim period, the 0.25-mile buffer as proposed by the Corps will be used to be conservative for the species. Noise disturbance within the Levee Project is at an estimated at 0-11 kHz based on other construction and rock crushing type noise disturbances (Maijala et al. 2017).

As earthen levee installation will occur at rates of approximately two miles per year, total disturbance impacts were estimated to affect one territory per year of adjacent construction activities. Noise disturbance impacts to the species consist of either having increased stress due to communication issues or the inability to attract a mate in the area between RM 157 to 152, where there have been a maximum of two territories based on the last three years of survey data. Therefore, the species will be adversely affected because both of these territories are expected to be non-fatally impacted in the form of harassment as a result of noise disturbance associated with the Levee Project. The following proposed conservation measures will minimize impacts associated with noise disturbance.

CM 1: Corps implementation of flycatcher and cuckoo protocol surveys.

Protocol surveys from one year prior and three years post construction will ensure that the Corps is aware of sensitive areas where cuckoos may be present and time to revise construction plans/schedules accordingly and where applicable.

CM 2: Seasonal and geographic buffers to avoid flycatcher and cuckoos during construction.

The Corps will not initiate construction activities within 0.25 mile of occupied cuckoo territories from late-May to early September. However, traffic will continue throughout the year and could be within the buffer area of nesting activity. For heavy machinery, traffic will be restricted to the maintenance roads that would be separated from the active floodway by the large spoil bank or engineered levee that may serve as a noise barrier to an unknown extent. Small vehicle traffic would occur wherever necessary and may include on top of the spoil bank or engineered levee.

CM 4: Best Management Practice (BMP) for minimization of noise impacts to listed species.

Corps will limit all construction equipment and large truck engine noise levels to 60 dBA. This is considered "noisy" within the Goodwin and Shriver 2010 study discussed at the beginning of this noise and traffic disturbance section, but may be buffered by the spoil bank noise barrier from CM 2.

CM 6: Corps vegetation removal activities and management in Vegetation Management Zone.

Corps will conduct vegetation clearing-and-grubbing activities and remove woody vegetation from the vegetation management zone (15 feet riverside of the levee and variable distances from the landside of the levee) only between September 1 and April 15, each year as needed. Therefore, no vegetation clearing-and-grubbing activities will occur when the species is present.

<u>Levee and grass only area footprint</u>
Removal of vegetation by levee footprint and the grass only area extending 15 feet into the floodway from the toe of slope would adversely affect vegetation that contributes to cuckoo proposed critical habitat PCEs within the floodway. The proposed action footprint encroaches into 265.8 acres of the floodway. There will be 85.5 acres of the floodway that will be permanently managed as grasslands and the remainder will be narrowing of the floodway itself due to the levee encroaching closer to the river. An estimated total of 130 acres of the vegetation to be removed is currently considered suitable (or of high to moderate value) for cuckoos, and thus, accommodates proposed cuckoo critical habitat PCEs (USACE 2018a; USACE 2018c). To offset these 130 acres of adversely affected proposed critical habitat, Corps has proposed to manage or enhance 265.8 acres of existing habitat by selectively removing non-native plants and planting native vegetation to increase density/canopy cover (CM 12 and 15).

Removing 130 acres of suitable habitat over the 20 years would minimize the amount of habitat available to accommodate breeding activity. Also, the total removal of general riparian habitat by 265.8 acres (which is currently proposed as critical habitat USFWS 2014c) reduces the opportunity for suitable habitat to develop in these areas in the future. However, by constructing an engineered levee, larger river flows could be supported without compromising infrastructure. By theoretically allowing larger river flows, it provides the opportunity for dynamic riverine system processes where sediments can be scoured and deposited and new growth can emerge. The loss of 130 acres of suitable or moderately suitable cuckoo habitat is more than offset by the proposed 265.8 acres of creation or management of suitable habitat via terraces, willow swales, or management of existing habitat, as well as the opportunity for scouring flows to create more dynamic riparian vegetation mosaics within the project area.

Depth to groundwater increases

The depth to groundwater is anticipated to increase as sediment accumulates within the floodway. As discussed in the flycatcher "Depth to groundwater increases" section, the process of having sediments accumulate on the floodway with incision also occurring within the river channel ultimately leads to a floodway where the depth to groundwater increases over time. The increased depth to groundwater leads to plant stress, reduction in habitat suitability, and ultimately could lead to decreased nesting success.

As indicated within the Corps' Hydrology and Hydraulics report (USACE 2017o), one sub reach is anticipated to experience aggradation (from the area below the Isleta Diversion Dam to Ag/Deg line 801) by as much as 1 foot over a 50 year period. Using the ArcGIS Software and the URGWOM Riparian Model, we looked at this aggrading sub reach and assumed anywhere the additional foot of aggradation would increase the depth to groundwater past 6.6 feet at 100 cfs flows within the Rio Grande that willows would experience at least some stress from lack of water availability (Table 6 - above). When willows become stressed, we assumed this would reduce habitat suitability by decreasing foliage cover within the canopy. By decreasing foliage cover in the canopy, less habitat would be available for cuckoo nest selection and territory establishment. Should territory establishment occur, nesting pairs would have nests more exposed to the elements of weather or would be likely more vulnerable to predators. Thus nest success could suffer and less young would be produced. These parameters selected (1 foot aggradation over 50 years and depth to groundwater being at least 6.6 feet at 100 cfs flows) were the most conservative for the species or the worst case scenario for water conditions within the MRG.

We note the uncertainties present or assumptions made upon these analyses which include: cuckoos have exhibited behavior of both site fidelity as well as being opportunistic in territory establishment; the fact that a habitat suitability model has not been created for the cuckoo specifically; and, the fact that not all areas within the floodway that are considered to be suitable or moderately suitable habitat has vegetation composed of willows (i.e. cottonwoods become stressed when depth to groundwater exceeds 7.4 feet as opposed to 6.5 feet). We also note that the amount of aggradation that may occur and its association with impacts due to the levee was estimated by Aubuchon in 2018. Aubuchon (2018) found that an estimated 65.2 acres of sediment accretion would occur and result in 65.2 acres of decreased overbank inundation at flows of 3,500 cfs. Corps is proposing to offset these losses, pending review, so that there is no net loss of overbank habitat inundated at 3,500 cfs. With the no net loss of overbank inundation being proposed, the following analysis may no longer be applicable because there may not be Levee Project aggradation impacts within the floodway.

Conservatively, and with benefit to the species and its habitat, an estimated 16 acres of impacts to proposed critical habitat is anticipated to be impacted by depth to groundwater increases. First, we found that 440.85 acres would have a depth to groundwater increase deeper than 6.6 feet over 50 years when one foot of aggradation was added to the current conditions using the URGWOM Riparian Model. Second, we attributed 3.5% of the 440.85 acres to the Levee Project based on the calculation of levee specific impacts calculated by Aubuchon (2018). That would leave 16 acres of proposed critical habitat that would be negatively impacted as a result of the depth to groundwater increases anticipated from aggradation that was estimated to occur as a result of the engineered levees.

The loss of 16 acres of proposed critical habitat is offset by the proposed 265.8 acres of creation or management of suitable habitat via terraces, willow swales, and management of existing habitat. The Corps will also offset the loss of 65.2 acres of decreased overbank flows at 3,500 cfs by creating additional terraces and swales or other HR site options to assure no net loss.

Buried Riprap and dewatering

The effects analysis for cuckoo is similar to the analysis above for flycatcher. Construction activities involving riprap and dewatering would not occur during the breeding season, and thus, the buried riprap and dewatering aspect of this Levee Project is not anticipated to adversely affect cuckoos or cuckoo proposed critical habitat.

Summary of Effects on Cuckoo

As a result of noise and traffic disturbance, the levee footprint and grass only area, and the aggradation of sediment within the floodway, we estimated that no more than two cuckoos will be non-fatally taken in the form of harassment from the noise disturbance, and 281.8 acres of habitat will be removed (Table 8). These impacts will be fully offset by the CMs proposed by the Corps. CM's offsetting impacts to the species and proposed critical habitat include seasonal and geographic activity restrictions, species surveys, monitoring of groundwater, and creation or enhancement of 45 acres of suitable or moderately suitable flycatcher habitat by lowering of terraces, creating swales, and maintaining 220.8 acres of existing suitable or moderately suitable habitat (by selective thinning or adding to native plant density with planting activity). Within the Action Area, there is an estimated 1,589.3 acres of suitable habitat currently available (USFWS ArcGIS Shapefile 2018a). With the loss of 281.8 acres of habitat, roughly 130 acres of that area is considered suitable to accommodate nesting activity. The total suitable habitat to remain for cuckoo is estimated to be 1,459.3 acres. Given that cuckoos nest in habitat patches, on average, of size roughly 12 acres (Halterman et al. 2016), that loss would be enough suitable or moderately suitable habitat to support 121 potential cuckoo territories in the future.

The total of all floodway within the Action Area is estimated at 7,247 acres (including riparian, open areas, river channel, etc). Post levee construction, the total of all floodway within the Action Area is estimated to be 6,981.2 acres. Though the floodway will be roughly 4% narrower, theoretically, it could accommodate larger, scouring flows as a result of the engineered levee. In 2017, the Corps was concerned about having flows above 6,000 cfs because of potential spoil bank failure (USACE 2018d). With the engineered levee, flows at 14,237 cfs could pass through the floodway at the Bosque Farms gage with an extra 2.18 feet of levee exposed past the elevated water surface elevation (USACE 2017o). By being able to accommodate larger flows (likely from local monsoonal events), it will benefit the species by allowing for dynamic environments where sediments can scour and redeposit, and opportunities for new emergent vegetation can take place allowing for dynamic environments that support the cuckoo and its habitat.

Table 8. Estimated cuckoo take and offsetting or conservation measures.

| Corps BA Proposed Activity | Estimated Incidental Take of Cuckoo Territories | Impacts to Cuckoo Proposed Critical Habitat (Acres) | Offsetting/Conservation Measure Proposed |
|---|---|---|---|
| Noise and Traffic Disturbance | 2 | 0 | Seasonal & Geographic Restrictions, Surveys (CM 1, 2, 4, and 6) |
| Earthen Levee Footprint and Vegetation Free Zone | 0 | 265.8 (130 considered suitable for nesting activity) | 220.8 acres + 45 acres swales/lowered terraces (CM 12 and 15) |
| Levee exacerbated sediment accumulation in floodway | 0 | 16 | 65.2 acres of swales/lowered terraces (CM 15) |
| Buried Riprap and dewatering | 0 | 0 | Monitoring |
| Column Totals | 2 | 281.8 | 331 |

## CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local or private actions that are reasonably certain to occur in the Action Area considered in this BO (50 FR 402.02). We anticipate that the local urban and rural communities will continue to grow, over time, which in turn would lead to an unknown amount of increases in recreation, agricultural activities, and road maintenance along bridges or roads adjacent to or across the Action Area. Increases in recreation could lead to effects such as increased noise disturbance or decreases in habitat suitability. For example, increased numbers of individuals visiting the Action Area could also increase vehicular traffic, increase potential for weedy vegetation species establishment as opposed to native species that are preferred by flycatchers and cuckoos. Local state, tribal and municipal effects (such as irrigation/agricultural needs and maintenance activities for example) have been previously considered in this BO within the Status of Species and Baseline sections as the actions associated with these entities were included in the Final Biological and Conference Opinion for Bureau of Reclamation, Bureau of Indian Affairs, and Non-Federal Water Management and Maintenance Activities on the Middle Rio Grande, New Mexico (Consultation Number 02ENNM00-2013-F-0033). Future Federal actions that are unrelated to the Proposed Action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

## CONCLUSION

In accordance with policy and regulation, the jeopardy analysis in this BO relies on four components: 1) the Status of the Species, which evaluates the silvery minnow, flycatcher, and cuckoo range wide, the factors responsible for their current status, and their survival and recovery needs; 2) the Environmental Baseline, which evaluates the conditions of the silvery minnows, flycatchers, and cuckoos in the Action Area, the factors responsible for those conditions, and the relationship of the Action Area to the survival and recovery of the silvery minnow, flycatcher, and cuckoo; 3) the Effects of the Action, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on the silvery minnow, flycatcher, and cuckoo; and 4) Cumulative Effects, which evaluates the effects of future, non-Federal activities in the Action Area on the silvery minnow, flycatcher, and cuckoo. The effects in the environmental baseline are not excluded (USACE 2018a:13) from the Service's jeopardy analysis of the Levee Project, below.

The jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the silvery minnow, flycatcher, and cuckoo current status, and considering any cumulative effects, to determine if implementation of the Levee Project is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the silvery minnow, flycatcher, and cuckoo in the wild.

The jeopardy analysis in this BO considers the range wide survival and recovery needs of the silvery minnow, flycatcher, and cuckoo, and the role of the Action Area in the survival and recovery of the silvery minnow, flycatcher, and cuckoo as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

The Service and the National Marine Fisheries Service published a final rule in 2016 (81 FR 7214), revising the definition for destruction or adverse modification of critical habitat in the ESA's implementing regulations at 50 CFR 402.02. The final regulatory definition is: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features." This BO analyzed the effects of the proposed action and its relationship to the function and conservation role of silvery minnow and flycatcher designated critical habitat, and cuckoo proposed critical habitat, to determine whether the current proposal destroys or adversely modifies critical habitat for these species.

*Rio Grande Silvery Minnow*

As currently proposed (USACE 2018a,c, Porter 2018 a-k), the Corps' Levee Project does not jeopardize the silvery minnow. Incidental takes from Levee Project construction activities were minor, did not significantly reduce either the survival or recovery of the species, or were within our estimated range of error. We estimated that the amount of levee fills (180.3 acres or ~3.2 percent of the floodway) and sediment deposition (30.8 acres of 0.6% of the floodway), which totals 211.1 acres, is offset by the 45 acres of flycatcher HR sites and 65.2 acres of silvery minnow HR sites proposed by Corps (USACE 2018c; analysis in Appendix 5).

Note that this is not a one-for-one replacement of the impacts of levee fills (180.3 acres) and sediment depositions (30.8 acres) with 45 acres of flycatcher HR sites and 65.2 acres silvery minnow HR sites. However, the proposed 110.2 acres of created or enhanced HR sites will result in no net loss of the areas floodable below 10,300 cfs flows (Appendix 5). As part of the Levee Project, 110.2 acres of HR sites will be constructed or enhanced in areas that will inundate at lower flood levels than the 211.1 acres of fills that will occur at higher flood levels (Appendix 5). In other words, the 110.2 acres of created or enhanced HR sites along the river will have greater functional value than the 211.1 acres of impacted area at the farthest point away from the river because the HR sites will flood more often and therefore provide habitat for silvery minnows more often. Corps will also develop an additional accounting mechanism, which will be reviewed by their peers, the Service, and others, to verify that no net loss of floodable areas will occur by the Levee Project over time. We found that for every one percent reduction in the overbank (and near channel) areas that are floodable, there is about a two percent reduction in the local abundance of silvery minnows. While small fills can have significant adverse effects on silvery minnow and physically reduce the amount of critical habitat, the Corps proposed habitat restoration and mitigation (HR sites) appeared to functionally offset the floodable areas affected at flows less than 10,300 cfs as measured at the ABQ Gage (Appendix 5). In the reasonable and prudent measures below, Corps will verify that the spatial and temporal losses by the final Levee Project fills and sediment deposition are offset by the planned HR Sites to ensure no net loss of floodable areas at or below the 10-year flood event over the duration of the Levee Project.

There is substantial uncertainty on the morphological trends expected from the Levee Project impacts by sediment deposition as well as projecting impacts 70 years into the future (Aubuchon 2018). The accounting methods to verify no net loss of floodable areas have yet to be developed and reviewed. Therefore, Corps has committed to obtaining a review of the amounts and locations of the final designed levee fills, the amounts of sediment depositions, areas of habitat restoration or enhancement, and work with the Service to develop accounting methods to verify no net loss with respect to the flood flows in the action area and over time. This commitment, along with development on an accountability mechanism to verify that these impacts and habitat offsets will result in no net loss of silvery minnow habitat for the duration of the Levee Project (USACE 2018c), also ensures that silvery minnow critical habitat will not be adversely modified. Without Corps commitment to no net loss, a 3.8 percent reduction of inundated floodway could result in approximately an 8 percent reduction in the local abundance of silvery minnows. With the proposed HR Sites that will result in no net loss for the duration of the Levee Project, we do not expect a measurable reduction in the abundance of silvery minnows in the Action Area due to the levee fills and sediment deposition. Therefore, with no silvery minnow take associated with habitat lost by levee fills and sediment deposition (other than due to construction noise and monitoring as described below), and with no net loss of functional silvery minnow habitat in the floodway caused by the entire proposed action that will include HR Sites and an accounting mechanism to verify no net loss for the duration of the Levee Project, then the Levee Project will not adversely modify or destroy silvery minnow critical habitat.

The implementation of BMPs (such as bubble barriers) will minimize silvery minnow take by the Levee Project activities, including those activities implemented during O&M. The adverse effects to silvery minnows will be minimized by the Service's requirement for presence/absence monitoring to take place following high spring runoff events or otherwise when the Silvery Minnow PMP results indicate that the population could easily sustain incidental takes from such monitoring. Additionally, we evaluated the effects of the cumulative total incidental takes (Table 5) due to the Levee Project activities on a simulated silvery minnow population for 48 years (and we included the effects of water management actions and the effects of climate change on silvery minnow status during those 48 years), the effects of the Levee Project action did not significantly reduce the survival or recovery of silvery minnow (Appendix 5).

That is, we used an average of 84 silvery minnow harmed (along with 651 mortalities from entrapment randomly occurring during a high runoff year) as an indicator of the maximum likely mortalities associated with Levee Project each year to a simulated population of silvery minnows for 48 years into the future (considering the status of the species, effects in the environmental baseline, and likely spring runoff reductions associated with climate change). The average rate of silvery minnow mortalities due to the Levee Project did not appreciably reduce the simulated population below the thresholds for silvery minnow survival (5,000) or recovery (20,000). When the simulated population was already below the threshold for survival (due to low spring runoff or other factors) the Levee Project's impact did not result in local extirpation. We note that our use of the $85^{th}$ percentile density for estimating Levee Project impacts and with high variability associated with our simulations, these estimates were likely conservative for the species. Also, because the Levee Project activities occur at a pace of about 2.5 miles per year, and most of the locations of silvery minnows exposed were spread out over 33 miles; we considered the use of an average loss of silvery minnows per year as a reasonable exposure scenario for our jeopardy analysis. As a result of these analyses, the maximum total number of incidental take estimated for the Levee Project in this BO (in Table 5) will not jeopardize the survival and recovery of silvery minnow in the action area or in the MRG (Appendix 5).

*Southwestern Willow Flycatcher*

Flycatchers within the Action Area require dense patches of riparian habitat, comprised of trees and shrubs, as well as an adequate prey base adjacent to riparian floodplains or moist environments. Maintaining adequate hydrology to provide adequate amounts of surface and groundwater is essential to maintaining the flycatcher habitat requirements. Proposed CMs that will result in lowered terraces and swales, will create additional areas more susceptible to adequate amounts of surface and/or groundwater at lower flow rates in the river as compared to current conditions. This will result in more flycatcher habitat with suitable hydrological conditions as compared to what is currently available.

The recovery goal for the MRG Unit is 100 territories and for the Upper Rio Grande Management Unit 75 territories. These recovery goals have been surpassed since 2003. An estimated 10 flycatcher territories are estimated to be within the Action Area based on survey results in 2016 and 2017, and all 10 are anticipated to experience non-fatal take in the form of harassment as a result of the Levee Project. The Proposed Action will result in impacts (temporary and permanent) to 246 acres of flycatcher critical habitat. The Service anticipates that CMs to be carried out by Corps will minimize the impacts to the species through the maintenance or addition of 331 acres of habitat restoration via terrace lowering, swales, non-native vegetation removal, and planting of native vegetation. Once complete, this could support up to 73 flycatcher territories. Therefore, we anticipate that recovery goals for the MRG Management Unit will continue to be surpassed.

*Yellow-billed Cuckoo*

An estimated 2 cuckoo territories are estimated to be within the Action Area based on survey results from 2016 and 2017, and both are anticipated to experience non-fatal take in the form of harassment as a result of the Levee Project. The Proposed Action will result in impacts (temporary and permanent) to 281.8 acres of cuckoo proposed critical habitat. The Service anticipates that the CMs to be carried out by Corps will minimize the impacts to the species through the maintenance or addition of 331 acres of habitat restoration via terrace lowering, swales, non-native vegetation removal, and planting of native vegetation. Once complete, this amount of habitat restoration could support up to 27 cuckoo territories. Therefore, we anticipate there would be no jeopardy on the species and no adverse modification to proposed critical habitat because the proposed habitat restoration and noise disturbance study will result in no net loss.

## INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined (50 CFR 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined (50 CFR 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by Corps in that they become binding conditions for the exemption in section 7(o)(2) to apply. Corps has a continuing duty to regulate all Levee Project activities covered by this Incidental Take Statement. If Corps 1) fails to assume and implement the terms and conditions, or 2) fails to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms, then protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Corps must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR 402.14(i)(3)].

In the estimation of incidental take of silvery minnow, flycatcher and cuckoo, the Service conservatively assumed the worst-case scenario and therefore, estimates of the amount of take may be high. In addition to annual reporting, the Incidental Take Statement (ITS) can be revised to a lower amount through Corps and Service agencies review conducted every five years that provides the results of all peer reviews, a synthesis of data collected, all revised modeling efforts that have been developed, any updates to the environmental baseline, and the effects of the action. In the case of the flycatcher and cuckoo, should the buffer distance or amount of take decrease as a result of the noise disturbance study, this can occur prior to the first five year milestone. If the Levee Project designs, timeline changes, effects to species, or the listed species' statuses change in the Action Area in a manner not contemplated or described in this BO, and then reinitiation of consultation would likely be required.

## AMOUNT OF EXTENT OF TAKE

*Rio Grande Silvery Minnow*

For all construction noise-related effects of the Levee Project, we quantified the number of individuals that are taken by using a high estimated density (the cumulative 85th percentile of the results from the nearest stations of the Silvery Minnow PMP) times the estimated area of effects (120,374 square meters) to arrive at the number of 17,310 silvery minnows harassed (in Table 5, repeated below). As many as 2,335 silvery minnows would likely be harmed (in Table 5, repeated below) by Levee Project construction-related and silvery minnow presence monitoring activities over the lifetime of the project.

Table 5 (repeated). Maximum total number of silvery minnows that may be incidentally taken by all Levee Project activities as described by activity type.

| Activity Type | Area of Takes (m2) | Number of harassed silvery minnows | Number of harmed, injured, or mortalities of silvery minnows |
|---|---|---|---|
| Levee Construction Noise | 32,665 | 7,414 | 1,457 |
| Levee Construction Monitoring | 31,618 | 4,966 | 140 |
| Floodway fills or deposition | 854,291 | Indeterminate and offset by habitat restoration or mitigation in action area | Indeterminate and offset by habitat restoration or mitigation in action area |
| HR Site Construction Noise | 29,270 | 1,815 | 0 |
| HR Site Potential Entrapments | 1,328 | 1,301 | 651 |
| HR Site Monitoring | 29,270 | 1,815 | 88 |
| Levee Project Maximum Total Incidental Take Statement for Rio Grande Silvery Minnow | 978,442 | 17,310 | 2,335 |

As the Levee Project construction activities will occur over 20 years, it is likely that the densities of silvery minnows affected by activities may change prior to or during levee or HR site construction. Therefore, the results from Corps Construction Monitoring will be used to estimate the density of silvery minnows actually affected by the construction noise and related activities (e.g., deployment of bubble barriers, etc.). The maximum silvery minnow densities (that is, silvery minnows caught per 100 $m^2$ of efforts sampling) estimated by Corps Construction Monitoring times the area of effects (as described in this BO) will determine the actual number of silvery minnows harassed (using Equation 1). Using the same mortality factors provided in this BO (specifically in Appendix 5 and described in Appendix A) times the silvery minnow densities estimated by Corps Construction Monitoring times the area of effects will be used to determine the actual number of silvery minnows harmed or killed (Equation 2). Corps will determine the actual number of silvery minnows harassed or harmed on a yearly basis.

Because the Levee Project action will occur over 20 years with varying fish densities, Corps will use the results from Equation 1 and Equation 2, described below, to verify that the cumulative actual incidental take of silvery minnows remains below the Levee Project Maximum Total Incidental Take Statement for Rio Grande Silvery Minnow (by using Equation 3) every five years. That is, for all silvery minnow take that are described in Table 5, in rows 1, 2, 4, and 6, (for all construction noise and monitoring activities including at HR sites) to be exempted from the provisions of section 9 for the Levee Project, the cumulative actual harassment (and harm) by the Construction Noise activity, in row 2, must remain below 7,414 (and 1,457 harmed) silvery minnows. We used this activity as the indicator for the incidental take by the other related construction noise and related activities because it had the greatest impact (of these activities) and was most easily quantifiable.

If the actual number of silvery minnows harassed or harmed by Levee Project construction noise and associated disturbance activities are those estimated using Equations 1 and 2 to be less than those using Equation 3 of this ITS, evaluated cumulatively on a five year basis, then all take of silvery minnows from both levee construction and HR site activities (described in Table 5, rows 1, 2, 4, and 6) are exempted from the provisions of section 9. This allows for the potential for a high spring runoff condition that is associated with higher densities of silvery minnows than we used (the $85^{th}$ percentile) in our take estimates. Corps shall report all estimates of actual silvery minnow take from Levee Project activities annually using Equations 1 and 2, to the Service in their annual report to verify compliance with the ITS. Every five years, Corps will determine and report the cumulative take using Equation 3 to verify compliance with the ITS with the Service for these construction noise and monitoring related activities.

> Equation 1: Actual Incidental Take as harassment of juvenile or adult silvery minnows by noise disturbance = (maximum density of silvery minnows determined by Corps Construction Monitoring) x (area of exposure [Appendix 5]).
>
> Equation 2: Actual Incidental Take as harm of juvenile or adult silvery minnows by noise disturbance = (the maximum density of silvery minnows determined by Corps Construction Monitoring) x (area of exposure [Appendix 5]) x Mortality Rate (Appendix A).
>
> Equation 3: If the cumulative Actual Incidental Take determined using Equation 1 is less than 7,414 juvenile or adult silvery minnows harassed and the cumulative Actual Incidental Take using Equation 2 is less than 1,457 juvenile or adult silvery minnows harmed or killed, evaluated every five years, then all other construction noise-related and HR site-related silvery minnow take described in Table 5 (in rows 1, 2, 4, and 6)) are exempted from the provisions of section 9.

Silvery minnows may also become trapped and perish within HR sites during flood recession or other conditions during high spring floods often due to a change in topography. The Service authorizes the one-time harassment of up to 1,301 silvery minnows and their mortality of up to 651 silvery minnows, which may become trapped and are subsequently transported out of any HR site (to river sites nearby without such deleterious conditions). Corps will report to the Service the fate and numbers of silvery minnows captured and transported during their deployment of the attached entrapment monitoring protocol (Appendix B) at a HR site within two business days. If the actual cumulative number of silvery minnows harassed or killed as determined by Corps entrapment monitoring protocol at any HR site is less than those in Table 5 (row 5), then take of silvery minnows from Corps entrapment and entrapment protocol monitoring is not exceeded.

We found it will be impractical to express a numerical measure of take for silvery minnow from the proposed action fill and sediment deposition activities for the following reasons: 1) the amount of levee fills and sediment deposition in the action area was not known with certainty; 2) there was uncertainty in the locations and areas of the Levee Project fills and the amount of sediment deposition relative to the frequency of flood events; 3) the rate of 30.8 acres of sediment deposition occurring over 50 years would be difficult to observe and quantify, especially with the high variability of deposition events; 4) Corps proposed to conduct levee construction and HR site construction generally within the time frame for a Levee Unit, which would confound the impact with the offset, and 5) there is no ability to find small eggs and larvae in an area that has been filled with sediment. The surrogate for incidental take by this activity is no net loss of floodable areas (at or below the 10-year chance flood event of 10,300 cfs at the ABQ Gage) over the duration of the Levee Project (termed “no net loss”). The methods for accounting for the levee fills, the sediment deposition areas, and the HR sites with respect to their level of flooding have not been formally described or peer reviewed. The design of the HR sites and their performance at maintaining 110.2 acres of Levee Project offsets to the impacts also needs to be further evaluated to verify no net loss over time.

By using “no net loss” as an incidental take surrogate for the impacts of the Levee Project fills and sediment deposition that would (if not offset by habitat restoration, mitigation, or enhancement) affect up to 8 percent of the local silvery minnow population (as measured by a density index in the fall). The “no net loss” incidental take surrogate results in an indicator of the complete offset of any functional loss to the spawning, nursery, feeding, and sheltering habitat of silvery minnows by the Levee Project fill and sediment activities. No net loss can be achieved by construction or enhancement of HR sites in areas that flood more readily and at lower flood levels such that they are inundated more readily than if those same areas were excavated at elevations subject to higher level floods. In Appendix 5, we demonstrate how 110.2 acres of HR sites, which will flood more frequently at lower flood levels, offset the impacts of the 211.1 acres of fills and sedimentation impact has at higher flood levels. As the project is still in the planning phase, we did not evaluate and demonstrate how those 110.2 acres of offsets are to be maintained over the duration of the Levee Project. However, additional review, and a Service-approved accounting mechanism implemented by the reasonable and prudent measures below will reduce uncertainties by which the Corps HR site construction and maintenance will serve to quantitatively offset the Levee Project fills and sediment deposition effects to silvery minnow and its habitat over the duration of the project.

However, both the Service and Corps (USACE 2018c) have agreed to no net loss of the areas flooded by impacts of the Levee Project (as determined by flows up to the 10-year chance flood event of 10,300 cfs as measured at the ABQ Gage). A method of accounting will be developed prior to the commencement of the Levee Project construction, to resolve uncertainties about the value of no net loss as a surrogate for effects to silvery minnow and its habitat. If the areas and amounts of Levee Project fills and sediment deposition activities are offset by Corps such that there is no net loss in the Action Area flooded within the floodway after commencement of construction but prior to 2030, and no net loss is maintained for the duration of the Levee Project, then incidental take of silvery minnows is not exceeded. Incidental take of silvery minnows from floodway fills and sediment deposition activities (Table 5, repeated; row 3) is exempted from the provisions of section 9 of the ESA when Corps provides a Service- approved accounting mechanism and implements the mitigation offsets that document no net loss of floodable silvery minnow habitat areas in the Action Area for the duration of the Levee Project. The Service provides a reasonable and prudent measure along with implementing terms and conditions, below, to address these uncertainties and monitor this surrogate for incidental take of silvery minnow.

Under section 7(o)(2) of the ESA, Corps may delegate, by letter, certain activities resulting in the incidental take of silvery minnows authorized in this BO to contractors (in possession of a valid section 10(a)(1)(A) permit) along with a list of authorized individuals letter from the Service. The Service is authorizing take of silvery minnows necessary for the Corps to conduct a Noise Study. The number of silvery minnows taken by the Noise Study activities will be authorized through the Service issuance of a section 10(a)(1)(A) permit issued to a qualified Corps contractor (that is, to individuals who have the experience and equipment necessary to conduct controlled underwater acoustic studies of fish, fish behavior, and fish injury) selected to conduct the Noise Study. The take of hatchery-reared silvery minnows used in the Noise Study will not adversely affect the silvery minnow population in the MRG.

Corps proposed and the Service refined and required Construction Monitoring of silvery minnows in specific habitats affected by construction noise for the verification of incidental take as exempted from the provisions of section 9 of the ESA by the Incidental Take Statement. Corps proposed and the Service constrained the timing of the presence/absence monitoring of silvery minnows at HR sites to minimize the effects to silvery minnow survival and recovery. Once the presence of silvery minnows is detected at Corps HR sites for HR site monitoring (Table 5, row 6), then these HR site monitoring activities shall cease because the use and suitability of the HR site by silvery minnows has been demonstrated.

There is no incidental take of silvery minnow exempted for the effects of potential water temperature changes due to removal of woody riparian vegetation from the Levee Project Vegetation Management Zone. There is no take of silvery minnow exempted for the implementation of the Levee Project Operations and Maintenance manual or to the project sponsors for levee operations and maintenance activities that are outside of those described and consulted upon by Corps and implemented in their issuance of the if these activities outside of the scope of Corps' final operations and maintenance manual.

*Southwestern Willow Flycatcher*

An estimated 10 flycatcher territories are estimated to be within the Action Area based on survey results in 2016 and 2017, and all 10 are anticipated to experience non-fatal take in the form of harassment as a result of the Levee Project. The Proposed Action will result in adverse impacts (temporary and permanent) to 246 acres of flycatcher critical habitat. As such, incidental take of flycatcher will be considered exceeded if more than 10 flycatcher territories are displaced, or if more than 246 acres of flycatcher critical habitat are impacted as a result of the Proposed Action over the 70-year Levee Project duration.

The Service anticipates the loss of approximately 246 acres of flycatcher critical habitat will be more than offset by the 331 acres of flycatcher habitat restoration being proposed by the Corps.

There is no take of flycatchers exempted from the provisions of section 9 for the implementation of the Levee Project Operations and Maintenance manual or to the project sponsors for levee operations and maintenance if outside of the Corps' proposed operations and maintenance as proposed.

*Yellow-billed Cuckoo*

An estimated 2 cuckoo territories are estimated to be within the Action Area based on survey results in 2016 and 2017, and both are anticipated to experience non-fatal take in the form of harassment as a result of the Levee Project. The Proposed Action will result in impacts (temporary and permanent) to 281.8 acres of cuckoo proposed critical habitat. As such, incidental take of cuckoo will be considered exceeded if more than 2 cuckoo territories are displaced, or if more than 281.8 acres of cuckoo proposed critical habitat are impacted as a result of the Proposed Action over the 70-year Levee Project duration.

The Service anticipates the loss of approximately 281.8 acres of cuckoo proposed critical habitat will be more than offset by the 331 acres of habitat restoration being proposed by the Corps.

There is no take of cuckoos exempted for the implementation of the Levee Project Operations and Maintenance manual or to the project sponsors for levee operations and maintenance if outside of the Corps' proposed operations and maintenance as proposed.

## EFFECT OF THE TAKE

In this BO, the Service determined that these levels of anticipated take are not likely to result in jeopardy to the species or destruction or adverse modification of critical habitats. The incidental take caused by the Levee Project, as proposed and modified, will not appreciably reduce the survival and recovery of the silvery minnow, flycatcher, or cuckoo. This was determined because Corps CM's and offsetting measures will result in no net loss to the species or their designated or proposed critical habitat.

## REASONABLE AND PRUDENT MEASURES

The Service finds the following RPMs are necessary and appropriate to minimize impacts of incidental takes of silvery minnows, flycatchers, and cuckoos from the Levee Project:

1. Corps shall complete a Noise Study and monitor construction impacts to minimize the adverse effects to silvery minnow from Levee Project construction noise, disturbance, and silvery minnow monitoring activities. As a result of these studies and monitoring, BMPs would be refined to minimize effects to silvery minnow.

2. Corps shall minimize effects to silvery minnow habitat from Levee Project activities associated with levee fills, sediment deposition, methods of accounting and review to

verify no net loss of floodable areas over the project duration, reduce entrapment effects at HR sites, and verify the Vegetation Management Zone impacts on water temperatures.

3. Corps shall complete a flycatcher noise disturbance study and presence/absence surveys to revise construction buffer distances and/or avoid occupied areas where necessary. Corps shall also seasonally restrict activities to minimize effects to flycatchers from Levee Project activities.

4. Corps shall minimize effects to flycatcher critical habitat from Levee Project activities by implementing habitat restoration.

5. Corps shall minimize effects to cuckoos from Levee Project activities by completing a noise disturbance study to identify the distance to which noise is impacting cuckoos and revise the buffer distance as proposed as a result of the study. Corps shall complete presence/absence surveys to identify and avoid cuckoo territories as proposed.

6. Corps shall minimize effects to cuckoo proposed critical habitat from Levee Project activities by implementing habitat restoration.

7. Corps shall provide an annual report to the Service that documents incidental takes and review cumulative takes with the Service every five years.

## TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the agencies must comply with the following terms and conditions. These terms and conditions implement the RPMs described above and outline required reporting and monitoring requirements. These terms and conditions are non-discretionary.

To implement RPM 1 (Minimize the adverse effects to silvery minnows from Levee Project construction and silvery minnow monitoring activities):

1.1 Conduct, complete, and implement results of the Noise Study within two years after the initiation of construction of any levee unit.

a. Prepare a Scope of Work describing the proposed Noise Study. Provide a copy of the scope of work, proposed work plan, or performance work statement to the Services' NMESFO and obtain their review and approval prior to initiating or implementing the Noise Study.

i. Corps shall select individuals to conduct the Noise Study that have at least five years of experience and the necessary equipment to expose live fish to controlled underwater acoustic (noise) treatments and to quantify the behavioral responses or injuries to fish in a controlled environment.

ii. Based on an approved scope of work, the Noise Study should be demonstrated that it will determine with certainty the magnitude and frequencies of sounds or vibrations that will propagate underwater and that will exceed a threshold that will harass or injure a treatment population of silvery minnow larvae or juvenile silvery minnows (as determined to be significantly different as compared to an exposed control population) or will otherwise ensure that all experimental activities are based on sound study designs and animal care practices that lead to scientifically valid and implementable results.

iii. Corps will determine the representative range of underwater noise exposures to affected silvery minnows in a field based study.

iv. Corps contractor to conduct the Noise Study is required to incorporate the American Fisheries Society "Guidelines for the Use of Fishes in Research" for all applicable experimental activities.

v. Corps contractor to conduct the Noise Study must independently qualify for and obtain a Section 10(a)(1)(A) permit prior to conducting the Noise Study. The Noise Study shall only be conducted by a contractor with the education, experience, and expertise necessary to complete the experimental research.

vi. Corps shall coordinate with the Service on the source, location, and availability of excess silvery minnow life stages necessary to conduct the Noise Study. (The Service must first consider the needs for augmentation of hatchery-reared fish into the MRG). If necessary, Corps shall independently fund a Service-authorized captive propagation facility to spawn, rear, and transport the number of silvery minnow life stages necessary to complete the Noise Study with scientifically valid results.

vii. Upon request, the Corps shall provide to the Service, any copies of publications and any records (including notes, observations, raw data, or other media) derived from or associated with the Noise Study.

b. Using the results of the Noise Study, and any modeling or determination of underwater noise levels at exposed sites in the MRG, Corps will assess and report the quantification of likely behavioral or injurious effects of construction noise to silvery minnow life stages.

c. The results of this quantitative assessment of adversely affected silvery minnows by noise will be compared to those in the ITS of this BO in an annual report and available for Service review within one year after the start of construction.

d. Based on the results of the Noise Study, Corps shall implement those necessary BMPs immediately to reduce any adverse effects of noise or vibrations on exposed silvery minnow life stages.

e. Corps shall produce a Standard Operating Procedure(s) (SOP) describing the BMPs necessary to reduce adverse effects to silvery minnows and make that SOP publically available within two years following the start of construction.

f. The results of the Noise Study and the SOP(s) or BMPs necessary to minimize adverse effects to silvery minnow life stages (such that effects of O&M activities are rendered are insignificant or discountable) shall be incorporated into the O&M manual prior to being implemented by Corps.

1.2 Corps shall monitor the incidental take of silvery minnows due to levee construction noise and minimize take by implementing noise reduction BMPs.

a. Corps shall conduct Construction Monitoring three times at nine locations (described in this BO in Appendix 5) just prior to or during the commencement of levee construction activities near the two river and seven irrigation facility (totaling nine) areas that are exposed to noise.

i. Corps shall compare the most recent results of the Corps Construction Monitoring to the maximum estimated density in habitats affected from construction monitoring in the ITS and ensure numbers of silvery minnow take is not exceeded.

ii. Corps may disturb silvery minnows in the nine affected areas during deployment of BMPs (such as equipment to create bubble barriers) to reduce the effects of noise on silvery minnows; and,

iii. Corps may conduct Construction Monitoring of silvery minnows in the nine affected areas after deployment of BMPs to verify functionality.

1.3 Corps shall conduct one-time monitoring (using standard sampling methods such as beach seine or fyke-net, see USFWS (2017)) to determine if juvenile or adult silvery minnows are present and therefore utilize the constructed or enhanced HR sites currently estimated at 110.2 acres during their inundation by spring runoff.

a. Corps shall contract qualified biologists possessing the knowledge, education, or experience necessary (see USFWS (2017)) to use standard sampling methods and conduct the presence/absence monitoring of juvenile or adult silvery minnows once at each of the HR sites.

b. Corps shall conduct such presence/absence monitoring when the overall estimated density in the previous fall is greater than 1 silvery minnows/100m2 as determined by the Silvery Minnow PMP and the April forecast of runoff amounts will exceed 280,000 acre-feet of water crossing the ABQ Gage during May and June prior to conducting this silvery minnow monitoring at inundated HR sites.

To implement RPM 2 (Corps shall minimize effects to silvery minnow habitat from Levee Project activities associated with levee fills, sediment deposition, methods of accounting and review to verify no net loss of floodable areas over the project duration, potential entrapment at HR sites, and the implementation of the Vegetation Management Zone on water temperatures) Corps shall:

2.1 Determine and report to the Service the final spatial extent and location (approximately every 500 feet) of levee fills in 500 cubic feet per second increments before construction. Identify and quantify the areas of impacts and any changes to the estimates from the initial design.

2.2 Develop a plan and design of HR sites that offsets the levee fills area and locations as well as the sediment deposition areas (amount only) such that the floodable areas that are impacted are offset such that there is no net loss of floodable areas (for all floods less than or equal to 10,300 cfs, mean daily flow, at the ABQ Gage) prior to the initiation of any levee fills or sediment deposition.

a. Corps will facilitate Service participation in development and reviews of all preliminary selection of sites for HR sites or other mitigation offsets.
    i. The Service may reject a preliminary HR site if issues are raised during preliminary reviews (involving the site selection criteria, the objectives, the minimum size, any buffers necessary, the plan of work, the HR site maintenance plans, HR monitoring requirements, or tracking and accounting systems to verify no net loss of floodway function prior to Levee Project) and such issues cannot be resolved between Corps and the Service.
    ii. Where other landscape level plans or multi-agency plans exist involving the length, width, depth, and duration of floods for listed species management, the Corps will attempt to integrate the final HR site selection and plans into those landscape-level or multiagency plans.

2.3 Corps will develop an accounting model for review and approval by the Service that describes the location and amount of levee fills (and amount of sediment depositions) based on the goals of no net loss of floodable areas for the project duration prior to initiation of construction of the Levee Project.

a. Corps will develop the accounting model of Levee Project fill and sediment deposition impacts along with HR Site construction or enhancements that results in a 1:1 function value replacement of the floodable overbanks (at mean daily flows less than or equal to 10,300 cfs at the ABQ Gage) that are impacted by the Levee Project within the Action Area.
b. HR site selection, construction, or enhancement may rely on a range of strategies including sediment excavations, connecting areas not accessible to the 10-year flood events, excavating banks, creating additional habitat, or other Service approved actions. Effective conservation outcomes and accountability through HR site monitoring can come about through Corps own adaptive management processes involving the Service and compliance with this BO.
c. The accounting model will also take into account the temporal nature of the impacted areas and the HR site credits and verify no net loss (currently estimated as 110.2 acres) of floodable areas are fully offset for the duration of the Levee Project. Such accounting principles can be based on the process known as Habitat Equivalency Analysis (see NOAA 1997), but any similar process accounting for the floodable functioning of the 110.2 acres constructed or enhanced of the final HR Sites must be assured for the duration of the Levee Project.
d. After peer review, the accounting model will be provided to the Service for approval along with the Plan and Design of the HR Sites prior to initiation of construction.

2.4 In the event of silvery minnow entrapment within a Corps HR site, then Corps will deploy the Service's attached Entrapment Monitoring Protocol (Appendix B) to enumerate and reduce incidental take of silvery minnows by entrapments.

2.5 Corps shall conduct a field study monitoring water temperature regimes (at least 96 observations per day) simultaneously in areas of silvery minnow habitats that are similar to those affected by the Vegetation Management Zone compared with a control condition over a year, including especially, any spring flood events.

a. If the 90% confidence intervals of the daily water temperatures are significantly different between the treatment and control sites due solely to riparian shading on water temperature, then additional analysis of potential adverse effects to silvery minnow life stages using Platania (2000) or Buhl (2011a,b) shall be conducted by Corps.

b. After evaluation, should adverse effects to silvery minnow life stages be suspected due to the differences in water temperatures based solely on riparian shading and be associated with thresholds of effects in the cited literature, then Corps shall re-evaluate those Vegetation Management Zone impacts to water temperature and potential adverse effects to silvery minnows and report such findings to the Service within 180 days of the completion of the temperature study.

To implement RPM 3 (Minimize effects to flycatchers from Levee Project activities):

3.1 Complete a noise disturbance study and submit results to the Service within 2 years of construction initiation. Depending on the results of the study, work with the Service to adjust buffer distances for construction activities to ensure minimal impacts from noise disturbance to individuals.

3.2 Complete flycatcher protocol presence/absence surveys as proposed.

3.3 All vegetation removal prior to and post construction (including O&M activities by the sponsor) for the life of the consultation (to 2088), shall occur outside of the breeding season from September 1st to April 15th.

3.4 Ensure that any of the low-drift herbicide to be used follows the Service guidance on herbicide use (White 2009).

To implement RPM 4 (Minimize effects to flycatcher critical habitat from Levee Project activities):

4.1 All 265.8 acres of habitat restoration activities will use the goal of establishing 50% cover of vegetation (estimated planting density of 1133 whips per acre (based on results associated with Moore 2007).

4.2 All 45 acres of proposed lowered terraces or swales must be at least 5 acres in size (as proposed) and at least 10 meters wide (as specified as the minimum width in finding breeding flycatchers Recovery Plan Appendix D).

4.3 All 45 acres of proposed swales or terraces lowering need to be lowered to a depth where groundwater will be anticipated to be less than 3 feet deep over the course of the proposed action period (until 2088).

4.4 The amount of sediment material removed shall equal or exceed the 16 acre feet of aggradation as estimated by the Service.

4.5 The Corps shall determine how many acres of suitable habitat will be removed in each phase of construction, and complete the same amount or more acreage of restoration simultaneous to the removal of suitable habitat (which may not necessarily be in the same Levee unit but within the overall Action Area).

4.6 In the event that the proposed groundwater monitoring program finds that it takes longer than 12 hours to recharge or the groundwater depth increases past 6.6 feet in willow habitat or 7.5 feet for cottonwoods, the pumping portion of the proposed action will need to cease in that area until the area re-wets or is watered during the growing season (estimated to be April to October).

To implement RPM 5 (Minimize effects to cuckoos from Levee Project activities):

5.1 Include the cuckoo in the noise disturbance study as described in Term and Condition 3.1.

5.2 Complete cuckoo protocol presence/absence surveys as proposed.

To implement RPM 6 (Minimize effects to cuckoo proposed critical habitat from Levee Project activities):

6.1 When selecting locations for the 45 acres of swales and terrace lowering, the Corps shall ensure these areas are adjacent to at least 7 acres of potential nesting habitat for cuckoos. This will ensure the combined patch will be at least 12 acres in total which is the typical size of nesting areas for cuckoos. The combined nesting area shall also have adjacent foraging habitat that may be less dense than 50% canopy cover.

To implement RPM 7 (Provide an annual report to the Service that documents activities completed and incidental take annually. Review cumulative take estimates with the Service every five years):

7.1 Annual reports stating the progress and findings shall be submitted to the Service's NMESFO by April 1st every year starting April 1st 2019.

7.2 The 5-year review shall provide cumulative takes, results of the studies associated with CM's, offsetting measures, RPMs, and Terms and Conditions and the Corps and Service shall review together to determine if there are opportunities to provide greater benefit to the species or minimize impacts associated with the proposed action.

7.2 Prior to submitting the final 5-year reviews, Corps will meet with the Service's NMESFO staff to discuss progress and findings.

*Disposition of Dead or Injured Listed Species*

Upon locating a dead, injured, or sick listed species initial notification must be made to the Service's Law Enforcement Office P.O. Box 1306, Albuquerque, NM 87103-1306, telephone 505-248-7889 within 3 working days of its finding. Written notification must be made within 5 calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office via email at nmesfo@fws.gov. Care must be taken in handling sick or injured animals and in handling dead specimens to preserve the biological material in the best possible state.

## CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a Proposed Action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. Cooperate with an evaluation of the flexibilities necessary to store, release, and time water to create essential spring runoff floods in the MRG for the benefit of the riparian environment and listed species.
2. Document and explore alternative management and control measures of the invasive, non-native, ravenna grass (*Saccharum ravennae*) and/or mistletoe (*Viscum* spp.) at any Habitat Restoration Sites, along the levees, in the Vegetative Management Zone, and within the floodway near listed species habitats.
3. Vegetation management zones shall be managed with minimal invasive species recruitment and least maintenance effort possible.
4. Evaluate the effects and options for management of sediment within the river channel to inundate more areas during spring runoff.
5. Develop a robust monitoring program for habitat restoration effectiveness to ensure that fish sampling and management actions continue to improve the survival and recovery of silvery minnow.
6. Coordinate with other agencies where levees will affect habitat restoration or mitigation activities (for example, the Highway 6 bridge in Los Lunas, New Mexico).

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

## REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Through formal conferencing, the Service has determined the Proposed Action is “not likely to destroy or adversely modify” cuckoo proposed critical habitat. Upon designation of critical habitat, you may request the Service to confirm the conference opinion as a BO issued through this formal consultation. Such a request must be in writing, and if the Service reviews the Proposed Action and finds no significant changes in the Proposed Action or the information used during this conference, the Service will confirm the conference opinion as the BO, and no further section 7 consultation will be necessary.

The Service appreciates Corps efforts to identify, minimize, and offset effects to listed species from this Levee Project. For further information, please contact David Campbell by telephone at 505-761-4745, or by email to david_campbell@fws.gov, or myself at telephone 505-761-4781, or by email to susan_millsap@fws.gov. Please refer to the consultation number 02ENNM00-2014-F-0302, in future correspondence regarding this project.

## LITERATURE CITED


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