Fish and Wildlife Coordination Act Report
for the
Upper Rio Grande Water Operations Review and Environmental Impact Statement
Colorado, New Mexico, and Texas

Submitted to:
U.S. Army Corps of Engineers
Albuquerque, New Mexico

U.S. Bureau of Reclamation,
Albuquerque, New Mexico

New Mexico Interstate Stream Commission
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INTRODUCTION

This is a Fish and Wildlife Coordination Act Report (CAR) for the Upper Rio Grande Water Operations Review (URGWOPs) and Environmental Impact Statement (EIS) prepared by the U.S. Fish and Wildlife Service (Service) under the authority of and in accordance with the requirements of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 USC 661-667e). This report addresses the URGWOPs alternatives developed by the U.S. Army Corps of Engineers (Corps), U.S. Bureau of Reclamation (Reclamation), and the New Mexico Interstate Stream Commission (NMISC). This report describes existing fish and wildlife resources in the project area, potential project impacts to fish and wildlife resources, and recommendations to avoid, minimize, and/or mitigate the potential adverse effects to fish and wildlife resources.

The Corps, Reclamation, and NMISC are conducting a review of their joint water storage and delivery operations of Federal dams, reservoirs, and other Federal facilities in the upper Rio Grande. The project area is divided into 5 sections (including 17 reaches) of river from the headwaters in Colorado to Fort Quitman, Texas (Figure 1). The Northern Section of the project area includes: Reach 1 - Alamosa to the New Mexico state line (Lobatos Guage); Reach 2 - Platoro Dam to the Rio Grande (Conejos River); Reach 3 - New Mexico state line to Velarde; and Reach 4 - Velarde to the Rio Chama confluence. The Rio Chama Section of the project area includes: Reach 5 - Heron Dam to El Vado Dam (Rio Chama); Reach 6 - El Vado Dam to Abiquiu Dam (Rio Chama); Reach 7 - Abiquiu Dam to the Rio Grande confluence; Reach 8 - Rio Grande/Chama confluence to Otowi Guage; and Reach 9 - Otowi Guage to Cochiti Dam. The Central Section of the project area includes: Reach 10 - Cochiti Dam to Bernalillo; Reach 11 - Jemez Dam to Rio Grande confluence; Reach 12 - Bernalillo to Isleta Diversion Dam; and Reach 13 - Isleta diversion to Rio Puerco confluence. The San Acacia Section includes Reach 14 - Rio Puerco confluence to Elephant Butte Reservoir. The Southern Section of the project area includes: Reach 15 - Elephant Butte Reservoir to Caballo Dam; Reach 16 - Caballo Dam to El Paso; and Reach 17 - El Paso to Fort Quitman, Texas.

The purpose of the URGWOPs EIS is to: 1) identify the operational flexibility of Federal reservoirs and facilities in the upper Rio Grande basin that are within the existing authorities of the Corps, Reclamation, and the NMISC; 2) develop a better understanding of how these facilities could be operated more efficiently and effectively as an integrated system; 3) formulate a plan for future water operations at these facilities that is within the existing authorities of the Corps, Reclamation, and NMISC; 4) comply with State, Federal, and other processes for making decisions about water operations through better interagency communications and coordination, and facilitation of public review and input; and 5) support Corps, Reclamation, and NMISC compliance with applicable law and regulations, including but not limited to, the National Environmental Policy Act (NEPA) of 1969, and the Endangered Species Act (Act) of 1973, as amended.

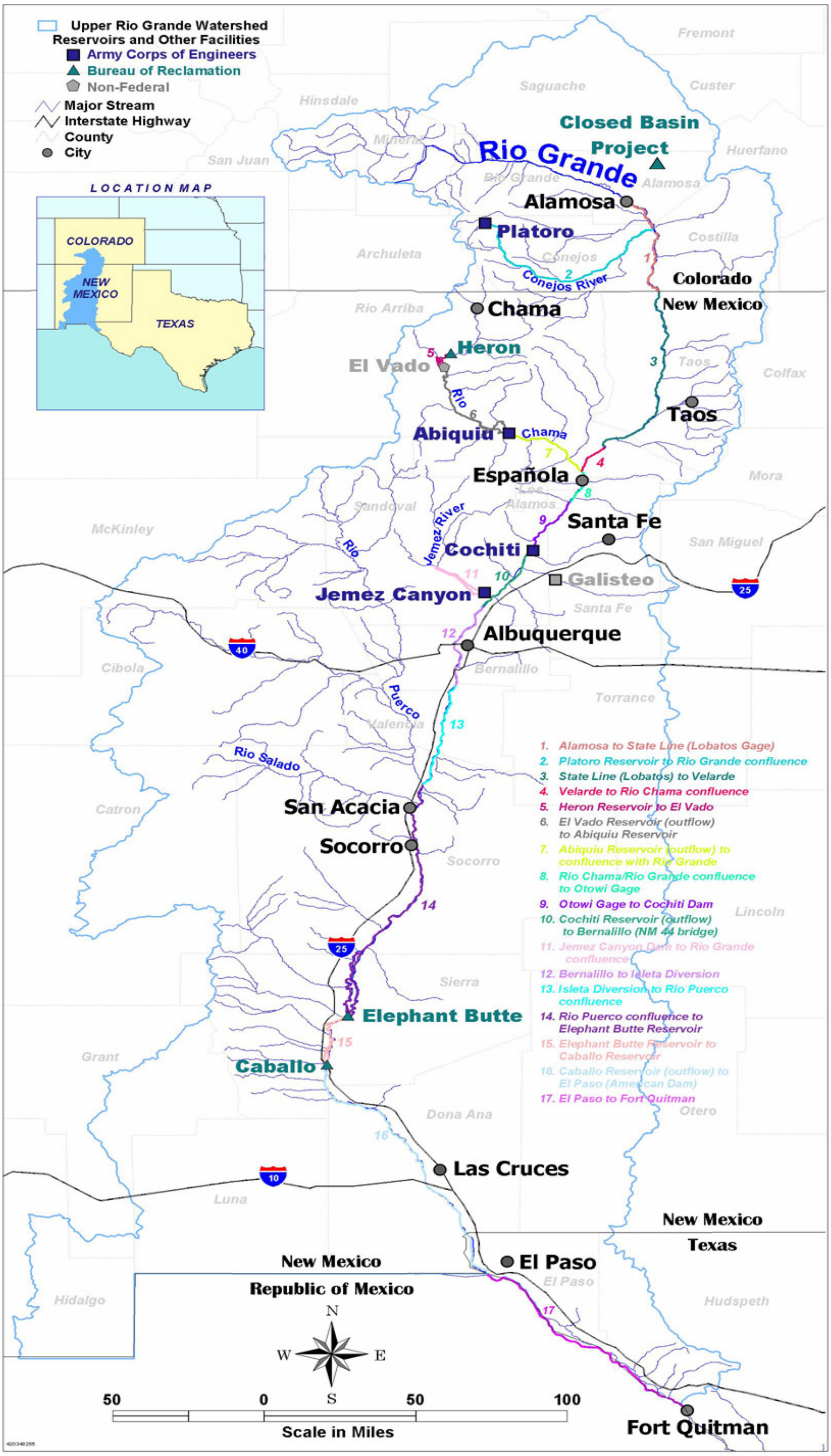

Figure 1. URGWOPs study area (from URGWOPs TeamLink website, July 2004)

DESCRIPTION OF PROJECT AREA

The Rio Grande is the fifth longest river in North America and one of the most ecologically degraded (Fullerton and Batts 2003). It originates in the San Juan Mountains of southern Colorado and flows south through New Mexico, then southeast along the border of Texas before emptying into the Gulf of Mexico at Boca Chica (Texas Natural Resource Conservation Commission 2002). In northern New Mexico, the river descends through the Rio Grande Gorge into the Española Valley, where it is joined from the northwest by the Rio Chama, its largest tributary in the project area. Flows from the Rio Chama originate from runoff in the Rio Chama watershed and from water imported from the San Juan River Basin (i.e., San Juan-Chama Project) in northwestern New Mexico. Further downstream, the river enters Cochiti Lake, which marks the northern boundary of the Middle Rio Grande Valley. From Cochiti Lake downstream to Fort Quitman, Texas, the river flows through a predominantly wide, low gradient valley.

The ancestral Middle Rio Grande developed into a single river system about 5 million years ago (Crawford et al. 1993). Incision of the Middle Rio Grande Valley has been cyclic, and has produced gravel, sand, and silt terraces 9 to 53 meters (m) (30 to 175 feet (ft)) above the current floodplain. The Rio Grande is thought to have reached maximum entrenchment between 10,000 and 20,000 years ago, at a depth 18 to 40 m (60 to 130 ft) below the current valley floor. Since that time, sediment influx from tributaries has resulted in a gradual aggradation of the river bed. Historically, this process led to frequent avulsions of the river channel. The historic river channel was braided and sinuous with a shifting sand substrate that freely migrated across the floodplain, limited only by valley terraces and bedrock outcroppings (Crawford et al. 1993).

It is believed that prior to human settlement and development the Middle Rio Grande generally supported perennial flows, although riverbed drying may have occurred in downstream areas during periods of prolonged drought (Crawford et al. 1993). Hydrographic patterns of the unregulated river would have mirrored the seasonal events of spring snowmelt and late-summer precipitation. Inputs from two tributaries in this region, the Rio Puerco and Rio Salado, were probably not perennial, but were likely more consistent than those provided by the predominantly dry riverbeds of today.

The Middle Rio Grande is the oldest continually inhabited area of the United States and the river valley has been continuously used by agricultural societies for the past 700 years. Prior to the arrival of Europeans, Pueblo farmers practiced floodwater agriculture relying on overbank flows, surface run-off, and to a limited extent, diversions from the river channel (Wozniak 1998). When Coronado’s expedition reached the Middle Rio Grande in 1540, it is estimated that 1,012 hectares (25,000 acres) of land were under cultivation. Ditch irrigation based on a network of canals and acequias became widespread with the establishment of Spanish settlements in the sixteenth and seventeenth centuries. More land in the floodplain was cleared for farming, and cottonwood forests were removed to provide timber for building material, fenceposts, and firewood. By 1850, most valley communities were established in their present locations, and by 1880 the area of irrigated land between Cochiti and San Marcial reached a maximum of about 125,000 acres (Crawford et al. 1993).

In the following decade, irrigated land use in the Middle Rio Grande dropped below 20,234 hectares (50,000 acres), until the 1930s. A combination of ecological and hydrological factors contributed to this decline. Overgrazing and deforestation of surrounding lands increased sediment loads and riverbed aggradation. This resulted in increased flooding, a higher water table, and saturation of riparian and cultivated lands. At the same time, increasing water demand upstream, particularly in the San Luis Valley of southern Colorado, decreased the supply of water for irrigation in the Middle Rio Grande. This increased the frequency of river drying in the southern reaches of the river, and supply shortages in the El Paso/Juarez area in the late 1880s and 1890s. The problems of uneven water distribution and saturation of valley lands persisted through the early stages of modern river management (Crawford et al. 1993, Middle Rio Grande Conservancy District (MRGCD) 1993).

Several small-scale water management facilities were constructed on the Middle Rio Grande prior to 1900. These structures were often unable to withstand the periodic flooding that occurred, and had to be continually repaired or replaced. The era of large-scale, federally-funded river management began shortly after the passage of the Reclamation Act in 1902. One of Reclamation's first projects after the passage of this act was constructing a dam and reservoir at Elephant Butte to serve the water needs of southern New Mexico and west Texas. Further north, the MRGCD was formed in 1925, to provide the Middle Rio Grande Valley an irrigation, drainage, and flood control system. Over the past century the various Reclamation, Corps, and MRGCD water projects transformed the Rio Grande in New Mexico into a fully managed and regulated river system. These projects and others continue to influence the hydrology, geomorphology, and fish and wildlife resources of the Rio Grande.

Major Water Management Facilities in the Project area

Several major water management facilities occur in the URGWOPs project area. These facilities include: the Closed-Basin wells; Platoro Dam; Heron Dam; El Vado Dam; Abiquiu Dam; Cochiti Dam; Jemez Canyon Dam; the Low Flow Conveyance Channel (LFCC); Elephant Butte Dam; and Caballo Dam. Although these facilities occur within the URGWOPs project area, not all of them fall within the authority of the URGWOPs EIS review.

<u>Closed-Basin Wells</u>

The Closed Basin [wells] Project (Project) was authorized by Congress in 1972 through PL 92-514, and later amended through PL 96-375 in 1980, PL 98-570 in 1984, and PL 100-516 in 1988. The Project is owned and operated by Reclamation. Management oversight is provided by a three member Operating Committee consisting of one representative from the Colorado Water Conservation Board, one from the Rio Grande Water Conservation District, and a member appointed by the Secretary of Interior. The Project's objectives include: 1) assisting Colorado in meeting annual deliveries under the Rio Grande Compact; 2) maintaining the Alamosa National Wildlife Refuge and the Blanca Wildlife Habitat Area, and stabilizing San Luis Lake; 3) allowing Colorado to apply for the reduction and elimination of any accumulated deficit in the deliveries as determined by the Rio Grande Compact Commission; and 4) providing irrigation supply and other beneficial uses in Colorado. The Project is authorized for groundwater production up to 600,000 acre-feet (ac-ft) in any consecutive ten-year period specifically to assist

Colorado in meeting annual Rio Grande Compact deliveries. Up to 5,300 ac-ft of water per year can be used for wildlife mitigation. Average annual water production is currently limited to 25,000 ac-ft due to well degradation. Although the Project is within the scope of the URGWOPs review and EIS, no operational flexibilities have been identified.

Platoro Dam and Reservoir

Platoro Dam was authorized under the Flood Control Act of 1944. The dam is owned by Reclamation, and managed by the Conejos Water Conservancy District (CWCD). The reservoir is operated for flood control and irrigation storage. The Corps monitors the flood and conservation space in a joint-use pool. If flood space is needed, then water in the conservation space is released to make room for flood inflows. Maximum releases are within the channel capacities in the Conejos River downstream (2,500 cubic feet per second (cfs)) at the Mogote gage and 1,600 cfs at the La Sauces gage). During normal operation, the CWCD maintains a 7 cfs release from October through April, and a bypass flow of 40 cfs or natural inflow whichever is less from May through September. Flood control is the only authority under review in the URGWOPs EIS for this facility.

Heron Dam and Reservoir

Heron Dam was authorized by Congress in 1962 through PL 87-483 (San Juan-Chama Transmountain Diversion Project). The reservoir is owned and operated by Reclamation to store and deliver water for irrigation, municipal, domestic, and industrial uses, and to benefit recreation and fish and wildlife resources. Up to 400,000 ac-ft (reservoir capacity) of San Juan-Chama water is stored in Heron Reservoir to provide a reliable water supply for downstream contractors. Carry-over storage of unused individual contractor water is not permitted except by the use of "waivers". A waiver allows a contractor to postpone the date in which they must take delivery of a current year's water allocation. Without the use of waivers, contractors must take delivery of their water by December 31 of each year. By using waivers, contractors can delay taking delivery of their water until April 30 of the following year. By agreement with San Juan-Chama water contractors, releases from Heron Reservoir are timed to maintain minimum winter flows below El Vado Reservoir. Winter releases follow Bureau of Land Management Rio Chama Instream Flow Assessment recommendations, and comply with the Wild and Scenic Rivers Act. The agreement also includes higher weekend releases in the summer over a six- to eight-week period to benefit whitewater rafting.

El Vado Dam and Reservoir

El Vado Dam and Reservoir were constructed by the MRGCD for flood control and irrigation (Reclamation 1983). In 1955, Reclamation rehabilitated the dam, and in 1966, constructed new outlet works to facilitate passage of additional water entering the reservoir from the San Juan-Chama Project (Reclamation 1983). El Vado Reservoir is owned by the MRGCD and operated by Reclamation under contract with the MRGCD. The reservoir's main function is irrigation storage, but the reservoir also provides incidental recreation, flood protection, sediment control, and power generation. El Vado Dam and Reservoir are not within the authority of the URGWOPs EIS review.

Abiquiu Dam and Reservoir

Abiquiu Dam was authorized for construction by the Flood Control Act of 1948, (PL 80-858) and the Flood Control Act of 1950 (PL 81-516). Construction of the dam was initiated in 1956, and the project was completed and placed into operation in 1963. The reservoir is owned and operated by the Corps primarily for flood and sediment control, but also for San Juan-Chama water supply storage, incidental recreation, and run of the river power generation. During flood control operations up to 1,800 cfs (i.e., channel capacity) is released downstream. However, releases are managed so that downstream flows do not exceed 3,000 cfs at Chamita and 10,000 cfs at the Otowi gage. Under normal operations, native water is bypassed at a rate below the downstream channel capacity. San Juan-Chama water, for Albuquerque and other contractors, is stored up to a reservoir elevation of 6,220 ft and released upon request. Voluntary water release exchanges occur between the MRGCD (at El Vado Reservoir) and Albuquerque (at Abiquiu Reservoir) to support irrigation, municipal, and industrial uses. Under normal operations efforts are made to maintain flows of 70 cfs from November through March for the trout fishery downstream of Abiquiu Reservoir. Carry-over floodwater in Abiquiu Reservoir or Cochiti Lake is held after July 1. Water is released between November 1 and March 31 when natural flow at the Otowi gage falls below 1,500 cfs.

Cochiti Dam and Lake

Cochiti Dam was authorized for construction by the Flood Control Act of 1960 (PL 86-645). The dam is owned and operated by the Corps for flood and sediment control, recreation, conservation, and development of fish and wildlife resources. During flood control operations, inflows are released as quickly possible without causing downstream flooding. During normal (non-flood control) operations, the dam passes native inflow. Carry-over floodwater in Cochiti Lake can be held after July 1, but cannot encroach upon the 212,000 acre-foot summer flood space.

Jemez Canyon Reservoir

Jemez Canyon Dam was authorized for construction by the Flood Control Act of 1948 (PL 80-858) and is owned and operated by the Corps for flood and sediment control. During flood control operations, water is released quickly without causing downstream flooding. Under current operations, the reservoir is dry and the project is operated as a run of the river facility.

Low Flow Conveyance Channel (LFCC)

The LFCC was constructed by Reclamation in the 1950s. The purpose of the LFCC is to convey Rio Grande flows downstream, improve drainage, supplement irrigation water supply, and assist New Mexico in making its downstream Rio Grande Compact deliveries. Up to 2,000 cfs can be diverted into the LFCC at San Acacia when outfall conditions allow (i.e., when the LFCC is physically capable of passing 2,000 cfs downstream into Elephant Butte Reservoir). However, diversions into the LFCC at San Acacia have not occurred since 1985 because of channel and outfall disrepair. Drainage flows in the LFCC supply the majority of the water needs at the Bosque del Apache National Wildlife Refuge, and supply the MRGCD with irrigation water. Between 2000 and 2003, drainage flows downstream of San Acacia were pumped to the river during low flows to support Rio Grande silvery minnow (*Hybognathus amarus*) (silvery minnow).

Elephant Butte Dam and Reservoir

Construction of Elephant Butte Dam was authorized in 1905 under provisions of the Newlands Act of 1902. The dam is owned and operated by Reclamation for irrigation water supply, municipal and industrial use, flood control, and recreation. It is secondarily operated for hydroelectric power generation and incidental sediment control. Elephant Butte Reservoir retains all inflows in excess of downstream irrigation demand. Releases from the dam during the irrigation season are to satisfy irrigation demand downstream of Caballo Dam and to maintain Caballo Reservoir pool levels. A 50,000 acre-foot flood control space is maintained in the reservoir from April 1 to September 30, and a 25,000 acre-foot space is maintained from October 1 to March 31. Flood control releases are required when the reservoir level is within the 50,000 acre-foot flood control space. Flood control releases are coordinated between Caballo Reservoir, upstream Corps projects, and the United States Section, International Boundary and Water Commission (IBWC). During flood control operations, maximum releases up to 5,000 cfs (downstream channel capacity) can occur. Flood control is the only authority under review in the URGWOPs EIS for Elephant Butte Dam and Reservoir.

Caballo Dam and Reservoir

Construction of Caballo Dam was authorized under the Rio Grande Rectification Treaty of 1933. Caballo Dam is owned and operated by Reclamation, however, flood control operations are directed by IBWC. The reservoir stores irrigation, municipal and industrial water, and provides flood control and incidental sediment control. During normal operations, the IBWC requires the 100,000 acre-foot flood pool to be evacuated as quickly as possible from June 1 to October 31. The reservoir retains all inflows in excess of downstream irrigation demands and the 5,000 cfs downstream channel capacity. Because of existing flood capacity, downstream target flows are 2,500 to 3,500 cfs. Reclamation and IBWC coordinate the operation of the flood control pool to ensure that flows at the American Diversion Dam downstream are maintained below 11,000 cfs. The reservoir is currently operated to maintain a storage level below 50,000 ac-ft from October 1 to January 31 to leave enough space for winter accretions. From February 1 to September 30, the reservoir is maintained within a 50,000 to 80,000 acre-foot storage level. Flood control is the only authority under review in the URGWOPs EIS for Caballo Dam and Reservoir.

PROJECT DESCRIPTION

Six action alternatives and a no action alternative are analyzed in the EIS (Table 1). The action alternatives consist of management scenarios that include: 1) adjusting waiver dates for the carry-over of stored, unused, non-permitted contract water in Heron Reservoir; 2) conserving storage of native Rio Grande water at Abiquiu Reservoir instead of releasing it downstream; and 3) Low Flow Conveyance Channel (LFCC) water diversions. The action alternatives also include modifications to the river channel capacity[1] (i.e., maximum releases during normal operations) below Abiquiu Reservoir and Cochiti Lake.

[1] The channel capacity is the normal (non-emergency) operations maximum flow in the river channel. This flow is usually set by analysis and policy and may not represent the transport capacity of the existing river channel.

Alternative	Operations
I-3	• Heron Waivers: No change-April 30 • Abiquiu conservation storage: up to 180,000 ac-ft • Abiquiu channel capacity: No change-1,800 cfs • Cochiti channel capacity: No change-7,000 cfs • LFCC water diversion: 0 to 2,000 cfs
I-2	• Heron Waivers: No change-April 30 • Abiquiu conservation storage: up to 75,000 ac-ft • Abiquiu channel capacity: No change-1,800 cfs • Cochiti channel capacity: No change-7,000 cfs • LFCC water diversion: 0 to 1,000 cfs
I-1	• Heron Waivers: No change-April 30 • Abiquiu conservation storage: up to 20,000 ac-ft • Abiquiu channel capacity: No change-1,800 cfs • Cochiti channel capacity: No change-7,000 cfs • LFCC water diversion: 0 to 500 cfs
E-3	• Heron Waivers: September 30 • Abiquiu conservation storage: up to 180,000 ac-ft • Abiquiu channel capacity: No change-1,800 cfs • Cochiti channel capacity: 10,000 cfs • LFCC water diversion: 0 to 2,000 cfs
D-3	• Heron Waivers: August 31 • Abiquiu conservation storage: up to 180,000 ac-ft • Abiquiu channel capacity: 2,000 cfs • Cochiti channel capacity: No change-7,000 cfs • LFCC water diversion: 0 to 2,000 cfs
B-3	• Heron Waivers: September 30 • Abiquiu conservation storage: up to 180,000 ac-ft • Abiquiu channel capacity: 1,500 cfs • Cochiti channel capacity: 8,500 cfs • LFCC water diversion: 0 to 2,000 cfs
No Action	• No operational changes • Heron Waivers: No change-April 30 • LFCC water diversion: 0 to 2,000 cfs

Table 1. URGWOPs EIS Alternatives

Alternative I-3

Under Alternative I-3, the existing April 30 waiver date at Heron Reservoir and the existing channel capacities below Abiquiu Reservoir and Cochiti Lake would not change. However, Alternative I-3 would include conservation storage up to 180,000 ac-ft of native Rio Grande water at Abiquiu Reservoir. According to the joint lead agencies, the release of this water would be managed to benefit fish and wildlife resources, while assisting NMISC in meeting their downstream Rio Grande Compact delivery obligations. In addition to conservation storage, Alternative I-3 would include water diversions between 0 and 2,000 cfs into the LFCC.

Alternative I-2

Under Alternative I-2, the existing April 30 waiver date at Heron Reservoir and the existing channel capacities below Abiquiu Reservoir and Cochiti Lake would not change. However, Alternative I-2 would include conservation storage up to 75,000 ac-ft of native Rio Grande water at Abiquiu Reservoir. Like Alternative I-3, the release of this water would be managed to benefit fish and wildlife resources while assisting NMISC in meeting their downstream Rio Grande Compact delivery obligations. Alternative I-2 would also include diversions into the LFCC between 0 and 1,000 cfs.

Alternative I-1

Under Alternative I-1, the existing April 30 waiver date at Heron Reservoir and the existing channel capacities below Abiquiu Reservoir and Cochiti Lake would not change. However, Alternative I-1 would include conservation storage up to 20,000 ac-ft of native Rio Grande water at Abiquiu Reservoir. Like the other action alternatives, the release of this water would be managed to benefit fish and wildlife resources while assisting NMISC in meeting their downstream Rio Grande Compact delivery obligations. Alternative I-1 would include diversions into the LFCC between 0 and 500 cfs.

Alternative E-3

Under Alternative E-3, the existing waiver date for carry-over water storage at Heron Reservoir would be changed from April 30 to September 30. Conservation storage up to 180,000 ac-ft of native Rio Grande water would be held at Abiquiu Reservoir and later released to benefit fish and wildlife resources while assisting NMISC in meeting their downstream Rio Grande Compact delivery obligations. The channel capacity below Abiquiu Reservoir would remain unchanged, however, the channel capacity below Cochiti Reservoir would increase from 7,000 to 10,000 cfs. Alternative E would also include diversions into the LFCC between 0 and 2,000 cfs.

Alternative D-3

Under Alternative D-3 the waiver date for carry-over water storage at Heron Reservoir would be changed from April 30 to August 31. Conservation storage up to 180,000 ac-ft of native Rio Grande water would be held at Abiquiu Reservoir and later released to benefit fish and wildlife resources while assisting NMISC in meeting their downstream Rio Grande Compact delivery obligations. The channel capacity below Abiquiu Reservoir would be increased from 1,800 to 2,000 cfs while the channel capacity below Cochiti Lake would remain unchanged. Alternative D-3 would also include diversions into the LFCC between 0 and 2,000 cfs.

Alternative B-3

Under Alternative B-3, the waiver date for carry-over water storage at Heron Reservoir would be changed from April 30 to September 30. Conservation storage of up to 180,000 ac-ft of native Rio Grande water would be held at Abiquiu Reservoir and later released to benefit fish and wildlife resources while assisting NMISC in meeting their downstream Rio Grande Compact delivery obligations. The channel capacity of the Rio Chama below Abiquiu Reservoir would be reduced from 1,800 cfs to 1,500 cfs. Below Cochiti Lake the channel capacity would be increased from 7,000 cfs to 8,500 cfs. Alternative B-3 would also include diversions into the LFCC of between 0 and 2,000 cfs.

No Action

The No Action Alternative would include no operational changes upstream of the LFCC, however, it would include diversions between 0 and 2,000 cfs into the LFCC at the San Acacia Diversion Dam.

EVALUATION METHODOLOGY

Since project planning began in 1998, the Service has been actively involved in the URGWOPs planning process, participating on numerous interdisciplinary teams and providing extensive verbal and written planning input to the joint lead agencies. In addition to this CAR, the Service has provided the lead agencies three Fish and Wildlife Coordination Act Planning Aid Letters (PALs). The first PAL was provided to the lead agencies on September 27, 2001, and contained a bibliography of pertinent literature related to fish and wildlife resources in the project area. The second PAL provided to the lead agencies on July 10, 2002, contained information on fish and wildlife resources in the project area, recommendations to minimize or avoid project impacts to fish and wildlife resources, and recommendations to enhance these resources. The third and final PAL, provided to the lead agencies on March 28, 2005, contained updated information on federally listed species, additional recommendations to minimize or avoid project impacts to fish and wildlife resources, and additional recommendations to enhance fish and wildlife resources in the project area.

The majority of the technical information used by the Service to evaluate project impacts to fish and wildlife resources was provided by the lead agencies. Much of this information was in the form of modeling output from the Upper Rio Grande Water Operations Model (URGWOM), Flow-2D, and Aquatic Habitat Models. Given the uncertainty of future climactic and hydrologic conditions, modeling information is the best available estimator of future change with or without the project. The modeling output provided by the lead agencies was useful not only in comparing the future with and without the project, but in predicting how baseline conditions would change over time. In addition to the technical information provided by the lead agencies, the Service also reviewed relevant project area literature.

FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Historic evidence of large fish species indicates that the Rio Grande was a clearer, larger, and more stable river than has been observed over the past century (Scurlock 1998). Prior to the development of Colorado's San Luis Valley in the 1870s, there were only two records of intermittent flows in the Middle Rio Grande, during prolonged and severe droughts in 1752 and 1861 (Service 2001). Over the past century, however, the Rio Grande has been consistently dewatered in the Angostura, Isleta, and San Acacia reaches, as irrigation diversions and drains have significantly reduced the overall volume of water in the river. Reaches particularly susceptible to drying in recent years include: 1) the area immediately downstream of Isleta Diversion Dam; 2) an 8-km (5-mi) reach near Tome; 3) an 8-km (5-mi) reach near the U.S. Highway 60 bridge; and 4) an extended 58-km (36-mi) reach from Brown Arroyo, downstream of Socorro, to Elephant Butte Reservoir (Service 2001).

A primary purpose of the various flood and sediment control facilities authorized under the 1948 Flood Control Act was to reverse the continuing aggradation of the river. This has largely been achieved by trapping sediment in the reservoirs, and using sediment-free reservoir releases as scouring flows to degrade (lower) the riverbed. These actions have incised the channel, increased channel capacity, reduced flood risk, and restored function to many MRGCD drains whose outfalls were formerly below the aggraded riverbed. At the same time, levees and channel modifications have constrained the river to an artificially small floodplain, reduced meandering, and produced a narrower, swifter river.

An important cumulative effect of water management activities in the project area has been to reduce the magnitude of peak spring run-off and summer thunderstorm flow events. While seasonal extremes in the river's annual flow remain present to some degree, the historic flow regime that provided a high spring peak flow leading to overbank flooding has largely been eliminated as a regular hydrological pattern (Crawford et al.1993). The current flow regime as dictated by irrigation, municipal uses, flood control, and water delivery obligations has substantially reduced the volume of peak flows and also altered their timing.

Impacts associated with the altered flow regime have been exacerbated by the use of artificial structures such as Kelner jetty jacks to control lateral migration of the river channel and artificially constrict the floodplain. A dampening of peak discharges, and subsequent decrease in sediment movement, have resulted in channel narrowing. Levee construction and channel straightening have allowed increased human development and use of the floodplain, while greatly restricting the width available to the active river channel. Between Cochiti and Elephant Butte Reservoirs, river channel surface area was reduced by roughly 50 percent between 1935 and 1989 (Crawford et al. 1993). Floodway capacity for sustained spring flows ranges from around 20,000 cfs in the Albuquerque area to around 7,500 cfs in adjacent river reaches. The channel capacity of the Rio Grande within the floodway is currently maintained by Reclamation at around 7,000 cfs (Crawford et al. 1993).

The active river channel continues to be modified, especially by the invasion of non-native plant species. Salt cedar and Russian olive have been replacing native vegetation in the Middle Rio Grande for decades. These exotic species are highly erosion-resistant, and river flows often scour the streambed rather than remove these plants. Erosion-resistant vegetation thus produces a narrower, deeper, and swifter river channel that may not provide suitable habitats for native aquatic biota. As a result of these changes, aquatic habitat characterized by sandy substrate, shallow water, and consistent low-velocity flows has diminished.

Aquatic Resources

Aquatic habitat in the Rio Grande has been altered by levees, dams, and reservoirs that store sediment and control water releases for agricultural use, flood control, recreation, and protection of development within the floodplain. Kellner jetty jack fields have straightened and channelized the river for more effective water transport. Reservoir operations have reduced peak flows and provided lower flows for a longer duration (Crawford et al. 1993). Downstream of Cochiti Dam, the altered sediment and flow regimes have resulted in the transformation from a wide, braided, sand bed system to a narrower and deeper channel with no active floodplain (Reclamation 1999). Therefore, wetlands and slack water areas are scarce (Crawford et al. 1993). The cold, clear-water releases from Cochiti Dam and the entrenched channel, armored with a gravel bed, have created an aquatic system that favors cool-water fishes and invertebrates, and limits warm water fisheries below the dam downstream to Albuquerque. Consequently, the existing aquatic resources in the project area differ from those that occurred historically due to human activities (Crawford et al. 1993).

The loss of native fish species in the project area illustrates that the hydrologic and morphological changes in the channel have had a major impact on fishery resources. The historic or pre-development ichthyofauna of the Middle Rio Grande in New Mexico is thought to have included at least 16 species (Hatch 1985, Smith and Miller 1986, and Propst et al. 1987), four of which were endemic to the region. The Phantom shiner (*Notropis orca*) and Rio Grande bluntnose shiner (*Notropis simus*) are extinct. The Rio Grande shiner (*Notropis jemezanus*) and Rio Grande speckled chub (*Extrarius aestivalis*) are extirpated from the New Mexico portion of the Rio Grande. The silvery minnow is the only native pelagic, broadcast spawning minnow surviving in the Middle Rio Grande (Bestgen and Platania 1991). A considerable number of non-native fishes have been introduced into the Rio Grande, either accidentally or as gamefish. Today, the project area contains at least 27 fish species, of which 12 are native and 15 are non-native.

Fish surveys have been conducted monthly in the project area by the Service's New Mexico Fishery Resources Office since October 1999. These surveys target the silvery minnow, but provide information on other species as well. Silvery minnows are caught consistently, but in very low numbers. Other species in the project area include brown trout, western mosquitofish, white sucker, flathead chub, fathead minnow, red shiner, gizzard shad, longnose dace, Rio Grande chub, channel catfish, small-mouth bass, white bass, common carp, and river carpsucker.

A listing of common and scientific names of fish that may occur in the Rio Grande within the project area is provided in Appendix A.

Terrestrial Resources

Vegetation

The Middle Rio Grande corridor extends through a matrix of Plains–Mesa Sand Scrub and Desert Grassland vegetation in the north, and Chihuahuan Desert Scrub in the south (Dick-Peddie 1993). Within the river floodplain, however, vegetation differs markedly from adjacent upland areas. The majority of riparian communities along the middle valley are dominated by Rio Grande cottonwood, which forms a sparse to dense canopy in the river floodplain. In areas of relatively intact native vegetation, cottonwoods sometimes share dominance with one of several native willows, particularly Gooding willow and peachleaf willow. These species may also be a major component of the understory. Other common native species in understory layers include coyote willow, New Mexico olive, skunkbush, rabbitbrush, and sandbar willow.

For cottonwoods and some willows, seed dispersal, germination, and seedling development typically take place only when the river overflows its banks and spills into the floodplain. High flows scour existing vegetation and deposit bare sediments required for the successful establishment of these species. Overbank flooding also helps facilitate vegetative reproduction of cottonwoods (Dick-Peddie 1993).

The riparian forest, or bosque, has been heavily impacted by human activities. Historically, cottonwoods were extensively harvested as fuel and building material. However, even greater impacts have resulted from twentieth-century flood control activities. Prior to human intervention, conditions necessary for cottonwood reproduction were available in most areas. Since the establishment of the levee system and flood control facilities, these conditions have become rare or non-existent. For example, the majority of cottonwoods in the Middle Rio Grande bosque today are roughly the same age, and were likely established during the last significant overbank flooding in 1941 (Crawford et al. 1993). Lack of flooding not only inhibits reproduction of cottonwoods and other native species; it also disrupts natural processes of decomposition, soil formation, and nutrient cycling. Lower river flows in general have also reduced the growth rate of established riparian vegetation. As a result, many of the Middle Rio Grande's cottonwood gallery forests are retreating, with a population of aging trees not being replaced by new growth. If these declines continue, non-native salt cedar and Russian olive will become the predominant plant species in the Rio Grande bosque (Crawford et al. 1993, Molles et al. 1998, Ellis et al. 1999).

In addition to riparian forests, other types of plant communities occur in limited areas. Sandbar communities consisting of grasses, forbs, and seedlings of cottonwood and willow exist in some locations, but are often scoured by high flows. Wetland habitats are limited in extent but present in some areas, particularly between the San Marcial railroad bridge and the delta of Elephant Butte Reservoir. Wetlands may include cattail marshes with cattail and bulrush, and wet meadows dominated by saltgrass, sedges, and young willows.

The failure of the cottonwood bosque to re-establish itself has coincided with an invasion of non-native species over the past 80 years. In many portions of the project area, cottonwood associations are being replaced by stands dominated by one or both of two fast-growing exotics: salt cedar and Russian olive. These invaders colonize the same kinds of open areas necessary for cottonwood and willow recruitment. Where not dominant, these species often form a major component of the shrubby understory. Particularly where there is no shady canopy to block sunlight, salt cedar form large, uniform stands in the floodplain. Salt cedar is most prevalent in the southern end of the Middle Rio Grande Valley, particularly in the San Acacia Reach, but extensive stands may be found throughout other portions of the project area.

Areas with dense growths of salt cedar can have major impacts on river and floodplain hydrology. Salt cedar thickets consume large amounts of water, and may locally deplete the water table. Because salt cedar is highly erosion resistant, thick stands growing alongside the river may armor river banks and contribute to river channelization. Salt cedar eradication projects have been undertaken at Bosque del Apache National Wildlife Refuge, Rio Grande Valley State Park in Albuquerque, and other locations.

Russian olive is the major exotic species in many locations in the northern part of the valley and along the Rio Chama. This species sometimes occurs in uniform stands, with few other species present, and often forms a dense understory in association with cottonwood. Other introduced species such as Siberian elm, tree-of-heaven, china-berry tree, mulberry, and black locust are found in the bosque, particularly along levee roads and in other disturbed areas. In the Corrales Bosque north of Albuquerque, Siberian elm may be poised to become the main overstory tree species as cottonwoods die off over the coming decades (Crawford et al. 1999). Suitability of non-native vegetation as habitat for native wildlife has been the subject of debate.

A listing of common and scientific names of plants that may occur in the Rio Grande floodplain within the project area is provided in Appendix B.

Mammals

Existing mammal populations are also a result of the water operations and land uses in the project area. Hink and Ohmart (1984) performed systematic floral and faunal surveys throughout the Middle Rio Grande. Residential development, agricultural conversion and subsequent irrigation systems, and construction of bridges/roads resulted in the permanent loss of habitats. Development has also caused a disruption of animal movement and dispersal patterns, and has caused continual disturbance to animal communities in the adjacent, fragmented portions of the bosque (Crawford et al. 1993). One of the largest mammals likely to occur in the project area is the coyote. Other mammals such as raccoon, beaver, muskrat, long-tailed weasel, and striped skunk may occur in the general project area. Desert cottontail rabbit, black-tailed jackrabbit, rock squirrel, pocket gopher, deer mouse, western harvest mouse, and American porcupine are also likely to occur. The most common small mammals in the Middle Rio Grande bosque are the white-footed mouse and house mouse (Stuart and Bogan 1996). Eleven species of bats are found along the Rio Grande (Findley *et al.* 1975). Two bat species are restricted to riparian areas, the Yuma myotis and little brown bat.

A listing of common and scientific names of mammals that may occur in the Rio Grande floodplain within the project area is provided in Appendix C.

<u>Birds</u>
Hink and Ohmart (1984), found that riparian areas are used heavily by most bird species in New Mexico. Cottonwood-dominated community types are highly used and are preferred habitat for many species, especially during the nesting season. Marshes, drains, and areas of open water contribute to the bird diversity of the riparian ecosystem as a whole because of the strong attraction by water-loving birds. At various times of the year, such as during migration, riparian areas support the highest bird densities and species richness in the project area. Since wetlands are scarce, reservoirs and the river in and near the project area provide habitat on a seasonal basis for a variety of waterfowl including Canada geese, mallard, gadwall, green-winged teal, American widgeon, northern pintail, northern shoveler, ruddy duck, and common merganser.

Shorebirds such as the spotted sandpiper and killdeer are likely to occur in the project area. Raptors that may occur in the project area include the bald eagle, turkey vulture, northern harrier, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, American kestrel, common barn owl, and great-horned owl. Birds from a variety of habitats that may be in the project area at any given time include the common nighthawk, belted kingfisher, great blue heron, northern flicker, downy woodpecker, hairy woodpecker, violet-green swallow, northern rough-winged swallow, cliff swallow, barn swallow, black-billed magpie, common raven, plain titmouse, white-breasted nuthatch, canyon wren, western bluebird, mountain bluebird, American robin, northern mockingbird, American pipit, American dipper, European starling, yellow warbler, spotted towhee, white-crowned sparrow, red-winged blackbird, Brewer's blackbird, northern oriole and evening grosbeak (Udvardy 1977). Game species include the mourning dove, Merriam's turkey, and scaled quail.

A listing of common and scientific names of birds that may occur in the Rio Grande floodplain within the project area is provided in Appendix D.

<u>Reptiles and Amphibians</u>
Hink and Ohmart (1984) documented 3 turtle species, 17 species of lizards, and 18 snake species in the Middle Rio Grande Valley. According to Degenhardt *et al.* (1996), up to 57 species of reptiles may occur in the Middle Rio Grande Region of New Mexico. Reptiles typically found within the project area include the western collared lizard, southern prairie lizard, Great Plains skink, regal ringneck snake, desert striped whipsnake, smooth green snake, and western garter snake. The most common reptiles observed during studies in 1982 and 1983 were the plateau striped whiptail lizard and New Mexico whiptail. Thirteen amphibian species may be found in

the Middle Rio Grande Valley (Degendardt *et al.* 1996). Amphibians associated with the riparian areas such as wet meadows and marshes include chorus frogs, leopard frogs, and bullfrogs (Crawford et al. 1993). Amphibians common to all the habitat types (wetland, riparian, and upland) include the tiger salamander, Woodhouse's toad, red-spotted toad, and northern leopard frog. The most often captured or perhaps the most abundant amphibians along the Rio Grande were the bullfrog and Woodhouse's toad (Hink and Ohmart 1984). Other species documented along the Rio Grande include Couch's spadefoot toad, New Mexico spadefoot, red-spotted toad, and northern leopard frog (Hink and Ohmart 1984). Applegarth (1983) suggests the northern leopard frog and painted turtle were more abundant when wetlands were more numerous.

A listing of common and scientific names of reptiles and amphibians that may occur in the Rio Grande floodplain within the project area is provided in Appendix E.

Threatened and Endangered Species

Federally endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (flycatcher), silvery minnow, and designated critical habitat for the silvery minnow occur in the project area. Other federally listed and candidate species occurring in the project area include the threatened bald eagle (*Haliaeetus leucocephalus*) and the candidate yellow-billed cuckoo (*Coccyzus americanus*) (cuckoo).

<u>Southwestern Willow Flycatcher</u>
The Service listed the flycatcher as endangered on February 27, 1995 (60 FR: 10693-10715). The flycatcher is also classified as endangered by the State of New Mexico (New Mexico Department of Game and Fish 1987). The current range of the flycatcher includes southern California, southern portions of Nevada and Utah, Arizona, New Mexico, western Texas, and southwestern Colorado (Unitt 1987, Browning 1993). In New Mexico, the species has been observed in the Rio Grande, Rio Chama, Zuni, San Francisco, San Juan, and Gila River drainages. Available habitat and overall numbers have declined statewide (62 FR: 39129-39147). A final recovery plan for the flycatcher was developed in 2003 (68 FR: 10485), and a final rule designating critical habitat was published on October 19, 2005 (FR 60886-61009).

Loss and modification of nesting habitat is the primary threat to this species (Phillips *et al.* 1964, Unitt 1987). Loss of migratory stopover habitat also threatens the flycatcher's survival. Large scale losses of southwestern wetlands have occurred, particularly the cottonwood-willow riparian habitats that are used by the flycatcher (Phillips *et al.* 1964, Carothers 1977, Rea 1983, Johnson and Haight 1984, Howe and Knopf 1991). The flycatcher is a riparian obligate and nests in riparian thickets associated with streams and other wetlands where dense growths of willow, buttonbush, boxelder, Russian olive, salt cedar or other plants are present. Nests are often associated with an overstory of scattered cottonwood. Throughout the flycatcher's range, these riparian habitats are now rare, widely separated by vast expanses of arid lands, and are reduced in size. Flycatchers begin arriving in New Mexico in late April and May to begin nesting and the young fledge in early summer. Flycatchers nest in thickets of trees and shrubs approximately 2 to 7 m (6.5 to 23 ft) in height or taller, with a densely vegetated understory from ground or water surface level to 4 m (13 ft) or more in height. Surface water or saturated soil is usually present beneath or next to occupied thickets (Phillips *et al.* 1964, Muiznieks *et al.* 1994). At some nest sites, surface water may be present early in the nesting season with only damp soil present by late June or early July (Muiznieks *et al.* 1994, Sferra *et al.* 1995). Habitats not selected for either nesting or singing are narrower riparian zones with greater distances between willow patches and individual willow plants. Suitable habitat adjacent to high gradient streams does not appear to be used for nesting. Areas not selected for nesting or singing may still be used during migration.

<u>Rio Grande Silvery Minnow</u>
The silvery minnow was formerly one of the most widespread and abundant fish species in the Rio Grande Basin occurring from Española, New Mexico, to the Gulf of Mexico (Bestgen and Platania 1991). This species is a moderately sized, stout minnow, approximately 9 centimeters (3.5 inches (in)) in length that spawns in the late spring and early summer, coinciding with high spring flows (Sublette *et al.* 1990). Natural habitat for the silvery minnow includes stream margins, side channels, and off-channel pools where water velocities are low or reduced from main-channel velocities. Stream reaches dominated by straight, narrow, incised channels with rapid flows are not typically occupied by silvery minnows (Sublette *et al.* 1990, Bestgen and Platania 1991).

Currently, the silvery minnow is restricted to the Middle Rio Grande in New Mexico, occurring only from Cochiti Dam downstream to the headwaters of Elephant Butte Reservoir (Platania 1991). The species was federally listed as endangered in July 1994 (59 FR: 36988-37001) and is also listed as endangered by the State of New Mexico. The Service (58 FR: 11821-11828) cited the de-watering of portions of the Rio Grande below Cochiti Dam through water regulation activities, the construction of main-stream dams, the introduction of non-native competitor/predator species, and the degradation of water quality as factors responsible for declines in the silvery minnow population. On February 19, 2003, the Service published a final rule establishing critical habitat for the silvery minnow within the last remaining portion of their historical range in the Middle Rio Grande, from Cochiti Dam to the utility line crossing the Rio Grande, a permanent identified landmark in Socorro County (68 FR: 8088-8135). The width of critical habitat along the Rio Grande is defined as those areas bound by existing levees or, in areas without levees, 91 m (300 ft) of the riparian zone adjacent to the bankfull stage of the river.

The Service determined the primary constituent elements of critical habitat for the silvery minnow based on studies of their habitat and population biology (68 FR 8088). The primary constituent elements of silvery minnow critical habitat include:

1. A hydrologic regime that provides sufficient flowing water with low to moderate currents capable of forming and maintaining diverse aquatic habitats (e.g., backwaters, side channels, pools, eddies, and runs). This hydrologic regime should, to the extent possible, mimic a natural hydrograph. Flows in the early spring to early summer (March through June) should create aquatic habitat complexity and trigger spawning; flows in the summer and fall (June through October) should be sufficient to maintain aquatic habitat and prevent river drying; and flows in the winter (November through February) should be relatively constant.

2. Unimpounded stretches (i.e., river miles) of river that contain a variety of habitat types (i.e., pools, backwaters, etc.) and year-round flow.

3. Silt and sand dominated substrates.

4. Suitable water quality; that is, water flowing through critical habitat should be well oxygenated (year-round) and remain in the temperature range of 1 ^{o}C (35 ^{o}F) to 30 ^{o}C (85 ^{o}F).

The primary constituent elements identified above facilitate the physiological, behavioral, and ecological requirements of the silvery minnow. The first primary constituent element provides sufficient flows to minimize the formation of isolated pools. This element is essential to the conservation of the silvery minnow because the species cannot withstand river drying. Water is a necessary component of all silvery minnow life history stages. The second primary constituent element facilitates silvery minnow reproduction and recruitment. Low-velocity habitats provide food, shelter, and nursery habitat, which are essential for the survival and recruitment of the species (68 FR 8008). The third primary constituent element, silt and sand substrates (Dudley and Platania 1997), characterize habitats that are used by the silvery minnow for foraging and shelter. The final primary constituent element provides suitable water quality necessary for silvery minnow survival.

Bald Eagle

The project area is also within the known and historic range of the bald eagle. The Service reclassified the bald eagle from endangered to threatened on July 12, 1995 (60 FR: 36000-36010). Adult bald eagles are easily recognized by their white heads and dark bodies. Wintering bald eagles frequent all major river systems in New Mexico from November through March, including the Rio Grande. This species prefers to roost and perch in large trees near water, typically cottonwoods in the project area. Prey includes fish, waterfowl, and small mammals.

Major present and foreseeable threats to the bald eagle include habitat degradation and destruction, and environmental contamination (e.g., prey base contamination). The main threats to New Mexico's wintering bald eagle population include impacts to their prey base and the availability of suitable roost sites. Between 1988 and 1996, the Corps conducted annual winter bald eagle surveys along the Rio Grande from Albuquerque, upstream to El Vado Dam. The mean annual number of bald eagle sightings during the surveys is 64, with the largest number sighted occurring in 1993 (88). Survey data show that wintering bald eagles use the habitat in the vicinity of the project for feeding, perching, and roosting (Reclamation 1999).

Yellow-billed cuckoo

The western population of the yellow-billed cuckoo has experienced a severe decline in distribution and abundance throughout the western United States. This is primarily attributed to loss, degradation, and fragmentation of riparian woodland habitats, overgrazing, and river management, including altered flow and sediment regimes, and flood control practices, such as channelization and bank protection (Laymon and Halterman 1989). On July 25, 2001, the

Service published a 12-month finding on a petition to federally list the cuckoo in the western United States under the Act. The Service found that the petitioned action was warranted, but precluded by higher priority listing actions, making the western population a candidate species. In New Mexico, the cuckoo is a candidate species in the western portion of the State, to and including the Rio Grande corridor.

The cuckoo prefers riparian habitat with dense willow, cottonwood, salt cedar and/or mesquite (Hamilton and Hamilton 1965, Gaines 1974, Walters 1983, Howe 1986, Lehman and Walker 2001). Food sources include large insects, caterpillars, katydids, cicadas, grasshoppers, crickets, frogs, lizards, bird eggs and young, fruit and seeds (Hughes 1999). Suitable breeding habitat consists of large stands of dense willow and cottonwood, but exotics like salt cedar are also used. South of Caballo Dam, nesting cuckoos were detected in Seldon Canyon along the Rio Grande (Tafanelli and Meyer 1999). These territories were located in either narrow salt cedar habitat, tall and dense salt cedar habitat, or mixed salt cedar/willow habitat. Therefore, habitat preferences of western cuckoos may be more varied than previously thought (Lehman and Walker 2001).

In New Mexico, the cuckoo was historically rare statewide, but common in riparian areas along the Rio Grande between Albuquerque and Elephant Butte Reservoir, and locally common along other New Mexico rivers. A review on the status of the species in New Mexico concluded that the species would likely experience future declines in the State due to loss of riparian woodlands (Howe 1986). Along the Rio Grande, water and flood control projects have altered flow regimes and river dynamics, inhibiting regeneration of cottonwood-willow riparian habitats. Future degradation and loss of such riparian vegetation would limit the amount of available habitat for the cuckoo (W. Howe, Service, pers., comm., 1999). Cuckoos have also been observed downstream of the San Marcial railroad bridge (Reclamation 2000).

Future Conditions Without the Project

The future conditions without the project include the affected environment with trends through the implementation period. Baseline biological conditions were projected through time to develop expected trends and future conditions.

Under the No Action Alternative, no operational changes are proposed in the Northern, Rio Chama, Central or Southern Sections of the project area. Therefore, fish and wildlife resources in these sections are expected to remain at or near their existing conditions without the project. In the Central Section, fish and wildlife resources may improve over time as a result of ongoing and proposed bosque and aquatic habitat improvement projects. In addition, the management of Jemez Canyon Reservoir as a flow-through facility should benefit fish and wildlife resources in the Central Section by increasing sediment inputs to the Rio Grande and reducing riverbed incision between the confluence of the Rio Grande and Bernalillo.

The No Action Alternative includes operational changes in the San Acacia Section that would impact fish and wildlife. According to the joint lead agencies, the future without the project would include diversions between 0 and 2,000 cfs into the LFCC at the San Acacia Diversion

Dam. These diversions would significantly impact fish and wildlife resources in and adjacent to the river in the San Acacia Section, particularly between the San Acacia Diversion Dam and the San Marcial railroad bridge. Impacts to fish and wildlife resources would include entrainment of fish and other aquatic biota into the LFCC, habitat degradation downstream of the San Acacia Diversion Dam. Diversion related impacts to fish and wildlife resources would be directly proportional to the the magnitude of flow diverted from the river. Diversions into the LFCC would further regulate or reduce the hydrograph in the San Acacia Section, increasing intermittency and diminishing natural hydrologic processes (e.g., overbank flooding, scouring, and deposition) that create and maintain diverse aquatic and riparian habitats. For example, under the No Action Alternative, flows downstream of the San Acacia Diversion Dam would be less than or equal to 250 cfs 87.5 percent of the time over the 40-year modeling period, compared to only 27.1 percent of the time without diversions. Mean flows would also decline. With diversions, mean flows downstream of the San Acacia Diversion Dam would be approximately 392.1 cfs over the 40-year modeling period, compared to 1,004.4 cfs without diversions. As a result of these hydrologic changes, aquatic and riparian habitats in the San Acacia Section would increasingly uniform and degraded. In riparian areas, highly water-consumptive, non-native vegetation such as salt cedar would have a competitive advantage over native vegetation and increasingly dominate the riparian vegetative community. As non-native vegetation proliferates, evapotranspiration rates could increase. This could result in a lowering of the water table and increase the frequency and duration of river drying, particularly in areas where monotypic salt cedar stands develop or expand.

Threatened and Endangered Species

Issues with federally listed species will be addressed in detail during section 7 consultation under the Act.

FISH AND WILDLIFE RESOURCES WITH THE PROJECT

No operational changes are proposed in the Northern or Southern Sections of the project area. Therefore, fish and wildlife resources in these sections are expected to remain at or near their existing conditions with the project. Operational changes are, however, proposed in the Rio Chama, Central, and San Acacia Sections that would impact fish and wildlife resources. The largest impacts to fish and wildlife resources would occur in the San Acacia Section, and occur as a direct result of diversions into the LFCC. Impacts associated with diversions would be similar to those described above for the No Action Alternative. Project-related impacts to fish and wildlife resources described below for the Rio Chama and Central Sections, are based on URGWOPs modeling information and include the full range of impacts anticipated. The same is true for the riparian impacts described for the San Acacia Section. Due to modeling limitations and the wide range of variability in potential diversions under each alternative (i.e., 0 to 2,000 cfs under Alternatives B-3, D-3, E-3, and I-3), the aquatic impacts described for the San Acacia Section include only those that would occur when flows in the river are sufficient to divert the maximum allowable under each alternative (i.e., up to 2,000 cfs). They do not include the impacts of the higher frequency, lower level diversions (e.g., less than 2,000 cfs) that would occur under each alternative. Thus, the impacts to aquatic resources described for the San Acacia Section are only a portion of the total impacts expected with the project.

Alternative I-3

Under Alternative I-3, the mean annual maximum acres of overbank flooding would decline by approximately 27 percent (39 acres) in the Rio Chama Section, 7 percent (19 acres) in the Central Section, and 40 percent (1,104 acres) in the San Acacia Section. In the three sections combined, the mean annual maximum acres of overbank flooding would decline by approximately 37 percent (1,162 acres).

Although the maximum extent of overbank flooding in the Rio Chama Section would be lower, the extent and duration of spring overbank flooding over the 40-year modeling period would be higher, increasing approximately 82 percent (936 acre-days). In the Central and San Acacia Sections, the extent and duration of spring overbank flooding would decline by approximately 10 percent (760 acre-days) and 54 percent (71,071 acre-days), respectively. For the three sections combined, the extent and duration of spring overbank flooding would decline by approximately 50 percent (70,895 acre-days).

Under Alternative I-3, longnose dace habitat in the Rio Chama, Central, and San Acacia Sections combined would decline by approximately 12.3 percent (102,405 square feet (ft^2)) on average, with the largest habitat losses (57.8 percent (87,333 ft^2)) occurring in the San Acacia Section. Channel catfish habitat would decline by approximately 8.1 percent (219,268 ft^2) for the three river sections impacted, with the largest habitat losses (39.9 percent, (198,403 ft^2)) occurring in the San Acacia Section. Flathead chub and river carpsucker habitat would decline by approximately 8.0 percent (91,459 ft^2)), with the largest habitat losses (40.7 percent (96,970 ft^2)) again occurring in the San Acacia Section.

Alternative I-2

Under Alternative I-2, the mean annual maximum acres of overbank flooding in the Rio Chama and San Acacia Sections would decline by approximately 15 percent (22 acres) and 10 percent (285 acres) respectively, and increase in the Central Section by approximately 3 percent (8 acres). In the three sections combined, the mean annual maximum acres of overbank flooding would decline by approximately 9 percent (299 acres).

Although the maximum extent of overbank flooding in the Rio Chama Section would be lower under Alternative I-2, the extent and duration of spring overbank flooding over the 40-year modeling period would be substantially higher, increasing by approximately 115 percent (1,313 acre-days). In the Central and San Acacia Sections, the extent and duration of spring overbank flooding would decline by approximately 3 percent (222 acre-days) and 31 percent (40,292 acre-days), respectively. For the three sections combined, the extent and duration of spring overbank flooding would decline by approximately 28 percent (39,201 acre-days).

Under Alternative I-2, longnose dace habitat in the Rio Chama, Central, and San Acacia Sections combined would decline by approximately 9.7 percent (80,483 ft^2) on average, with the largest habitat losses (45.1 percent (68,143 ft^2)) occurring in the San Acacia Section. Channel catfish habitat would decline by approximately 6.6 percent (179,149 ft^2), with the largest habitat losses (31 percent (154,122 ft^2)) occurring in the San Acacia Section. Flathead chub and river carpsucker habitat would decline by 6.8 percent (77,179 ft^2) with the largest habitat losses (32.3 percent (76,856 ft^2)) again occurring in the San Acacia Section.

Alternative I-1

Under Alternative I-1, the mean annual maximum acres of overbank flooding in the Rio Chama section would remain unchanged. However, in the Central and San Acacia Sections, it would increase by approximately 17 percent (43 acres) and 5 percent (148 acres), respectively. In the three sections combined, the mean annual maximum acres of overbank flooding would decline by approximately 3 percent (105 acres).

Although the maximum extent of overbank flooding in the Rio Chama Section would not change under Alternative I-1, the extent and duration of spring overbank flooding over the 40-year modeling period would be substantially higher, increasing by approximately 164 percent (1,867 acre-days). In the Central Section, the extent and duration of spring overbank flooding would increase by approximately 8 percent (609 acre-days). In the San Acacia Section, the extent and duration of spring overbank flooding would decline by approximately 15 percent (20,164 acre-days). For the three sections combined, the extent and duration of spring overbank flooding would decline by approximately 13 percent (17,688 acre-days).

Under Alternative I-1, longnose dace habitat in the Rio Chama, Central, and San Acacia Sections combined would decline by approximately 5 percent (41,737 ft^2) on average, with the largest habitat losses (27 percent (40,802 ft^2)) occurring in the San Acacia Section. Channel catfish habitat would decline by approximately 3.7 percent (100,632 ft^2), with the largest habitat losses (18.7 percent (92,966 ft^2)) occurring in the San Acacia Section. Flathead chub and river carpsucker habitat would decline by 3.9 percent (44,898 ft^2), with the largest habitat losses (19.7 percent (44,898 ft^2)) again occurring in the San Acacia Section.

Alternative E-3

Under Alternative E-3, the mean annual maximum acres of overbank flooding would decline by approximately 27 percent (39 acres) and 53 percent (1,464 acres) in the Rio Chama and San Acacia Sections, respectively, and increase by approximately 91 percent (236 acres) in the Central Section. Channel capacity in the Central Section would also increase from 7,000 to 10,000 cfs. In the three sections combined, the mean annual maximum acres of overbank flooding would decline by approximately 40 percent (1,267 acres).

Although the maximum extent of overbank flooding in the Rio Chama Section would decline under Alternative E-3, the extent and duration of spring overbank flooding over the 40-year modeling period would be substantially higher, increasing by 76 percent (869 acre-days). In the Central Section, the extent and duration of spring overbank flooding would increase by approximately 14 percent (1,087 acre-days). In the San Acacia Section, the extent and duration of spring overbank flooding would decline by approximately 65 percent (85,206 acre-days). For the three sections combined, the extent and duration of spring overbank flooding would decline by approximately 59 percent (83,250 acre-days).

Under Alternative E-3, longnose dace habitat in the Rio Chama, Central, and San Acacia Sections combined would decline by approximately 12.2 percent (101,506 ft^2) on average, with the largest habitat losses (57.8 percent (87,226 ft^2)) occurring in the San Acacia Section. Channel catfish habitat would decline by a total of approximately 8 percent (215,816 ft^2), with the largest habitat losses (39.7 percent (197,695 ft^2)) occurring in the San Acacia Section. Flathead chub and river carpsucker habitat would decline by 7.9 percent (90,087 ft^2), with the largest habitat losses 40.6 percent (96,667 ft^2)) again occurring in the San Acacia Section.

Alternative D-3

Under Alternative D-3, the mean annual maximum acres of overbank flooding in the Rio Chama and San Acacia Sections would decline by approximately 9 percent (13 acres) and 55 percent (1,516 acres), respectively, and increase in the Central Section by approximately 8 percent (20 acres). In the three sections combined, the mean annual maximum acres of overbank flooding would decline by approximately 48 percent (1,509 acres).

Although the maximum extent of overbank flooding in the Rio Chama Section would decline under Alternative D-3, the extent and duration of spring overbank flooding over the 40-year modeling period would be substantially higher, increasing by 132 percent (1,506 acre-days). This increase is due, in part, to the proposed increase in channel capacity from 1,800 to 2,000 cfs downstream of Abiquiu Reservoir. In the Central and San Acacia Sections, the extent and duration of overbank flooding would decrease by approximately 1 percent (40 acre-days) and 63 percent (83,309 acre-days), respectively. For the three sections combined, the mean duration of overbank flooding would decline by approximately 58 percent (81,843 acre-days).

Under Alternative D-3, longnose dace habitat in the Rio Chama, Central, and San Acacia Sections combined would decline by approximately 12 percent (100,206 ft^2) on average, with the largest habitat losses (57.8 percent (87,235 ft^2)) occurring in the San Acacia Section. Channel catfish habitat would decline by approximately 8 percent (215,060 ft^2), with the largest habitat losses (39.8 percent (198,089 ft^2)) occurring in the San Acacia Section. Flathead chub and river carpsucker habitat would decline 7.9 percent (90,148 ft^2), with the largest habitat losses (40.7 percent (96,929 ft^2)) again occurring in the San Acacia Section.

Alternative B-3

Under Alternative B-3, the mean annual maximum acres of overbank flooding would decline by approximately 53 percent (78 acres) in the Rio Chama Section and 53 percent (1,455 acres) in the San Acacia Section, and increase by approximately 78 percent (203 acres) in the Central Section. The decline in the mean annual maximum acres of overbank flooding in the Rio Chama Section is partly attributed to the proposed decrease in channel capacity downstream of Abiquiu Reservoir from 1,800 to 1,500 cfs. Likewise, the increase in the mean annual maximum acres of overbank flooding in the Central Section is due, in part, to the proposed increase in channel capacity from 7,000 to 8,500 cfs downstream of Cochiti Lake. In the three sections combined, the mean annual maximum acres of overbank flooding would decline by approximately 42 percent (1,330 acres).

In the Rio Chama and San Acacia Sections, the extent and duration of spring overbank flooding over the 40-year modeling period would decrease by 6 percent (67 acre-days) and 64 percent (85,009 ac-ft), respectively. In the Central Section, the extent and duration of overbank flooding would increase by approximately 10 percent (783 ac-ft). For the three sections combined, the mean duration of overbank flooding would decline by approximately 60 percent (84,293 acre-days).

Under Alternative B-3, longnose dace habitat in the Rio Chama, Central, and San Acacia Sections combined would decline by approximately 12.7 percent (105,999 ft^2) on average, with the largest habitat losses (58.5 percent 88,240 ft^2)) occurring in the San Acacia Section. Channel catfish habitat would decline by approximately 8.2 percent (220,763 ft^2), with the largest habitat losses (40.2 percent (199,925 ft^2)) occurring in the San Acacia Section. Flathead chub and river carpsucker habitat would decline by 8.0 percent (91,348 ft^2), with the largest habitat losses (41.1 percent (97,736 ft^2)) again occurring in the San Acacia Section.

Threatened and Endangered Species

Issues with federally listed species will be addressed in detail during section 7 consultation under the Act.

DISCUSSION

The Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-667e) directs the Federal action agency to consult with the Service for purposes of "preventing a net loss of and damage to wildlife resources." It further directs the action agency to give wildlife conservation measures equal consideration to features of water resource development. Consideration is to be given to all wildlife, not simply those that are legally protected under the Endangered Species Act or those with high economic and recreational value. Further, the recommendations of the Service are to be given full consideration by the action agency. All aspects of the proposed project should be managed to avoid and minimize impacts to wildlife resources.

Water development projects that result in adverse impacts to fish and wildlife require the development of mitigation plans. These plans consider the value of fish and wildlife habitat affected. The Service has established a mitigation policy used as guidance in recommending mitigation (Service 1981). The policy states that the degree of mitigation should correspond to the value and scarcity of the fish and wildlife habitat at risk. Four resource categories in decreasing order of importance are identified:

> Resource Category No. 1 Habitats of high value for the species being evaluated that are unique and irreplaceable on a national basis or in the ecoregion section. No loss of existing habitat value should occur.

Resource Category No. 2 Habitats of high value that are relatively scarce or becoming scarce on a national basis or in the ecoregion section. No net loss of in-kind habitat value should occur.

Resource Category No. 3 Habitats of high to medium value that are relatively abundant on a national basis. No net loss of habitat value should occur and loss of in-kind habitat should be minimized.

Resource Category No. 4 Habitats of medium to low value. Loss of habitat value should be minimized.

The habitats in the immediate project area are classified as follows: Resource Category No. 2 - riparian vegetation (includes trees and shrubs such as willows) and aquatic habitat.

Riparian habitats are classified in category 2 because they are scarce and are rapidly disappearing. About 90 percent of the historic wetland and riparian habitat in the Southwest has been eliminated (Johnson and Jones 1977). The mitigation goal for riparian areas (trees and shrubs) in the project area is no net loss in wildlife value as a result of the proposed project. To ensure that mitigation is successful for impacts to riparian habitats, we recommend that a long-term monitoring and mitigation plan be developed.

Aquatic habitats are classified in category 2 because they are relatively scarce in the Southwest and provide high wildlife value for several native fish species (e.g., longnose dace, flathead chub, river carpsucker, etc.). The mitigation goal for aquatic habitat (e.g., backwaters, riffles, and runs) in the project area is to have no net loss of habitat value as a result of the proposed project. To ensure that mitigation is successful for impacts to aquatic habitats, we recommend that a long-term monitoring and mitigation plan be developed.

The Service has ranked the Project alternatives based on the overall amount of habitat potentially impacted and thus, the resulting impacts to aquatic and terrestrial resources throughout the project area, from least to most:

- Alternative I-1
- Alternative I-2
- Alternative I-3
- Alternative D-3
- Alternative E-3
- Alternative B-3
- No Action

The proposed project would include actions that could have both positive and negative impacts on fish and wildlife resources in the project area. Actions that could potentially benefit fish and wildlife resources include conservation storage of native Rio Grande flood carry-over water at Abiquiu Reservoir, and increasing the capacity of the river channel downstream of Abiquiu

Reservoir and Cochiti Lake. Conservation storage could be used to augment peak flows during low flow years, minimize intermittency, trigger spawning, and meet other life history requirements of fish and wildlife downstream. Increasing the channel capacity downstream of Abiquiu Reservoir and Cochiti Lake could facilitate higher magnitude releases and promote overbank flooding, scouring, deposition, and other natural hydrologic processes that create and maintain diverse aquatic and riparian habitats.

Although conservation storage could benefit fish and wildlife resources, it could also negatively impact these resources as well. Increased storage at Abiquiu Reservoir could further regulate the hydrograph and diminish naturally occurring high flow events that create and maintain fish and wildlife habitats. It could also reduce flows necessary for spawning, rearing, and other fish and wildlife life history requirements. Furthermore, the release of conservation storage in November and December as modeled in URGWOPs, would provide little if any benefit to fish and wildlife resources. The Service strongly recommends that the joint lead agencies seek to obtain the authority and flexibility to manage conservation storage in a manner that maximizes benefits to fish and wildlife resources while also assisting the NMISC in meeting their downstream delivery obligations. This authority should include the ability to carry-over conservation storage from year-to-year and release it in a manner and at times (i.e., spring and summer) most beneficial to fish and wildlife resources.

Of the operational changes proposed, diversions into the LFCC would cause the most impacts to fish and wildlife resources. Because of the wide range of potential diversions (e.g., 0 to 2,000 cfs), implementation of each alternative as proposed could have major impacts to fish and wildlife resources in the San Acacia Section that would be difficult to mitigate, if not impossible. This is because under all of the alternatives as proposed, diversions could occur whenever flows at the San Acacia Diversion Dam exceed 250 cfs. For example, under Alternative B-3, up to 89 percent of the river flow could be diverted into the LFCC when flows at San Acacia are 2,250 cfs. Although these diversions may benefit wetlands west of the LFCC, they could reduce available instream habitat by 89 percent or more, significantly impacting fish and wildlife resources. Even under Alternative I-1 where diversions are capped at 500 cfs, up to 67 percent of the river flow could be diverted into the LFCC. If rates of entrainment correspond to the proportion of river flow diverted, then up to 89 percent and 67 percent of the eggs and larve in the drift at San Acacia could be entrained into the LFCC under Alternatives B-3 and I-1, respectively.

Diversion related impacts to fish and wildlife could be reduced to a mitigable level by limiting the magnitude of flow diverted from the river and diverting only what is necessary to improve downstream deliveries. The joint lead agencies should continue to study the surface and groundwater hydrology of the river and LFCC in the San Acacia Section to determine the level of diversions required to improve downstream deliveries. Only those levels shown to improve deliveries should be considered for diversion, and only when they comprise a small proportion of the flow in the river. However, to the extent possible, diversions should be avoided to ensure the protection of fish and wildlife resources in the San Acacia Section.

To further reduce diversion related impacts to fish and wildlife resources, the joint lead agencies should redesign the diversion structure at San Acacia to minimize or avoid entraining fish, eggs, and larvae into the LFCC. To avoid entrainment related impacts, the joint lead agencies should investigate the feasibility of infiltration galleries rather than a surface diversion. If infiltration galleries are found to be infeasible, then the diversion structure should be screened and include design features to reduce approach velocities. Reducing the approach velocities would help to minimize entrainment and impingement of fish, larvae, and other aquatic biota on the intake screens.

To further minimize diversion related impacts to fish and wildlife resources, the joint lead agencies should consider increasing the channel capacity below Abiquiu Reservoir and Cochiti Lake, and avoid decreasing channel capacity and further limiting management flexibility. Channel capacity increases could facilitate higher magnitude releases from Abiquiu Reservoir and Cochiti Lake that could benefit fish and wildlife resources in the Rio Chama and Central Sections while minimizing diversion related impacts in the San Acacia Section. Higher magnitude spring releases from Cochiti Lake could be timed to increase spring peak flows in the Central Section above levels typically considered safe for the San Marcial railroad bridge downstream. This “extra” water could then be diverted from the river into the LFCC ensuring flows at the San Marcial railroad bridge remain at a safe level. Thus, fish and wildife resources in the Central Section could benefit from larger spring peak flows, diversion related flow reductions downstream of the San Acacia Diversion Dam could be minimized or avoided, and flows below the San Marcial railroad bridge could remain within safe levels.

Without diversions into the LFCC the proposed project would result in a net benefit to fish and wildlife resources. Conservation storage could be used to increase peak flows necessary for habitat creation and maintenance as well as provide spawning cues necessary for other life history requirements. It could also be used to reduce intermittency downstream and help to maintain habitat during critical low-flow periods. Increasing the channel capacities below Abiquiu Reservoir and Cochiti Lake could facilitate higher spring releases and channel forming and maintaining flows. Large diversions into the LFCC would be difficult if not impossible to mitigate, particularly with the wide variability of diversions proposed in each alternative.

RECOMMENDATIONS

To avoid or minimize project related impacts to fish and wildlife resources, we recommend that the joint lead agencies:

1. Develop a long-term monitoring and mitigation plan to identify and offset project related impacts to aquatic and riparian habitats.

2. Obtain the authority to carry-over conservation storage from year-to-year and release it in a manner and at times (i.e., spring and summer) most beneficial to fish and wildlife resources.

3. Continue studying the surface and groundwater hydrology of the river and LFCC in the San Acacia Section to determine the level of diversions necessary to improve downstream deliveries.

4. To the extent possible, minimize, diverting into the LFCC. Divert only the amount necessary to improve downstream deliveries, and only when diversions would comprise a small proportion of the flow in the river.

5. Investigate the use of infiltration galleries instead of a surface diversion at San Acacia.

6. Redesign the LFCC intake to include screens and minimize approach velocities.

7. Increase the channel capacity below Abiquiu Reservoir and Cochiti Lake.

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Appendix A. Common and Scientific Names of Fish That May Occur in the URGWOPs Project Area.

Common Name	Scientific Name
Gizzard shad (N)	*Dorosoma cepedianum*
Rainbow trout (I)	*Oncorhynchus mykiss*
Brown trout (I)	*Salmo trutta*
Northern pike (I)	*Esox lucius*
Red shiner (N)	*Cyprinella lutrensis*
Common carp (I)	*Cyprinus carpio*
Rio Grande chub (N)	*Gila pandora*
Rio Grande silvery minnow (N)	*Hybognathus amarus*
Fathead minnow (N)	*Pimephales promelas*
Flathead chub (N)	*Platygobio gracilis*
Longnose dace (N)	*Rhinichthys cataractae*
River carpsucker (N)	*Carpiodes carpio*
Flathead catfish (N)	*Pylodictis olivaris*
White sucker (I)	*Catostomus commersoni*
Rio Grande sucker (N)	*Catostomus plebeius*
Smallmouth buffalo (N)	*Ictiobus bubalus*
Black bullhead (I)	*Ictalurus melas*
Yellow bullhead (I)	*Ictalurus natalis*
Channel catfish (I)	*Ictalurus punctatus*
Western mosquitofish (N)	*Gambusia affinis*
White bass (I)	*Morone chrysops*
Green sunfish (I)	*Lepomis cyanellus*
Bluegill (N)	*Lepomis macrochirus*
Longear sunfish (I)	*Lepomis megalotis*
Largemouth bass (I)	*Micropterus salmoides*
White crappie (I)	*Pomoxis annularis*
Black crappie (I)	*Pomoxis nigromaculatus*
Yellow perch (I)	*Perca flavescens*

(N=native, I=introduced or non-native)

Appendix B. Common and Scientific Names of Plants That May Occur in the URGWOPs Project Area.

Common Name	**Scientific Name**
Baccharis (N)	*Baccharis spp.*
Seepwillow (N)	*Baccharis glutinosa*
Coyote willow (N)	*Salix exigua*
Peachleaf willow (N)	*Salix amygdaloides*
Goodding's willow (N)	*Salix gooddingii*
Buttonbush (N)	*Cephalanthus spp.*
False indigo bush (N)	*Amorpha fruticosa*
New Mexico olive (N)	*Forestiera neomexicana*
Black locust (N)	*Robinia pseudo-acacia*
Boxelder (N)	*Acer negundo*
Chinaberry (I)	*Melia azedarach*
Rio Grande cottonwood (N)	*Populus fremonti*
White mulberry (I)	*Morus alba*
Russian olive (I)	*Elaeagnus angustifolia*
Salt cedar (I)	*Tamarix spp.*
Siberian elm (I)	*Ulmus pumila*
Tree-of-heaven (I)	*Ailanthus altissima*
Apache plume (N)	*Fallugia paradoxa*
Wolfberry (N)	*Lycium andersonii*
Fourwing saltbush (N)	*Atriplex canescens*
Virginia creeper (I)	*Parthenocissus inserta*
Phragmites (N)	*Phragmites communis*
Sago pondweed (N)	*Potamogeton pectinatus*
Sedge (N)	*Carex spp.*
Saltgrass (N)	*Distichlis stricta*
Spikerush(N)	*Eleocharis spp.*
Horsetail (N)	*Equisetum spp.*
Rush (N)	*Juncus spp.*
Bulrush (N)	*Scirpus spp.*
Sacaton (N)	*Sporobolus spp.*
Cattail (N)	*Typha latifolia*
Smartweed (N)	*Polygonum lapathifolium*
American milfoil (N)	*Myriophyllum exalbescens*
Yerba manza (N)	*Anemopsis californica*
Primrose (N)	*Oenothera spp.*
Fendler globemallow (N)	*Sphaeralcea fendleri*
Pricklypear (N)	*Opuntia spp.*
Buffalo gourd (N)	*Cucurbita foetidissima*
Spiny aster (I)	*Aster spinosus*
Golden currant (N)	*Ribes aureum*
Watercress (N)	*Nasturtium officionale*

(N=native, I=introduced or non-native)

Appendix C. Common and Scientific Names of Mammals That May Occur in the URGWOPs Project Area.

Common Name	Scientific Name
Opossum	*Didelphis virginiana*
Desert shrew	*Notiosorex crawfordi*
Yuma myotis	*Myotis yumanensis*
Little brown bat	*Myotis lucifugus*
Long-legged myotis	*Myotis volans*
Silver-haired bat	*Lasionycteris noctivagans*
Big brown bat	*Eptesicus fuscus*
Hoary bat	*Lasiurus cinereus*
Spotted bat	*Euderma maculatum*
Townsend's big-eared bat	*Plecotis townsendii*
Pallid bat	*Antrozous pallidus*
Brazilian free-tailed bat	*Tadarida brasiliensis*
Desert cottontail	*Sylvilagus auduboni*
Black-tailed jackrabbit	*Lepus californicus*
Beaver	*Castor canadensis*
Gunnison's prairie dog	*Cynomys gunnisoni*
Colorado chipmunk	*Eutamias quadrivittatus*
Spotted ground squirrel	*Spermophilus spilosoma*
Rock squirrel	*Spermophilus variegatus*
Red squirrel	*Tamiasciurus hudsonicus*
Northern grasshopper mouse	*Onychomys leucogaster*
Deer mouse	*Peromyscus maniculatus*
White-footed mouse	*Peromyscus leucopus*
Piñon mouse	*Peromyscus truei*
Western harvest mouse	*Reithrodontomys megalotis*
Hispid cotton rat	*Sigmodon hispidus*
Norway rat	*Rattus norvegicus*
Muskrat	*Ondatra zibethicus*
New Mexican jumping mouse	*Zapus hudsonius luteus*
Ord kangaroo rat	*Dipodomys ordii*
Merriam kangaroo rat	*Dipodomys merriami*
Silky pocket mouse	*Perognathus flavus*
Plains pocket mouse	*Perognathus flavescens*
Yellow-faced pocket gopher	*Pappogeomys castanops*
Botta pocket gopher	*Thomomys bottae*
American porcupine	*Erethizon dorsatum*
Coyote	*Canis latrans*
Gray fox	*Urocyon cinereoargenteus scottii*
Raccoon	*Procyon lotor*
Striped skunk	*Mephitis mephitis*
Long-tailed weasel	*Mustela frenata*
Mink	*Mustela vison*
Badger	*Taxidea taxus*
Bobcat	*Lynx rufus*
Mountain lion	*Felis concolor*
Mule deer	*Odocoileus hemionus*

Appendix D. Common and Scientific Names of Birds That May Occur in the URGWOPs Project Area.

Common Name	**Scientific Name**
Pied-billed grebe	*Podilymbus podiceps*
Common loon	*Gavia immer*
American white pelican	*Pelecanus erythrorhynchos*
Double-crested cormorant	*Phalacrocorax auritus*
Olivaceous cormorant	*Phalacrocorax olivaceus*
American bittern	*Botaurus lentiginosus*
Least Bittern	*Ixobrychus exilis*
Great blue heron	*Ardea herodias*
Great egret	*Ardea alba*
Snowy egret	*Egretta thula*
Little blue heron	*Egretta caerulea*
Cattle egret	*Bubulcus ibis*
Green-backed heron	*Butorides striatus*
Black-crowned night heron	*Nycticorax nycticorax*
White-faced ibis	*Plegadis chihi*
Snow goose	*Chen caerulescens*
Canada goose	*Branta canadensis*
Wood duck	*Aix sponsa*
Green-winged teal	*Anas crecca*
Mallard	*Anas platyrhynchos*
Northern pintail	*Anas acuta*
Cinnamon teal	*Anas cyanoptera*
Northern shoveler	*Anas clypeata*
Gadwall	*Anas strepera*
Hooded merganser	*Mergus cuculatus*
Red-breasted merganser	*Mergus serrator*
Ruddy duck	*Oxyura jamaicensis*
Virginia rail	*Rallus limicola*
Sora	*Porzana carolina*
Common moorhen	*Gallinula chloropus*
American coot	*Fulica americana*
Sandhill crane	*Grus canadensis*
Whooping crane	*Grus americana*
Killdeer	*Charadrius vociferus*
Black-necked stilt	*Himantopus mexicanus*
American avocet	*Recurvirostra americana*
Solitary sandpiper	*Tringa solitaria*
Spotted sandpiper	*Actitis macularia*
Long-billed curlew	*Numenius americanus*
Forster’s tern	*Sterna forsteri*
Black tern	*Chlidonias niger*
Turkey vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Black-shouldered kite	*Elanus caeruleus*
Mississippi kite	*Ictinia mississippiensis*

Appendix D continued. Common and Scientific Names of Birds That May Occur in the URGWOPs Project Area.

Common Name	Scientific Name
Bald eagle	*Haliaeetus leucocephalus*
Northern Harrier	*Circus cyaneus*
Cooper's hawk	*Accipiter cooperii*
Common black-hawk	*Buteogallus anthracinus*
Swainson’s hawk	*Buteo swainsoni*
Red-tailed hawk	*Buteo jamaicensis*
American kestrel	*Falco sparverius*
American peregrine falcon	*Falco peregrinus anatum*
Ring-necked pheasant	*Phasianus colchicus*
Northern bobwhite	*Colinus virginianus*
Scaled quail	*Callipepla squamata*
Gambel’s quail	*Callipepla gambelii*
Rock dove	*Columba livia*
White-winged dove	*Zenaida asiatica*
Morning dove	*Zenaida macroura*
Common ground-dove	*Columbina passerina*
Yellow-billed cuckoo	*Coccyzus erythropthalmus*
Greater roadrunner	*Geococcyx californianus*
Common barn-owl	*Tyto alba*
Great horned owl	*Bubo virginianus*
Burrowing owl	*Athene cunicularia*
Lesser nighthawk	*Chordeiles acutipennis*
Common nighthawk	*Chordeiles minor*
White-throated swift	*Aeronautes saxatalis*
Black-chinned hummingbird	*Archilochus alexandri*
Rufous hummingbird	*Selasphorus rufus*
Belted kingfisher	*Ceryle alcyon*
Northern flicker	*Colaptes auratus*
Olive-sided flycatcher	*Contopus borealis*
Western wood-pewee	*Contopus sordidulus*
Southwestern willow flycatcher	*Empidonax traillii extimus*
Black phoebe	*Sayornis nigricans*
Say’s phoebe	*Sayornis saya*
Ash-throated flycatcher	*Myiarchus cinerascens*
Cassin’s kingbird	*Tyrannus vociferans*
Western kingbird	*Tyrannus verticalis*
Eastern kingbird	*Tyrannus tyrannus*
Violet-green swallow	*Tachycineta thalassina*
Bank swallow	*Riparian riparia*
Cliff swallow	*Hirundo pyrrhonota*
Barn swallow	*Hirundo rustica*
Northern rough-winged swallow	*Stelgidopteryx serripennis*
Black-billed magpie	*Pica pica*
American crow	*Corvus caurinus*
Chihuahuan raven	*Corvus cryptoleucus*

Appendix D continued. Common and Scientific Names of Birds That May Occur in the URGWOPs Project Area.

Common Name	Scientific Name
Black-capped chickadee	*Parus atricapillus*
Verdin	*Auriparus flaviceps*
White-breasted nuthatch	*Sitta carolinensis*
Cactus wren	*Campylorhynchus brunneicapillus*
Black-tailed gnatcatcher	*Polioptila melanura*
Eastern bluebird	*Sialia sialis*
Western bluebird	*Sialia mexicana*
Hermit thrush	*Catharus guttatus*
American robin	*Turdus migratorius*
Gray catbird	*Dumetella carolinensis*
Northern mockingbird	*Mimus polyglottos*
Curved-billed thrasher	*Toxostoma curvirostre*
Crissal thrasher	*Toxostoma dorsale*
European starling	*Sturnus vulgaris*
Bell's vireo	*Vireo bellii*
Warbling vireo	*Vireo gilvus*
Orange-crowned warbler	*Vermivora celata*
Virginia's warbler	*Vermivora virginiae*
Lucy's warbler	*Vermivora luciae*
Yellow warbler	*Dendroica petechia*
Yellow-rumped warbler	*Dendroica coronata*
Common yellowthroat	*Geothlypis trichas*
Wilson's warbler	*Wilsonia pusilla*
Yellow-breasted chat	*Icteria virens*
Summer tanager	*Piranga rubra*
Western tanager	*Piranga ludoviciana*
Northern cardinal	*Cardinalis cardinalis*
Pyrrhuloxia	*Cardinalis sinuatus*
Rose-breasted grosbeak	*Pheucticus ludovicianus*
Black-headed grosbeak	*Pheucticus melanocephalus*
Blue grosbeak	*Guiraca caerulea*
Lazuli bunting	*Passerina amoena*
Indigo bunting	*Passerina cyanea*
Painted bunting	*Passerina ciris*
Spotted towhee	*Pipilo maculatus*
Brown towhee	*Pipilo fuscus*
Dark-eyed junco	*Junco hyemalis*
Rufous-crowned sparrow	*Aimophila ruficeps*
American tree sparrow	*Spizella arborea*
Chipping sparrow	*Spizella passerina*
Lark sparrow	*Chondestes grammacus*
Black-throated sparrow	*Amphispiza bilineata*
Lark bunting	*Calamospiza melanocorys*
Lincoln's sparrow	*Melospiza lincolnii*
White-crowned sparrow	*Zonotrichia leucophrys*

Appendix D continued. Common and Scientific Names of Birds That May Occur in the URGWOPs Project Area.

Common Name	Scientific Name
Red-wing blackbird	*Agelaius phoeniceus*
Western meadowlark	*Sturnella neglecta*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Brewer's blackbird	*Euphagus cyanocephalus*
Great-tailed grackle	*Quiscalus mexicanus*
Bronzed cowbird	*Molothrus aeneus*
Brown-headed cowbird	*Molothrus ater*
Orchard oriole	*Icterus spurius*
Northern oriole	*Icterus galbula bullockii*
House finch	*Carpodacus mexicanus*

Appendix E. Common and Scientific Names of Reptiles and Amphibians That May Occur in the URGWOPs Project Area.

Common Name	Scientific Name
Western hooknose snake	*Gyalopion canum*
Western hognose snake	*Heterodon nasicus*
Night snake	*Hypsiglena torquata*
Common kingsnake	*Lampropeltis getula*
Milk snake	*Lampropeltis triangulum*
Coachwhip	*Masticophis flagellum*
Striped whipsnake	*Masticophis taeniatus*
Bullsnake or gopher snake	*Pituophis melanoleucus*
Longnose snake	*Rhinocheilus lecontei*
Big Bend patchnose snake	*Salvadora deserticola*
Mountain patchnose snake	*Salvadora grahamiae*
Ground snake	*Sonora semiannulata*
Plains blackhead snake	*Tantilla nigriceps*
Blackneck garter snake	*Thamnophis cyrtopsis*
Wandering garter snake	*Thamnophis elegans*
Checkered garter snake	*Thamnophis marcianus*
Common garter snake	*Thamnophis sirtalis*
Lyre snake	*Trimorphodon biscutatus*
Western diamondback rattlesnake	*Crotalus atrox*
Blacktail rattlesnake	*Crotalus molossus*
Western rattlesnake	*Crotalus viridis*
Massasauga	*Sistrurus catenatus*