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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Mountain-Prairie Region

IN REPLY REFER TO:

FWS/BR
GJ-6-CO-95-F-033
COKANUT

MAILING ADDRESS:
Post Office Box 25486
Denver Federal Center
Denver, Colorado 80225

STREET LOCATION:
134 Union Blvd.
Lakewood, Colorado 80228

FEB 26 1996

Memorandum

To: Regional Director, Bureau of Reclamation, Upper Colorado Regional Office, Salt Lake City, Utah

From: Deputy Regional Director, Region 6
U.S. Fish and Wildlife Service
Denver, Colorado

Subject: Final Biological Opinion for the Animas-La Plata Project, Colorado and New Mexico

In accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR 402), this transmits the Fish and Wildlife Service's biological opinion for impacts to federally listed endangered species for the Animas-La Plata Project. While Region 6 assumed the lead for this consultation, recommendations contained herein have the concurrence of the Regional Director of Region 2 in Albuquerque, New Mexico.

Reference is made to your June 2, 1995, correspondence requesting reinitiation of formal consultation for the subject project. The Service concurs that the proposed project "may affect" the Colorado squawfish (Ptychocheilus lucius) and razorback sucker (Xyrauchen texanus) and their designated critical habitat. In addition, the proposed project "may affect" the bald eagle (Haliaeetus leucocephalus). The Service concurs that the proposed project is not likely to adversely affect the peregrine falcon (Falco peregrinus) or the southwestern willow flycatcher (Empidonax traillii extimus). The Service also concurs that the proposed project is not likely to adversely affect the black-footed ferret (Mustela nigripes); provided that prairie dog communities are not affected.

CONSULTATION HISTORY

The Animas-La Plata Project has been in the planning process since the early 1960's and resulted in the preparation of a Definite Plan Report in 1979. At that time, Region 2 entered into formal section 7 consultation with Reclamation and rendered a biological opinion on December 28, 1979 (2-2-80-F-13). The 1979 biological opinion addressed the potential effects of the proposed Project on the endangered Colorado squawfish, bald eagle, and peregrine falcon. Based on the capture of a single juvenile Colorado squawfish in the San Juan River at the mouth of McElmo Creek near Aneth, Utah, it was concluded that ". . . the proposed project is likely to further degrade the San Juan River to a point that this population will be lost. However, because of the apparent small size of the San Juan River squawfish population and its already tenuous hold on survival, its possible loss should have little impact on the successfully reproducing Green and Colorado Rivers squawfish populations and, therefore, the species itself."

A wintering population of approximately 20 bald eagles and the presence of an active nest site along the Animas River led to the 1979 conclusion that reductions in streamflow would neither significantly affect the food base of the Animas River nor deter eagle use of the area. While a historical aerie for peregrine falcons exists within the Project area, it has been unoccupied since 1963, and there was no evidence of breeding activity or sightings in or around the immediate Project area. In addition, the Colorado Division of Wildlife determined that the surrounding hunting habitat is of marginal quality (Jerry Craig, CDOW, pers. comm.).

The 1979 biological opinion found the Project was unlikely to jeopardize the continued existence of any of the three species identified above; however, several recommendations were made regarding Colorado squawfish and bald eagles in furtherance of their conservation. It was recommended that a Bald Eagle Management Plan be developed for Project reservoirs. For Colorado squawfish, it was recommended that:

1. native fish populations of the San Juan River be thoroughly surveyed,

2. environmental needs of Colorado squawfish be determined,

3. an attempt be made to meet the above needs by adjusting projects on the San Juan River drainage, and

4. provide and fund artificial facilities in which to spawn and rear Colorado squawfish until such time that suitable habitats in the San Juan River can be developed and maintained.

On February 6, 1990, Reclamation reinitiated section 7 consultation and provided the Service with an updated biological assessment of Project impacts on Colorado squawfish. On May 7, 1990, the Service issued a draft biological opinion concluding that the Project would jeopardize the continued existence of the Colorado squawfish. No reasonable and prudent alternatives were identified at that time. Reclamation and the Service began actively seeking reasonable and prudent alternatives and in a March 4, 1991, letter Reclamation proposed a reasonable and prudent alternative to preclude the likelihood of jeopardy from the Project. The Service issued a final biological opinion for the Animas-La Plata Project on October 25, 1991, that concluded the project as proposed would likely jeopardize the continued existence of the Colorado squawfish and razorback sucker. The reasonable and prudent alternative in that opinion included: (1) an Animas-La Plata Project that results in an initial depletion[1] of 57,100 acre-feet, (2) 7 years of research to determine endangered fish habitat needs, (3) operation of the Navajo Dam to provide a wide range of flow conditions for the endangered fish, (4) a guarantee that the Navajo Reservoir will be operated for the life of the Project to mimic a natural hydrograph based on the research, and (5) legal protection for the reservoir releases to and through the endangered fish habitat to Lake Powell and a commitment to develop and implement a Recovery Implementation Program for the San Juan River.

The 1991 opinion also concluded that the project was not likely to jeopardize the continued existence of the bald eagle. Development and implementation of a Bald Eagle Management Plan was included as a conservation recommendation.

As a result of the reasonable and prudent alternative in the 1991 biological opinion, the San Juan River Basin Recovery Implementation Program (San Juan RIP) was formulated in 1992.

During informal consultation the Service determined that no threatened or endangered plant species would be impacted by the project. Also, after surveys were conducted, the Service concurred with Reclamation's no affect determination for the Mexican spotted owl (<u>Strix</u> <u>occidentalis</u> <u>lucida</u>).

BIOLOGICAL OPINION

Based upon the best scientific and commercial information currently available, it is the Service's biological opinion that the Project, as described below, is likely to jeopardize Colorado squawfish and razorback sucker and adversely modify or destroy their critical habitat by reducing prespawning and nursery habitats and increasing the concentrations of contaminants in the aquatic habitat of the San Juan River. The San Juan RIP is designed to act, if sufficient progress toward recovery is determined by the Service, as a reasonable and prudent alternative to actions within the basin that are found likely to jeopardize the continued existence of listed aquatic species or result in the adverse modification or destruction of critical habitat in the basin. The Service has determined that sufficient progress has not yet been achieved to avoid jeopardy or adverse modification to critical habitat of Colorado squawfish and razorback sucker for a depletion of 149,220 acre-feet. Therefore, the Service has developed reasonable and prudent alternatives to avoid the likelihood of jeopardy and adverse modification of critical habitat.

It is the Service's biological opinion that the Project, as described herein, is not likely to jeopardize the continued existence of the bald eagle. Implementation of the conservation recommendations will aid in the conservation of the species.

Reclamation has agreed with the Service's opinion that the Project is likely to jeopardize Colorado squawfish and razorback sucker and adversely modify or

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[1]The Service defines a depletion as the amount of water that is not returned to a river system due to project implementation, i.e., the amount diverted minus return flows and evaporation equals the depletion.

destroy their critical habitat. Reclamation has agreed to carry out all elements of the reasonable and prudent alternative to avoid the likelihood of jeopardy and adverse modification of critical habitat of the endangered fishes. They also have agreed that the conservation recommendation for the bald eagle is appropriate.

PROJECT DESCRIPTION

The following project description is based on information provided to the Service in Reclamation's 1995 biological assessment and the Service's 1991 biological opinion. The Project, located in southwest Colorado in La Plata and Montezuma Counties and northwest New Mexico in San Juan County, would divert water from the Animas and La Plata Rivers to annually provide 111,130 acre-feet for full-service and supplemental irrigation use and 80,100 acre-feet for municipal and industrial uses. Project water would be delivered to non-Indians and the Southern Ute Indian and Ute Mountain Ute Tribes, and the Navajo Nation in both States. Project features include two storage reservoirs, seven pumping plants, and over 200 miles of conveyance canals, conduits, and laterals (Figure 1).

Project water designated for the two Colorado Ute Tribes is a part of the settlement of their reserved water rights claims. Under the Colorado Ute Indian Water Rights Final Settlement Agreement (Agreement) of December 10, 1986, water to be supplied from the Project in the amounts set out in the Agreement is to be provided to the tribes in partial settlement of their reserved water rights.

The construction and operation of the project has been divided into stepped phases. Phase I, Stage A would develop an initial water supply of 80,100 acre-feet, which would result in an average annual depletion[2] of 57,100 acre-feet. The Service's 1991 biological opinion for this project contained a reasonable and prudent alternative that limits the project's maximum annual depletion[3] to 57,100 acre-feet until the end of the 7-year research program. Stage A facilities would include: Durango Pumping Plant, Ridges Basin Inlet Conduit, Ridges Basin Dam and Reservoir, Ridges Basin Recreation Facilities, a small Ridges Basin Pumping Plant, and the Shenandoah, La Plata Rural, and Durango M&I Pipelines. The completion of Phase I, Stage A, would provide M&I water to the two Ute Tribes, the Navajo Nation, the San Juan Water Commission, the City of Durango, the Animas-La Plata Water Conservancy District (future development supply), and to the La Plata Rural and Shenandoah M&I Pipelines. The La Plata Rural Pipeline would supply 2,000 acre-feet of municipal water to residents in the La Plata River drainage.

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[2]An average annual depletion is the amount of water depleted each year averaged over a number of years (in this case 1929 - 1989). Some years depletions will be greater than the average and other years they would be less.

[3]A maximum annual depletion is a depletion amount that can not be exceeded in any year.

Phase I, Stage B would involve the development of a total project water supply of up to 169,710 acre-feet. Additional project facilities associated with Stage B would be: a full sized Ridges Basin Pumping Plant, Long Hollow Tunnel, and the Dryside Canal to the Dryside Lateral Turnout. Completion of Phase I would provide project water at Ridges Basin Reservoir for the Southern Ute Indian and Ute Mountain Ute Tribes, irrigation facilities and water to serve most of the non-Indian and Southern Ute Tribal Project lands, in additional to the entire M&I water supply provided under Phase I, Stage A. Additional pumps needed for the completion of Phase I would be added to Durango and Ridges Basin Pumping Plants, which would satisfy the requirements for Phase I and II. The Southern Ute Diversion Dam and an interim extension of the Southern Ute Inlet canal would be constructed to service irrigated land in New Mexico. If Stage B were constructed, water supply for the La Plata rural water users would be delivered via the Dry Side Canal to a point along the canal near the Red Mesa Pumping Plant, and the La Plata Rural Pipeline would not be constructed.

Phase II would develop a total water supply of up to 191,230 acre-feet (average annual depletion of 149,220 acre-feet). Additional facilities would include: Southern Ute Dam and Reservoir; La Plata Diversion Dam; the remaining portion of the Southern Ute Inlet Canal; the Dry Side Canal would be extended to near the Ute Mountain Ute Reservation boundary; New Mexico Irrigation canal; Alkali Gulch, Ute Mountain, Southern Ute, and the Third Terrace Pumping Plants; and the laterals to serve Phase II lands. With the completion of Phase II, all Project lands, with the exception of those above the Dry Side Canal, would be served by sprinkler irrigation.

Ridges Basin Reservoir, the primary storage facility, would be located on Basin Creek, an intermittent tributary to the Animas River, southwest of Durango, Colorado. The reservoir would have a maximum capacity of 273,100 acre-feet--127,900 acre-feet of active, usable capacity and 145,200 acre-feet of inactive and dead storage. Average evaporation from Ridges Basin Reservoir is estimated at 3,300 acre-feet annually. Secondary storage would be provided at Southern Ute Reservoir, an offstream facility located about 2 miles east of the La Plata River on the Colorado-New Mexico State line. Southern Ute Reservoir would have a maximum capacity of 70,000--40,000 acre-feet of active, usable capacity and 30,000 acre-feet of inactive and dead storage. Average evaporation from Southern Ute Reservoir is estimated at 3,300 acre-feet annually. None of the above depletions will occur until completion of the Ridges Basin Dam and Durango Pumping Plant. Upon completion of the Project, full development and operations would result in a average annual depletion of 149,220 acre-feet of water.

The Project would pump water from the Animas River via the Durango Pumping Plant, through Ridges Basin inlet conduit to Ridges Basin Reservoir for storage. Stored water would be used for irrigation and industrial needs of the Southern Ute Indian and Ute Mountain Ute Tribes and the Navajo Nation; other Colorado and New Mexico irrigators; and municipal and industrial uses for Durango, surrounding communities, and northwestern New Mexico. During low-flow periods, stored water would be released down Basin Creek, back to the Animas River to meet Aztec, Farmington, and other municipal and industrial needs in New Mexico. Additionally, stored water would be pumped through

Ridges Basin Pumping Plant on the west end of the reservoir, into Dry Side Canal (or the La Plata Rural Pipeline for Stage A) for delivery to Project lands as depicted in Figure 1.

Southern Ute Reservoir would store La Plata River water, diverted by the Southern Ute Diversion Dam and conveyed to the reservoir through the inlet canal. Water stored in Southern Ute Reservoir would be used for irrigation needs in New Mexico, including the Navajo Nation, and municipal and industrial needs for the Southern Ute Indian Tribe in Colorado, and for non-Indian irrigation needs in New Mexico.

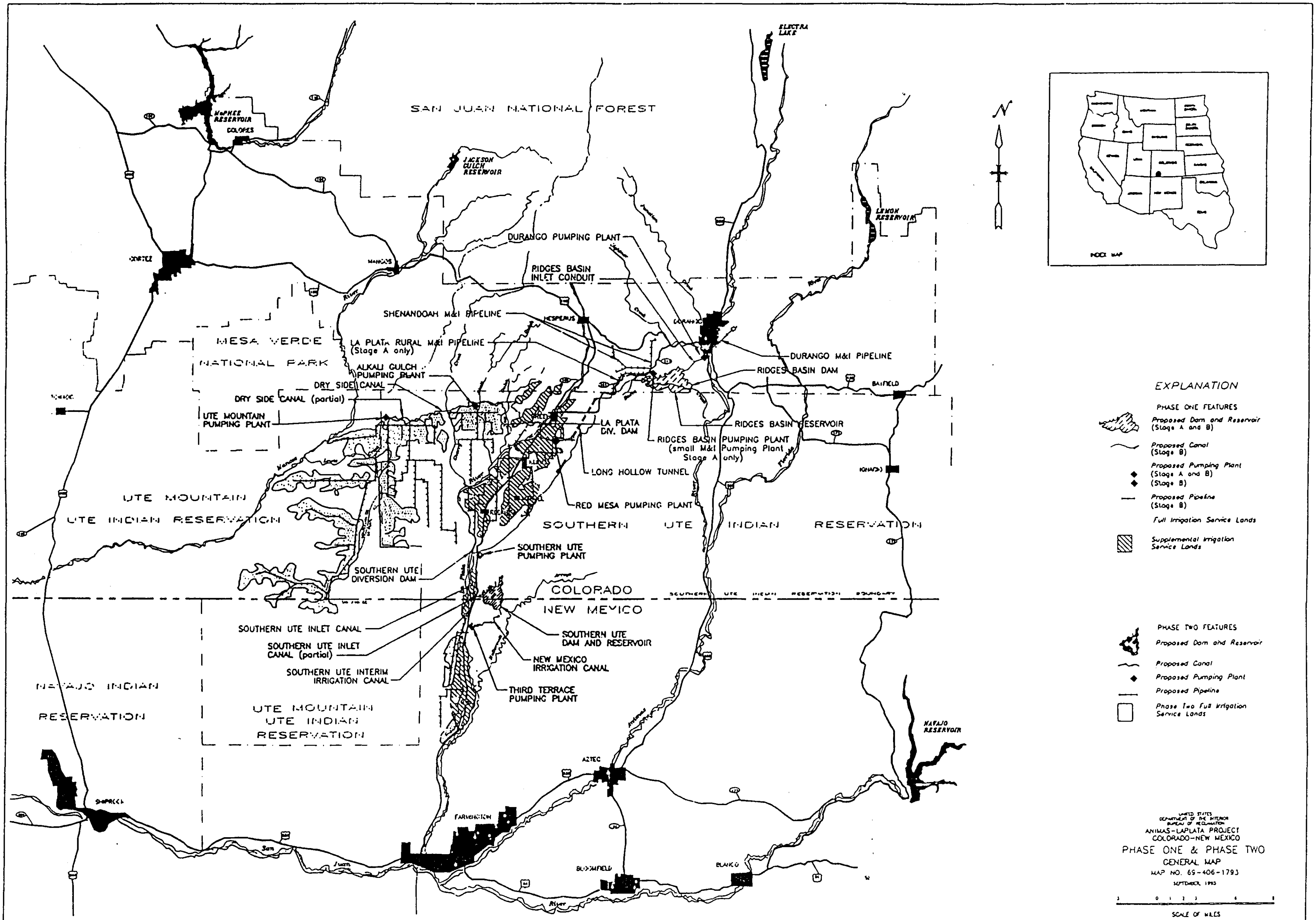
SAN JUAN NATIONAL FOREST
MESA VERDE NATIONAL PARK
UTE MOUNTAIN UTE INDIAN RESERVATION
SOUTHERN UTE INDIAN RESERVATION
NAVAJO INDIAN RESERVATION
COLORADO
NEW MEXICO
ELECTRA LAKE
JACKSON GULCH RESERVOIR
LEMON RESERVOIR
NAVAJO RESERVOIR
CORTEZ
MANCOS
HESPERUS
DURANGO
BAYFIELD
AZTEC
FARMINGTON
BLANCO
DURANGO PUMPING PLANT
RIDGES BASIN INLET CONDUIT
SHENANDOAH M&I PIPELINE
LA PLATA RURAL M&I PIPELINE (Stage A only)
ALKALI GULCH PUMPING PLANT
DRY SIDE CANAL
DRY SIDE CANAL (partial)
UTE MOUNTAIN PUMPING PLANT
DURANGO M&I PIPELINE
RIDGES BASIN DAM
LA PLATA DIV. DAM
RIDGES BASIN RESERVOIR
RIDGES BASIN PUMPING PLANT (small M&I Pumping Plant Stage A only)
LONG HOLLOW TUNNEL
RED MESA PUMPING PLANT
SOUTHERN UTE PUMPING PLANT
SOUTHERN UTE DIVERSION DAM
SOUTHERN UTE INLET CANAL
SOUTHERN UTE INLET CANAL (partial)
SOUTHERN UTE INTERIM IRRIGATION CANAL
SOUTHERN UTE DAM AND RESERVOIR
NEW MEXICO IRRIGATION CANAL
THIRD TERRACE PUMPING PLANT
SOUTHERN UTE INDIAN RESERVATION BOUNDARY
EXPLANATION
PHASE ONE FEATURES
Proposed Dam and Reservoir (Stage A and B)
Proposed Canal (Stage B)
Proposed Pumping Plant (Stage A and B) (Stage B)
Proposed Pipeline (Stage B)
Full Irrigation Service Lands
Supplemental Irrigation Service Lands
PHASE TWO FEATURES
Proposed Dam and Reservoir
Proposed Canal
Proposed Pumping Plant
Proposed Pipeline
Phase Two Full Irrigation Service Lands
INDEX MAP
ANIMAS-LAPLATA PROJECT
COLORADO-NEW MEXICO
PHASE ONE & PHASE TWO
GENERAL MAP
SCALE OF MILES

Figure 1

BASIS FOR BIOLOGICAL OPINION

This biological opinion is based on the full Project development scenario as requested by Reclamation. Reclamation estimates that the Project would result in an average annual depletion of 149,220 acre-feet of water from the two rivers. The Animas and La Plata Rivers are tributaries to the San Juan River, which is inhabited by Colorado squawfish and razorback sucker.

Water depletions in the San Juan River Basin have been recognized as a major source of impact to endangered fish species. Continued water withdrawal has restricted the ability of the San Juan River system to produce flow conditions required by various life stages of the fishes. In 1963, the Navajo Dam was closed, and Navajo Reservoir began to fill with water from the San Juan River. Historically, flows in the San Juan River prior to the Navajo Dam were highly variable and ranged from a low of 44 cubic feet per second (cfs) in September 1956 to a high of 19,790 cfs in May 1941 (mean monthly values) at the U.S. Geological Survey Station 93680000, Shiprock, New Mexico. Conversely, post-Navajo Dam flows in the San Juan River have ranged from a low of 185 cfs in July 1963, while the reservoir was filling, to a high of 9,508 cfs in June 1979. Since 1963, Navajo Dam has significantly altered flow of the San Juan River by typically storing spring peak flows and releasing water in summer, fall, and winter months resulting in an average decrease in spring peak flows of 45 percent, while approximately doubling winter base flows at the Bluff gauge in Utah. Similar comparisons can be made at the upstream gauges at Shiprock and Farmington, New Mexico. Significant depletions and redistribution of flows of the San Juan River also have occurred as a result of other major water development projects, including Navajo Indian Irrigation Project (NIIP) and the San Juan-Chama Project. At the current level of development, average annual flows at Bluff, Utah, already have been depleted by 30 percent. Further depletions associated with the Project would raise that figure to 38 percent. By comparison, the Green and Colorado Rivers have been depleted approximately 20 percent (at Green River) and 32 percent (at Cisco), respectively. These depletions, along with a number of other factors, have resulted in such drastic reductions in the populations of Colorado squawfish and razorback sucker throughout their ranges that the Service has listed these species as endangered and has implemented programs to prevent them from becoming extinct.

Critical habitat has been designated for the Colorado squawfish and razorback sucker within the 100-year floodplain in portions of their historic range (59 F.R. 13374). Destruction or adverse modification of critical habitat is defined in 50 CFR 402.02 as a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of listed species. In considering the biological basis for designating critical habitat, the Service focused on the primary physical and biological elements that are essential to the conservation of the species without consideration of land or water ownership or management. The Service has identified water, physical habitat, and biological environment as the primary constituent elements. This includes a quantity of water of sufficient quality that is delivered to a specific location in accordance with a hydrologic regime that is required for the particular life stage for each species. Water depletions reduce the ability of the river system to provide the required water quantity and hydrologic regime necessary for recovery of the fishes. The physical habitat includes areas of the San Juan River system below Farmington, New Mexico, that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, feeding, and nursery habitats. Water depletions reduce the ability of the river to create and maintain these important habitats. Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity, which could be limited by reduction of high spring flows brought about by water depletions. Predation and competition from nonnative fish species has been identified as a factor in the decline of the endangered fishes. Water depletions contribute to alterations in flow regimes that favor nonnative fishes. The Service concludes that water depletions impact the primary constituent elements and cause destruction or adverse modification to critical habitat.

BIOLOGICAL BACKGROUND

A marked decline in Colorado squawfish and razorback sucker populations can be closely correlated with the construction of dams and reservoirs between the 1930's and the 1960's, introduction of nonnative fishes, and removal of water from the Colorado River system. Behnke and Benson (1983) summarized the decline of the natural ecosystem. They pointed out that dams, impoundments, and water use practices are probably the major reasons for drastically modified natural river flows and channel characteristics in the Colorado River Basin. Dams on the main stem Colorado and San Juan Rivers have essentially segmented the river systems, blocking Colorado squawfish and razorback sucker spawning migrations and drastically changing river characteristics, especially flows, temperatures, and channel geomorphology. In addition, major changes in species composition have occurred due to the introduction of nonnative fishes, many of which have thrived as a result of changes in the natural riverine system (i.e., flow and temperature regimes). The decline of endemic Colorado River fishes seems to be at least partially related to competition or other behavioral interactions with nonnative species, which have perhaps been exacerbated by alterations in the natural fluvial environment.

As the southernmost tributary of the Upper Colorado River Basin (Upper Basin), the San Juan River peaks earlier in the year and attains warmer water temperatures than other Upper Basin streams and is conducive to longer and better growth potential for young Colorado squawfish and razorback suckers. Any additional large loss of water or further degradation of remaining habitats of the San Juan River will exacerbate problems the Colorado squawfish and razorback sucker are currently experiencing in the San Juan and other subbasins throughout the Upper Basin.

COLORADO SQUAWFISH

Historical and Current Distribution

The Colorado squawfish evolved as the main predator in the Colorado River and San Juan River systems. The diet of Colorado squawfish longer than 3 or 4 inches consists almost entirely of other fishes (Vanicek and Kramer 1969). The Colorado squawfish is the largest cyprinid fish (minnow family) native to North America and, during predevelopment times, may have grown as large as 6 feet in length and weighed nearly 100 pounds (Behnke and Benson 1983). These large fish may have been 25-50 years of age. The Colorado squawfish currently occupies about 1,030 river miles in the Colorado River system (20 percent of its original range) and is presently found only in the San Juan and other subbasins above Glen Canyon Dam (Tyus 1990).

Based on early fish collection records, archaeological finds, and other observations, the Colorado squawfish was once found throughout warmwater reaches of the entire Colorado River Basin, including reaches of the upper San Juan River and possibly its major tributaries. Colorado squawfish were apparently never found in colder headwater areas. Seethaler (1978) indicated that the species was abundant in suitable habitats throughout the entire Colorado River Basin prior to the 1850's. Platania and Young (1989) summarized historic fish collections in the San Juan River drainage which indicate that Colorado squawfish once inhabited reaches above what is now the Navajo Dam and Reservoir near Rosa, New Mexico. Since closure of the dam in 1962 and the accompanying fish eradication program, physical changes (flow and temperature) associated with operation of the Navajo Project have eliminated Colorado squawfish in the upper San Juan River, both from the reservoir basin as well as from several miles of river downstream of the dam.

The San Juan River currently flows approximately 225 river miles from the Navajo Dam downstream to Lake Powell. The reach of currently known occupied Colorado squawfish habitat extends from Lake Powell upstream to river mile 158.4 and could be significantly impacted due to upstream water withdrawals. Of the 225 miles, about 159 of those are potentially available to the Colorado squawfish. Two diversion structures near Fruitland, New Mexico (the Hogback at river mile 158.6 and the weir at river mile 166.2), span the entire river channel and are believed to be effective blocks to upstream fish migrations (Platania 1990). The Hogback is often breached during high water which may allow passage at certain water levels, however, after breaching the structure is rebuilt and is a block to upstream fish movement.

Extreme fluctuations occurring within the framework of a natural annual hydrograph may enhance spawning success of native species and inhibit exotic species. Haynes et al. (1984) reported that fish species, such as Colorado squawfish, that evolved under highly fluctuating flow conditions, were better able to survive and successfully recruit under those conditions than the introduced species. The decline of endemic Colorado River fishes seems to be partially related to competition or other behavioral interactions with nonnative species, which perhaps have been exacerbated by alterations in the natural fluvial environment. Valdez (1990) reported that densities of three nonnative cyprinids (red shiner, sand shiner, and fathead minnow) in the Colorado River were much lower following high-flow years and increased three to four times in a 2-year period during normal- and low-water years. Platania (1990) noted that, during the 3 years of studies on the San Juan River, spring flows and Colorado squawfish reproduction were highest in 1987. He further noted catch rates for channel catfish were lowest in 1987. Appendix A, Figure 20, compares the 1987 flow of record to historical conditions for dry, average, and wet years. Recent studies also found catch rates for young-of-year Colorado squawfish to be highest in high water years, such as 1993 (Buntjer et al. 1994, Lashmett 1994).

Biology

The life-history phases that appear to be most critical for the Colorado squawfish include spawning, egg fertilization, and development of larvae through the first year of life. These phases of Colorado squawfish development are tied closely to specific habitat requirements. Natural spawning of Colorado squawfish is initiated on the descending limb of the annual hydrograph as water temperatures approach 20° Celsius (C). Spawning, both in the hatchery and in the field, generally occurs in a 2-month timeframe between July 1 and September 1, although high flow water years may suppress river temperatures and extend spawning in the natural system into September. Conversely, during low flow years when the water warms earlier, spawning may occur in late June.

A natural hydrograph with a large spring peak; a gradually declining/descending limb into early summer; and low, stable flows through summer, fall, and winter are thought to create the best habitat conditions for endangered fishes while maintaining the integrity of the channel geomorphology. Tyus and Karp (1989) pointed out the importance of peak flows (spring runoff) associated with reproductive activities of Colorado squawfish. They further stated that alteration of this hydrological event may affect initiation of Colorado squawfish migration and spawning. Additionally, maintenance of low stable flows in summer and fall are necessary for growth and survival of young Colorado squawfish.

Temperature also has an effect on egg development and hatching. In the laboratory, egg mortality was 100 percent in a controlled test at 13° C. At 16° to 18° C, development of the egg is slightly retarded, but hatching success and survival of larvae was higher. At 20° to 26° C, development and survival through the larval stage was up to 59 percent (Hamman 1981). Juvenile temperature preference tests showed that preferred temperatures ranged from 21.9° to 27.6° C. The most preferred temperature for juveniles and adults was estimated to be 24.6° C. Temperatures near 24° C also are needed for optimal development and growth of young (Miller et al. 1982).

Miller et al. (1982) concluded from collections of larvae and young-of-year below known spawning sites that there is a downstream drift of larval Colorado squawfish following hatching. Extensive studies in the Yampa and upper Green Rivers have demonstrated downstream distribution of young Colorado squawfish from known spawning areas (Archer et al. 1986; Haynes et al. 1985). Miller et al. (1982) also found that young-of-year Colorado squawfish, from late summer through fall, preferred natural backwater areas of zero velocity and less than 1.5-foot depth over a silt substrate. Juvenile Colorado squawfish habitat preferences are similar to that of young-of-year fish, but they appear to be mobile and more tolerant of lotic conditions away from the sheltered backwater environment.

Miller et al. (1982) and Archer et al. (1986) demonstrated that Colorado squawfish often migrate considerable distances to spawn in the Green and Yampa Rivers, and similar movement has been noted in the main stem San Juan River. A fish captured and tagged in the San Juan Arm of Lake Powell in April 1987 was later recaptured in the San Juan River approximately 80 miles upstream in September 1987 (Platania 1990).

Only two Colorado squawfish confirmed spawning sites, as defined in the Colorado Squawfish Recovery Plan, have been located in the Upper Basin: river mile 16.5 of the Yampa River and river mile 156.6 of the Green River. These areas have the common characteristics of coarse cobble or boulder substrates forming rapids or riffles associated with deeper pools or eddies. It is believed that a stable, clean substrate is necessary for spawning and incubation. Substrates are swept clean of finer sediments by high flows scouring the bed prior to the spawning period.

O'Brien (1984) studied the hydraulic and sediment transport dynamics of the cobble bar within the Yampa River spawning site and duplicated some of its characteristics in a laboratory flume study. Based on field observations, he reported:

> "On the rising limb of the hydrograph, sands are deposited in the cobble interstices. These sands are interchanged between the bed and the suspended zone for discharges less than bankfull. Depending on the supply-capacity relationship, either deposition or scour could be occurring. When the cobbles move, the sand, of course, is washed from the interstices and may be completely removed from around the cobbles. Rearrangement of the cobbles will result in more stability of the armor layer. On the falling limb, the armor layer becomes a trap for sands until finally, the sand reservoir is again filled. Without cobble movement, sand will be scoured only to a depth of one-half to one median cobble diameter below the cobble bed surface."

In the flume experiments, the sand level was observed approximately 0.50 to 1 cobble diameter below the surface of the cobble bed, which compared to field observations of sand depth at approximately 0.50 to 1 median cobble diameter. O'Brien reported a cobble size range of 50-100 mm with a median size of 75 mm at the spawning site. Milhous (1982) proposes discharges of approximately one-half that required to initiate cobble movement will be capable of extracting sands and fines from the cobble substrate. Thus, after the supply of sand diminishes, flows of sufficient magnitude and duration are required to scour the cobble bed in preparation for spawning and incubation.

Colorado Squawfish Activity: San Juan River

As a result of the 1991 biological opinion, Reclamation agreed to fund approximately 7 years of research on the San Juan River and its tributaries. While these studies are not yet complete, annual reports indicate that a small reproducing population of Colorado squawfish exists on the San Juan River. Based on radio telemetry studies and visual observations, two potential spawning areas have been located at river mile 132.0 and 131.15 (Miller 1994, Ryden and Pfeifer 1995a). Both of these sites are located in an area of the river known as the "Mixer" (river mile 133.4 to river mile 129.8). The highest concentration of adult Colorado squawfish in the San Juan River occur between the Cudei Diversion (river mile 142.0) and Four Corners (river mile 119.2). Ryden and Pfeifer (1995a) report that a Colorado squawfish captured at river mile 74.8 (between Bluff and Mexican Hat) made a 50-60 mile migration to the Mixer during the suspected spawning season in 1994. The fish then returned to within 0.4 river miles of its original capture location.

Successful reproduction was documented in the San Juan River in 1987, 1988, 1992, 1993, and 1994, by the collection of young-of-year Colorado squawfish. Majority of the young-of-year squawfish were collected in the San Juan River inflow to Lake Powell (Buntjer et al. 1994, Lashmett 1994, Platania 1990). Some young-of-year squawfish have been collected from the vicinity of the Mancos River confluence in New Mexico and in the vicinity of the Montezuma Creek confluence near Bluff, Utah, and at a drift station near Mexican Hat, Utah (Buntjer et al. 1994, Platania 1990). In 1994, a young-of-year squawfish was collected at the confluence with the Mancos River, which is the first specimen collected at this site since 1987 (Frank Pfeifer, USFWS, pers. comm.).

The San Juan River is one of only three remaining areas where a wild, reproducing population of Colorado squawfish still persists. The San Juan River subbasin, isolated from the Colorado and Green River subbasins, provides a third population of wild fish, contributing an additional essential buffer against a catastrophic event (such as an oil spill) elsewhere in the basin. While the Colorado squawfish population may be small in the San Juan River, it may be important as unique genetic stock. Because of this the Colorado River Fishes Recovery Team (consisting of scientists from the entire Colorado River Basin, including representatives from State wildlife agencies of California, Arizona, New Mexico, Utah, and Colorado, as well as Federal representatives from the National Park Service, Reclamation, and the Service) recommended that the San Juan River be added to the Colorado squawfish recovery plan. The updated Colorado Squawfish Recovery Plan (August 6, 1991) states that the species can be downlisted to threatened when all recovery areas (including the San Juan River from Lake Powell upstream to the confluence of the Animas River) have naturally self-sustaining populations. The San Juan River also is included in the delisting criteria.

Critical Habitat

Critical habitat has been designated within the 100-year floodplain of the Colorado squawfish's historical range in the following section of the San Juan River Basin (59 F.R. 13374).

New Mexico, San Juan County; and Utah, San Juan County. The San Juan River from the State Route 371 Bridge in T. 29 N., R. 13 W., section 17 to Neskahai Canyon up to the full pool elevation in the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26.

RAZORBACK SUCKER

Historical and Current Distribution

The razorback sucker, an endemic species unique to the Colorado River Basin, was historically abundant and widely distributed within warmwater reaches throughout the Colorado River Basin. Historically, razorbacks were found in the main stem Colorado River and major tributaries in Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming, and in Mexico (Ellis 1914; Minckley 1973). Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers, and further, that commercially marketable quantities were caught in Arizona as recently as 1949. In the Upper Basin, razorback suckers were reported in the Green River to be very abundant near Green River, Utah, in the late 1800's (Jordan 1891). An account in Osmundson and Kaeding (1989) reported that residents living along the Colorado River near Clifton, Colorado, observed several thousand razorback suckers during spring runoff in the 1930's and early 1940's. In the San Juan River drainage, Platania and Young (1989) relayed historical accounts of razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century. Platania and Young (1989) also reported the 1976 capture of two adult razorback suckers by VTN Consolidated, Inc., from an irrigation pond adjacent to the San Juan River near Bluff, Utah.

In August 1990, the New Mexico Department of Game and Fish (Lief Ahlm, NMGF, pers. comm.) interviewed two anglers from Aztec, New Mexico, who claimed to have "commonly" caught razorback suckers in the Animas River near Cedar Hill bridge in the 1930's and 1940's. When the two men were shown a battery of photographs, including roundtail chub (Gila robusta), humpback chub (Gila cypha), bonytail (Gila elegans), bluehead sucker (Pantosteus discobolus), flannelmouth sucker (Catostomus latipinis), razorback sucker, and Colorado squawfish, they both immediately identified the razorback sucker as the fish they had caught. However, prior to the 1976 capture by VTN Consolidated, Inc., there were no scientifically verified reports of razorback sucker captures in the San Juan River drainage.

The current distribution and abundance of razorback sucker has been significantly reduced throughout the Colorado River system (McAda 1987; McAda and Wydoski 1980; Holden and Stalnaker 1975; Minckley 1983; Marsh and Minckley 1989; Tyus 1987). The only substantial population of razorback suckers remaining, made up entirely of old adults (McCarthy and Minckley 1987), is found in Lake Mohave; however, they do not appear to be successfully recruiting. While limited numbers of razorback sucker persist in other locations in the lower Colorado River, they are considered rare or incidental and may be continuing to decline.

In the Upper Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic and lotic environments. The largest population of razorback suckers in the Upper Basin is found in the upper Green River and lower Yampa River (Tyus 1987). Lanigan and Tyus (1989) estimated that from 758 to 1,138 razorback suckers inhabit the upper Green River. In the Colorado River most razorback suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. Osmundson and Kaeding (1991) report that the number of razorback sucker captures in the Grand Junction area have declined dramatically since 1974.

In the San Juan River subbasin, small concentrations of razorback suckers have been reported at the inflow area in the San Juan arm of Lake Powell, Utah (Meyer and Moretti 1988), and one specimen was captured in the San Juan River near Bluff, Utah, in 1988 (Platania 1990; Platania et al. 1991). In Bestgen (1990) additional captures of small numbers of razorback suckers also were reported from the Dirty Devil and Colorado River arms of Lake Powell.

Beginning in May 1987 and continuing through October 1989, complementary investigations of fishes in the San Juan River were conducted in Colorado, New Mexico, and Utah (Platania 1990; Platania et al. 1991). In 1987, a total of 18 adult razorbacks (6 recaptures) were collected on the south shore of the San Juan arm of Lake Powell (Platania 1990; Platania et al. 1991). These fish were captured near a concrete boat ramp at Piute Farms Marina and were believed to be either a spawning aggregation or possibly a staging area used in preparation for migration to some other spawning site. Of the 12 individual razorbacks handled in 1987, 8 were running ripe males while the other 4 specimens were females that appeared gravid.

In 1988, a total of 10 razorback suckers were handled at the same general location, 5 of which were in reproductive condition (Platania et al. 1991). Six of the ten individual specimens in the 1988 samples were recaptures from 1987. Also, in 1988, a single adult tuberculate male razorback sucker was captured at approximately river mile 80 on the San Juan River near Bluff, Utah. Particularly noteworthy is that this is the first confirmed record of this species from the main stem San Juan River. The presence of this reproductively mature specimen suggests that the razorback may be attempting to spawn in some unknown location within the riverine portion of the San Juan drainage. No razorback suckers were captured in 1989. No larval specimens, nor any other size classes of razorbacks (other than adults), have ever been documented in the San Juan River drainage.

All recent captures of wild razorback suckers in the upper basin have been mature adults. In 1994 an experimental augmentation program was initiated on the San Juan River; 30 radio tagged razorback suckers and 656 razorback suckers marked with passive integrated transponder (PIT) tags were released in the San Juan River. There is no evidence anywhere in the Colorado River system that indicates significant recruitment to any population of razorback sucker (Bestgen 1990, Platania 1990, Platania et al. 1991, Tyus 1987, McCarthy and Minckley 1987, Osmundson and Kaeding 1989).

The existing scientific literature and historic accounts by local residents strongly suggests that razorback suckers were once a viable, reproducing member of the native fish community in the San Juan River drainage. Currently, the razorback sucker is rare throughout its historic range and extremely rare in the main stem San Juan River.

Biology

Specific information on biological and physical habitat requirements of the razorback sucker is very limited. Localized extirpation of razorback suckers from some localities, coupled with the species' continued decline in numbers and distribution, has prompted some research; however, details of its life history requirements, particularly in riverine environments, are still not fully understood.

In general, a natural hydrograph with a large spring peak, a gradually descending limb into early summer, and low stable flows through summer, fall, and winter are thought to create the best habitat conditions for razorback suckers. Prior to construction of large main stem dams and the suppression of spring peak flows, low velocity, off-channel habitats (seasonally flooded bottomlands and shorelines) were commonly available throughout the Upper Basin (Tyus and Karp 1989; Osmundson and Kaeding 1991). The absence of these seasonally flooded riverine habitats is believed to be a limiting factor in the successful recruitment of razorback suckers in their native environment (Tyus and Karp 1989; Osmundson and Kaeding 1991). Tyus (1987) and McAda and Wydoski (1980) reported springtime aggregations of razorback suckers in off-channel impoundments and tributaries; such aggregations are believed to be associated with reproductive activities. Tyus and Karp (1990) and Osmundson and Kaeding (1991) reported off-channel habitats to be much warmer than the main stem river and that razorback suckers presumably moved to these areas for feeding, resting, sexual maturation, spawning, and other activities associated with their reproductive cycle. While razorback suckers have never been directly observed spawning in turbid riverine environments within the Upper Basin, captures of ripe specimens, both males and females, have been recorded (Valdez et al. 1982; McAda and Wydoski 1980; Tyus 1987; Osmundson and Kaeding 1989; Tyus and Karp 1989; Tyus and Karp 1990; Platania 1990; Osmundson and Kaeding 1991) in the Yampa, Green, Colorado, and San Juan Rivers. Sexually mature razorback suckers are generally collected on the ascending limb of the hydrograph from mid-April through June and are associated with coarse gravel substrates (depending on the specific location).

Outside of the spawning season, adult razorback suckers occupy a variety of shoreline and main channel habitats including slow runs, shallow to deep pools, backwaters, eddies, and other relatively slow velocity areas associated with sand substrates (Tyus 1987; Tyus and Karp 1989; Osmundson and Kaeding 1989; Valdez and Masslich 1989; Tyus and Karp 1990; Osmundson and Kaeding 1991).

The virtual absence of any recruitment suggests a combination of biological, physical, and/or chemical factors that may be affecting the survival and recruitment of early life stages of razorback suckers. Within the Upper Basin, recovery efforts endorsed by the "Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River" (U.S. Fish and Wildlife Service 1987), include the capture and removal of razorback suckers from all known locations for genetic analyses and development of discrete brood stocks if necessary. These measures have been undertaken to develop refugia populations of razorback sucker from the same genetic parentage as their wild counterparts such that, if these fish are genetically unique by subbasin or individual population, then separate stocks will be available for future augmentation. Such augmentation may be a necessary step to prevent the extinction of razorback suckers in the Upper Basin.

Habitat requirements of young and juvenile razorback suckers in the wild are largely unknown, particularly in native riverine environments. Life stages, other than adults, have been extremely rare in the upper basin in recent times. One confirmed capture of razorback sucker juveniles in the upper basin was in the Colorado River near Moab, Utah (Taba et al. 1965). The only capture in recent years was the 1991 collection of two early juvenile razorback suckers in the lower Green River, 89.5 km above the confluence with the Colorado River (Gutermuth et al. 1994).

Razorback Sucker Activity: San Juan River

Because razorback sucker are so rare in the San Juan River and spawning or recruitment has not been documented, an experimental stocking program was initiated. In March of 1994, 15 radio-tagged razorback sucker were stocked in the San Juan River at Bluff, Utah (river mile 79.6); near Four Corners Bridge (river mile 117.5); and above the Mixer in New Mexico (136.6). In November of 1994, at these same locations plus at an additional site just below the Hogback Diversion in New Mexico (river mile 158.5), an additional 15 radio-tagged adults and 656 PIT-tagged fish were stocked. Monitoring found that these razorback suckers used slow or slackwater habitats such as eddies, pools, backwaters, and shoals in March and April and fast water 92.2 percent of the time in June and August (Ryden and Pfeifer 1995b). During 1995 both radio-tagged fish and PIT-tagged fish were contacted or captured. Razorback suckers were found in small numbers from the Hogback Diversion (river mile 158.6) to 38.1 river miles above Lake Powell (Dale Ryden, USFWS, pers. comm.)

Critical Habitat

Critical habitat has been designated within the 100-year floodplain of the razorback sucker's historical range in the following section of the San Juan River Basin (59 FR 13374).

> New Mexico, San Juan County; and Utah, San Juan County. The San Juan River from the Hogback Diversion in T. 29 N., R. 16 W., section 9 to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26.

BALD EAGLE

Status

On August 11, 1995, the bald eagle was reclassified as a threatened species (60 FR 36000) in the conterminous United States where it was previously listed as endangered (every state except for Washington, Oregon, Minnesota, Wisconsin, and Michigan where it will remain threatened). Its overall decline has been attributed to the loss of breeding habitat, illegal shooting, and the occurrence of chlorinated hydrocarbon pesticides in its food supply which caused egg deterioration and reproduction failures. Since the banning of dichloro-diphenyl-trichloro-ethane (DDT) and intensive protection efforts, bald eagle populations and the number of occupied nesting territories have increased throughout much of the United States over the past two decades.

In the Northern States Recovery Region, including Colorado, bald eagle nesting activity has more than doubled in the past 10 years, from fewer than 700 to nearly 1,800 territories that are known to be occupied. In Colorado, the Colorado Division of Wildlife reported 8 or 9 nesting pairs in the late 1980's, and 21 pairs in 1995 (Jerry Craig, CDOW, pers. comm.). Of those 21 pairs, 16 are located west of the continental divide.

In the Southwestern Recovery Region, including New Mexico, 30 breeding territories were occupied in 1994. In New Mexico, there were two occupied territories in 1995, both were outside of the San Juan Basin.

Bald eagles are often found in association with open water along seacoasts, large lakes and rivers. Their diet consists largely of fish and waterfowl, but also includes upland birds, small mammals, and carrion. In southwest Colorado, castings from one nest were made up entirely of prairie dog remains (Jerry Craig, CDOW, pers. comm.). Bald eagles are skilled hunters but also have been observed stealing prey captured by other raptors.

Survival of individual eagles, particularly those in their first year of life, probably depends heavily on conditions they encounter during the wintering period. The physiological condition of adults at the beginning of each breeding season, an important factor influencing reproductive success, also is affected by how well their energy demands are met in wintering areas. Thus, the survival and recovery of nesting populations depend on eagles having suitable wintering areas with an adequate prey base (U.S. Fish and Wildlife Service 1983). During the primary wintering period of December to March, suitable roosting and foraging habitat is important to eagles (U.S. Fish and Wildlife Service 1992, Harmata 1984, Stalmaster et al. 1979, U.S. Fish and Wildlife Service 1983).

Colorado is a popular wintering area for bald eagles (U.S. Fish and Wildlife Service 1992, Harmata 1984). In 1993-1994, 1,235 bald eagles were counted by the Colorado Division of Wildlife during midwinter counts, and 931 were counted in 1994-1995 (Jerry Craig, CDOW, pers. comm.). In New Mexico, during the winter of 1994-1995, the New Mexico Department of Fish and Game counted 402 bald eagles state wide, with 35 occurring in the San Juan basin (John Pittenger, CDOW, pers. comm.).

As part of the conservation recommendations of the 1991 biological opinion, Reclamation conducted wintering bald eagle surveys from 1993-1995. Results of the surveys show that the Animas and La Plata Rivers are important wintering areas for bald eagles. The number of eagles observed along the Animas and La Plata Rivers was consistent with counts conducted by the Colorado Division of Wildlife and the New Mexico Game and Fish Department during their annual

January mid-winter counts. Numbers of wintering eagles fluctuate from year to year depending on weather patterns.

AREA OF IMPACT AND CONCERN FOR ENDANGERED FISHES

The San Juan River originates in the mountains of southwestern Colorado and flows southwesterly into the Navajo Reservoir situated on the Colorado/New Mexico border (Figure 2). Downstream of the Navajo Dam, the San Juan River continues westerly, flowing through the towns of Archuleta, Blanco, Bloomfield, Farmington, Fruitland, and Shiprock, New Mexico. It then turns north and eventually reenters the extreme southwest corner of Colorado near Four Corners. Downstream of Four Corners, the San Juan River enters Utah and continues northwesterly through the towns of Aneth, Montezuma Creek, Bluff, and Mexican Hat, Utah, and empties into Lake Powell near Piute Farms Wash.

The reach of currently known occupied habitat extends from Lake Powell upstream to approximately river mile 158.6. A diversion structure near Fruitland, New Mexico (the Hogback at river mile 158.6), and a weir at river mile 166.1 span the entire river channel and are believed to be effective blocks to upstream fish migrations (Platania 1990). Ryden and Pfeifer (1995a) reported an observation of a Colorado squawfish 0.2 river miles below the Hogback diversion in 1994, this is the farthest upstream report of a Colorado squawfish during recent studies.

A new waterfall (25-30 feet high) developed in 1989 at the Lake Powell inflow area during declining reservoir levels and changing river channel alignment between Clay Hills and Piute Farms. This is considered a complete barrier to upstream fish passage when Lake Powell reservoir levels are low, however, in 1995 reservoir levels increased significantly and inundated the waterfall. The status of the waterfall will not be known until reservoir levels recede.

The Animas River, from which a majority of Project water will be diverted, is the largest perennial tributary to the San Juan River and affects the entire length of Colorado squawfish and razorback sucker critical habitat. Historically, flows in the San Juan River prior to the Navajo Dam were highly variable. The change in flows at three locations in the San Juan River are listed in Table 1.

Table 1
Change in Mean Monthly Flow After the Navajo Dam

Units = cfs	Pre-Navajo		Post-Navajo		Percent Change	
	Low	High	Low	High	Low	High
Farmington	170	13,471	418	9,803	+145%	-27%
Shiprock	44	19,790	213	9,045	+384%	-54%
Bluff	65	15,380	250	10,334	+284%	-48%

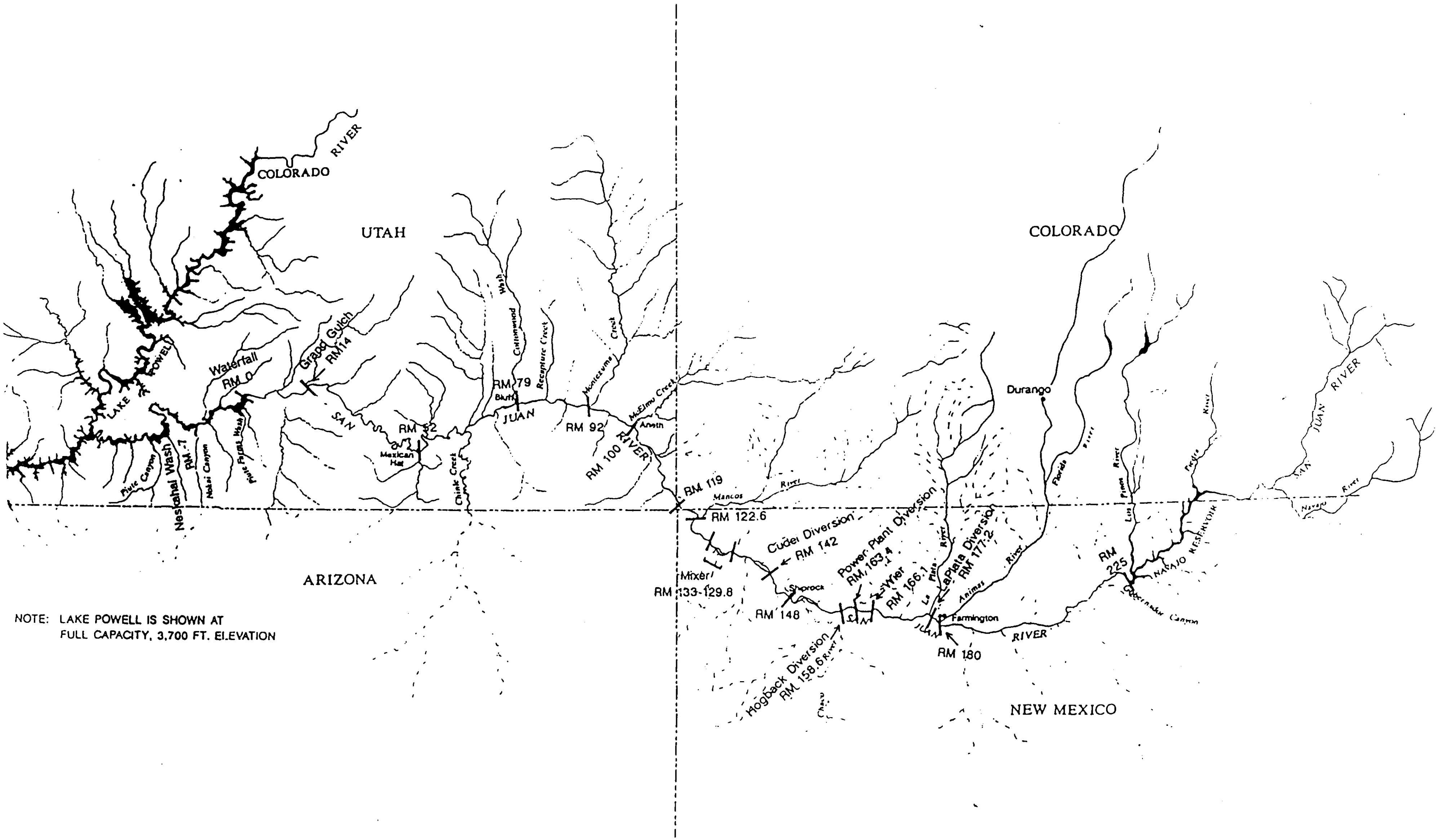

Figure 2
San Juan River

ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all Federal, State, and private actions and other human activities in the action area; the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal section 7 consultation; and the impact of State or private actions contemporaneous with the consultation process.

In formulating this biological opinion, the Service considered adverse and beneficial effects likely to result from cumulative effects of future State and private activities that are reasonably foreseeable to occur within the project area, along with the direct and indirect effects of Reclamation's proposed Federal action for the project and impacts from actions that are part of the environmental baseline (50 CFR 402.02 and 402.14 (g)(3)).

Colorado squawfish and razorback sucker

The physical and biological features that were the basis for designating the San Juan River critical habitat for Colorado squawfish are water, physical habitat, and biological environment. These primary constituent elements were determined necessary for survival and recovery of the Colorado squawfish and razorback sucker on the San Juan River. This includes a quantity of water of sufficient quality, with a hydrologic regime that is required for each life stage. Physical habitat includes areas of the San Juan River that are inhabited or potentially habitable by Colorado squawfish and razorback sucker for use in spawning, nursery, feeding, and rearing or corridors between these areas. Biological environment includes food supply, predation, and competition.

Water Quantity

To determine the effects of the proposed action on water quantity and alteration of the hydrologic regime, an analysis of flow changes was conducted. This analysis compared the effects of the Project to a pre-Project section 7 baseline (updated since 1991). The analysis included hydrologic information from three Geological Survey gaging stations: Farmington, Shiprock, and Bluff (near Mexican Hat, Utah). Three levels of development were simulated: (1) historical gage, (2) section 7 environmental baseline (baseline), and (3) baseline plus the Project (post-Project). The period of record selected for the analysis was 1929 to 1974. From this period, wet, dry, and average years were selected for analysis based upon water volumes during the spring runoff. The wet year selected was 1949, the dry year was 1951, and the average year was 1945.

Projects for inclusion in the baseline for the San Juan River were identified. Pursuant to section 7 regulations, the baseline for the Project included: (1) the past and present impacts of Federal, State, and private actions in the basin; (2) the anticipated impacts of all Federal projects having previously undergone formal section 7 consultation in the area; and (3) the impact of State or private actions contemporaneous with this consultation. The baseline for the Project includes all historical depletions in the San Juan River

Basin. Table 2 identifies each project in the baseline and its associated depletions.

Included in the baseline, along with a number of other smaller water projects, are existing operational portions of the Navajo Indian Irrigation Project, which was authorized on June 13, 1962, to provide irrigation water for 110,630 acres of Navajo-owned land in northwest New Mexico, generally south of Farmington. Construction of the Navajo Indian Irrigation Project began in 1973, and limited operation began in 1976 and 1977. The Navajo Indian Irrigation Project is being constructed in blocks of 8,000 to 10,000 acres, based on congressional appropriations. Through 1990, 6 blocks were completed with a total of 54,500 acres developed, representing an annual depletion of 132,980 acre-feet. On January 12, 1995, the Service issued a biological opinion for Blocks 1 through 8, therefore, the updated baseline shows Blocks 7 and 8, with water required for the additional blocks taken from existing Navajo depletions within the baseline. The Hogback and Fruitland Projects were limited to an aggregate depletion of 31,280 acre-feet with the remaining 16,420 acre-feet transferred to the Navajo Indian Irrigation Project. Thus, no further depletions were associated with Blocks 7 and 8. Existing depletions caused by the San Juan-Chama Project and evaporation losses from the Navajo Reservoir also are included in the baseline.

The analysis quantified the post-Project condition by adding the full Animas-La Plata depletions of 149,220 acre-feet to the baseline of 570,500 acre-feet (a depletion of 592,500 acre-feet upstream of the Mancos River, with a return flow of 22,000 acre-feet from the Dolores Project) identified in Table 2. This results in a post-Project depletion in the San Juan River Basin of 719,720 acre-feet, or 38 percent of the 1.9 MAF mean annual yield.[4]

The depletion numbers used in the analysis were provided by Reclamation for the wet, average, and dry years described above. The changes in river flow, based upon this full development, were quantified for the Project effects analysis. These changes were analyzed and a summary of the changes between baseline and post-Project flows is presented in Table 3.

4

A mean annual yield of 1.9 MAF for the San Juan River Basin has been used throughout this report and is consistent with the period of record used in the hydrological analysis. Reclamation has estimated that the long-term mean annual yield of the San Juan River Basin is 2.2 MAF. The period 1929 - 1974 was the data available in the San Juan River operations model and reflects the lower basin yield.

Table 2
San Juan Section 7 Baseline
Units = KAF

New Mexico Depletions	Depletions	Totals
San Juan-Chama		110.0*
NIIP Blocks 1-8		149.4
Navajo Reservoir Evaporation		26.0
Hammond Canal		10.0
Hogback Extension		0.0
Utah International		39.0
Existing Private Rights		
Citizen's Ditch	15.0	
Industrial Diversion	3.0	
Fruitland and Hogback	23.3	
Farmer's Mutual Ditch	8.0	
Jewitt Valley	2.0	
Municipal and Industrial Diversions	5.0	
Additional Depletions	38.3	
Minor Depletions Allowed Under RIP Since 1992	1.5	
		96.1
Municipal and Industrial Contracts from Navajo		
San Juan Powerplant		16.0
Total New Mexico Depletions		446.5
Colorado Depletions		
Upstream of Navajo		
Upper San Juan	7.8	
Navajo-Blanco	6.5	
Piedra	6.5	
Pine River	58.1	
		78.9
Downstream of Navajo		
Florida	18.1	
Animas and La Plata Rivers	32.8	
Mancos	16.2	
		67.1
Total Colorado Depletions		146.0
Total San Juan River Depletions		592.5
Return flows from Dolores River Imports		22.0
Depletions calculated at Bluff gage		570.5

* San Juan-Chama diversions have historically averaged 104,000 acre-feet for the 1929-1974 period of record; 110,000 acre-feet for the 1925-1985 period of record

Water Quality

Baseline conditions describing water quality in the San Juan River were described in the Service's January 12, 1995, biological opinion for the Navajo Indian Irrigation Project. Information on existing water quality in the San Juan River has been derived from data gathered by the Department of the Interior as part of its National Irrigation Water Quality Program investigation of the San Juan River area in northeastern New Mexico (Blanchard et al. 1993) and results from Reclamation's water quality data for the Animas-La Plata project. While a fair amount of data has been collected, the selenium data collected to date may not be conclusive.

Concentrations of selenium in water samples collected from the mainstem of the San Juan River exhibit a general increase in concentration levels with distance downstream from Archuleta, New Mexico, to near Bluff, Utah, (<1 μg/l to 4 μg/l). Tributaries to the San Juan carry higher concentrations of selenium than found in the mainstem river immediately upstream from their confluence with the San Juan; although these levels are diluted by the flow of the San Juan, the net effect is a gradual accumulation of the element in the river's flow as it travels downstream. Increased selenium concentrations may also result from the introduction of ground water to the mainstem of the river along its course. Recent data (1989 -94) collected by Reclamation show mean selenium levels in water samples from the Animas River at the Durango pumping plant site are 5.7 μg/l, with a maximum level of 28 μg/l. Data collected from March to October 1993 showed average selenium levels of 6.4 μg/l at the pumping plant site, with levels increasing downstream to 13.6 μg/l at Aztec, New Mexico. Questions have been raised regarding the high values in Reclamation's selenium data from the Animas River. Reclamation is in the process of investigating the validity of this data and continues to collect samples from the Animas River.

Sediments and biota associated with the San Juan River also showed elevated selenium levels. Composite fish samples were collected during the Department of the Interior study from six reaches of the San Juan River in spring 1990 and from seven reaches in fall 1990. Each composite sample typically consisted of five individuals of a single species. Composite samples of common carp (Cyprinus carpio) and flannelmouth sucker (Catostomus latipinnis) were collected from each reach during each sampling period. In addition, six channel catfish (Ictalurus punctatus) composite samples were collected during the two sampling periods in reaches where the species was encountered. The highest concentrations of selenium in common carp and flannelmouth sucker occurred in the river from Bloomfield to Farmington, New Mexico (Blanchard et al. 1993).

The other contaminants of concern are polycyclic aromatic hydrocarbons (PAHs), also known as polynuclear aromatic hydrocarbons (PNAs). The PAH compounds may reach aquatic environments in domestic and industrial sewage effluents, in surface runoff from land, from deposition of airborne particulates, and particularly from spillage of petroleum and petroleum products into water bodies (Eisler 1987). The PAHs were the first compounds known to be associated with carcinogenesis (Lee and Grant 1981). Several PAHs are among the most potent carcinogens known to exist, producing tumors in some organisms through single exposures to microgram quantities. The PAHs act at both the site of application and at organs distant to the site of absorption; their effects have been demonstrated in nearly every tissue and species tested, regardless of the route of administration (Lee and Grant 1981). The evidence implicating PAHs as inducers of cancerous and precancerous lesions is overwhelming, and this class of substances is probably a major contributor to the recent increase in cancer rates reported for industrialized nations (Cooke and Dennis 1984).

Ongoing Service analyses of PAH contamination of aquatic biota of the San Juan River and hepato-histological examinations of fish in the river have raised concerns regarding the exposure of these organisms to contaminants introduced into the basin through the intensive development of energy resources in the area. Analyses of bile samples taken from fish in the San Juan River indicate that these organisms are being exposed to high levels of three PAH compounds, and strongly suggest that the aquatic environment of the river is heavily impacted by PAHs.

The primary PAH compounds of concern in the San Juan River are naphthalene, phenanthrene, and benzo(a)pyrene. The lower molecular weight unsubstituted PAH compounds, such as naphthalene and phenanthrene, have significant acute toxicity to some organisms (Krahn et al. 1984, 1986: Zitko 1975). Higher molecular weight PAHs, including benzo(a)pyrene, have been found to cause mutations and cancer in aquatic and terrestrial organisms (Eisler 1987). Background concentrations of these compounds are <10,000 nanograms per gram (ng/g) for naphthalene, <3,000 ng/g for phenanthrene, and <100 ng/g for benzo(a)pyrene (National Marine Fish. Serv. 1989). Flannelmouth suckers (Catostomus latipinnis) (n=36) analyzed from the San Juan River had mean concentrations of 97,110 ng/g wet weight naphthalene, 15,767 ng/g phenanthrene, and 256 ng/g benzo(a)pyrene in bile samples. From these data, it is apparent the flannelmouth suckers in the San Juan River are exposed to and accumulating PAH compounds in bile. Utilizing the flannelmouth suckers as indicators of similar exposures experienced by the Colorado squawfish and razorback sucker, these levels are of significant concern.

Physical Habitat

The impacts to physical habitat involve the loss of the quantity and quality of water in critical habitat and the change in flow regime. The quantity and timing of flows influence how various habitats are formed and maintained. Water depletions reduce the ability of the river to create and maintain these habitats; degradation of water quality lessens the ability of endangered species to survive in these habitats.

Osmundson and Kaeding (1991) reported observations on the Colorado River (15-mile reach) during the drought years of 1988 -1990, that backwaters were filling in with silt and sand because spring flows were not sufficient to flush out the fine sediment. Also they reported that tamarisk colonized sand and cobble bars, stabilizing the river banks. On the San Juan River, lack of flooding since Navajo Dam was completed and introduction of exotic riparian vegetation (tamarisk and Russian olive) has armored the channel banks resulting in a narrowing of the channel with reduced flood capacity (Bliesner and Lamarra 1994).

Biological Environment

Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity, which could be limited by the presence of contaminants. Predation and competition from nonnative fishes has been identified as a factor in the decline of the endangered fishes. Depending upon species-specific tolerance levels, nonnative fishes may have competitive advantages in habitats damaged by the presence of contaminants and altered flow regimes.

Bald eagle

The existing habitat in the project area consists of the Animas, La Plata, and Mancos Rivers and their attendant riparian zones. Fish and waterfowl from these river systems provide a prey base for wintering eagles. Upland areas, some of which may be converted to agricultural lands with project implementation, contribute to the prey base used by bald eagles. Reclamation (1995) reported mule deer, prairie dog, and rabbit as components of bald eagle diets in the project area. Reclamation reported that habitats receiving the highest use during the day in the winter are cottonwood dominated plant communities with large mature trees and adjacent emergent wetlands, where human development is minimal. Isolated cottonwood trees outside the riparian zone, such as those associated with irrigation canals, also provide habitat for bald eagles.

Three bald eagle breeding territories occur in La Plata County, Colorado. One is located on the Animas River, but it has not been active since 1979. The other two are north of the project area and have been active in recent years. One is in the vicinity of the Animas-La Plata Project, approximately 4 miles from Ridges Basin, west of Perins Peak. The pair of bald eagles are often observed collecting prey at Lake Durango and a fish hatchery on Lightner Creek. If Ridges Basin were constructed, it would likely provide a prey base for these birds (Scott Wait, CDOW, pers. comm., Jerry Craig, CDOW, pers. comm.).

Because Ridges Basin Reservoir (when not frozed) would likely provide a prey base for nesting and wintering bald eagles, the Service finds that potential water quality problems or bioaccumulation of contaminants may affect bald eagles. Soil extracts from Ridges Basin show several sites with selenium concentrations well above any of the aquatic life criteria. Soil extracts represent the soluble fraction of materials in the soils under laboratory conditions. The safe levels of selenium concentrations for protection of fish and wildlife in water are <2.0 μg/l and toxic levels are considered >2.7 μg/l (Lemley 1983, Lemley and Smith 1987, Maier and Knight 1994). On the north side of the proposed reservoir basin, soil extracts had a concentration of 24 μg/l of selenium and a concentration of 60 μg/l of selenium was found on the south side.

Recent data (1989-94) collected by Reclamation shows mean selenium levels in water samples from the Animas River at the pumping plant site are 5.7 $\mu g/l$, with a maximum level of 28 $\mu g/l$. Data collected from March to October 1993 showed average selenium levels of 6.4 $\mu g/l$ at the pumping plant site, with levels increasing downstream to 13.6 $\mu g/l$ at Aztec, New Mexico. The Service understands that there is some question as to the accuracy of this data. Fish and invertebrate samples were collected from the Animas River and the average selenium concentrations were 2.3 and 2.4 ppm respectively. These levels in fish and invertebrates are not indicative of a selenium problem.

EFFECTS OF THE PROPOSED ACTION

Colorado squawfish and razorback sucker

Water Quantity

When Project depletions are considered (Table 3), impacts occur under all conditions with further reduction in flow virtually every month. The months of April, May, June, July, and August of dry and average years displayed the greatest impact from the Project. Mean monthly flow reductions range from 3 to 27 percent in an average year (1945) at Bluff, from 4 to 41 percent at Shiprock, and from 3 to 42 percent at Farmington. For average years, the percent of flow reduction at Shiprock and Farmington in July is greater than at Bluff. The 1991 analysis only looked at conditions at Bluff, this analysis includes Shiprock and Farmington because the greatest concentrations of adult Colorado squawfish are found upstream of Bluff. Mean monthly flow reductions for a wet year (1949) are from 2 to 22 percent at Bluff, from 2 to 43 percent at Shiprock, and from 2 to 34 percent at Farmington. For wet years, the percent of flow reductions was highest in August; again the percent change in depletions at Shiprock and Farmington are greater than at Bluff. Dry years (1951) tend to reflect the most significant changes where flow reductions range between 1 and 61 percent at Bluff, between 2 and 43 percent at Shiprock, and between 3 and 30 percent at Farmington.[2] In dry years, the greatest percent of flow reductions occurs at Bluff in May, and at Shiprock and Farmington in July. Table 3 does not reflect any proposed operational changes of Navajo Dam as required in the reasonable and prudent alternative.

2

The calculation of changes in flow between baseline and post-Project was accomplished using Reclamation's model of the San Juan River. The modeled depletions at Bluff may vary somewhat from the Animas-La Plata depletions shown in Appendix B due to reservoir and diversion operations. The model is the best available, but has some limitations and may not reflect all current operational objectives for the Navajo Reservoir. The major difference lies in the way flood releases are treated. Present operations call for releases in anticipation of spring floods, while the model does not (i.e., spills occur). The changes between baseline and post-Project were modeled as they occur in the Project operation plan and accurately reflect the change in flow expected to occur.

Table 3

Post-Project Conditions for the Animas-La Plata Project at Bluff, Utah

DRY

Water Year 1951 (units = cfs)

Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	890	-41	849	-5
November	871	-17	854	-2
December	934	-29	904	-3
January	899	-16	883	-2
February	927	-13	915	-1
March	719	-24	694	-3
April	502	-54	449	-11
May	610	-372	237	-61
June	2040	-598	1442	-29
July	1241	-177	1064	-14
August	1065	-65	1000	-6
September	1245	7	1252	1

AVERAGE

Water Year 1945 (units = cfs)

Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	1189	-138	1051	-12
November	1136	-91	1045	-8
December	1012	-59	953	-6
January	977	-44	934	-4
February	1259	-76	1183	-6
March	1015	-112	903	-11
April	1178	-277	901	-24
May	5112	-159	4952	-3
June	4583	-504	4079	-11
July	1722	-470	1252	-27
August	1654	-280	1374	-17
September	625	-24	602	-4

Table 3 Cont.

Post-Project Conditions for the Animas-La Plata Project at Bluff, Utah

WET

Water Year 1949 (units = cfs)				
Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	1402	-107	1295	-8
November	1267	-62	1205	-5
December	982	-37	945	-4
January	1288	-44	1244	-3
February	1484	-59	1424	-4
March	1586	-145	1441	-9
April	3017	-449	2568	-15
May	6487	-194	6294	-3
June	10729	-217	10512	-2
July	4417	-498	3919	-11
August	1220	-263	956	-22
September	807	-18	788	-2

Post-Project Conditions for the Animas-La Plata Project at Shiprock, New Mexico

DRY

Water Year 1951 (units = cfs)				
Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	707	-57	651	-8
November	862	-30	832	-4
December	846	-42	803	-5
January	815	-26	789	-3
February	848	-22	826	-3
March	740	-33	707	-4
April	513	-62	450	-12
May	1148	-384	764	-33
June	2091	-612	1479	-29
July	450	-192	259	-43
August	550	-80	470	-14
September	551	-8	543	-2

Table 3 Cont.

Post-Project Conditions for the Animas-La Plata Project at Shiprock, New Mexico

AVERAGE

Water Year 1945 (units = cfs)

Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	899	-153	746	-17
November	948	-104	844	-11
December	864	-70	794	-8
January	812	-55	756	-7
February	960	-86	873	-9
March	914	-122	792	-13
April	1124	-287	837	-26
May	4437	-171	4266	-4
June	4183	-518	3665	-12
July	1186	-485	701	-41
August	720	-296	424	-41
September	492	-40	452	-8

WET

Water Year 1949 (units = cfs)

Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	989	-122	867	-12
November	1008	-76	933	-8
December	885	-49	836	-6
January	872	-54	818	-6
February	1140	-68	1071	-6
March	1212	-153	1059	-13
April	2361	-457	1904	-19
May	6331	-203	6128	-3
June	10408	-229	10179	-2
July	3583	-511	3072	-14
August	651	-276	374	-43
September	496	-34	462	-7

Table 3 Cont.

Post-Project Conditions for the Animas-La Plata Project at Farmington, New Mexico

DRY

Water Year 1951 (units = cfs)

Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	808	-80	729	-10
November	817	-40	776	-5
December	873	-50	823	-6
January	881	-31	851	-4
February	898	-25	873	-3
March	812	-39	773	-5
April	788	-69	719	-9
May	1325	-382	943	-29
June	2154	-608	1546	-28
July	686	-208	478	-30
August	720	-89	631	-12
September	662	-20	642	-3

AVERAGE

Water Year 1945 (units = cfs)

Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	945	-171	774	-18
November	956	-103	854	-11
December	875	-65	810	-7
January	859	-54	805	-6
February	958	-79	879	-8
March	914	-109	805	-12
April	1225	-224	1002	-18
May	4690	-120	4570	-3
June	4220	-504	3716	-12
July	1202	-501	701	-42
August	929	-309	620	-33
September	627	-52	575	-8

Table 3 Cont.

Post-Project Conditions for the Animas-La Plata Project at Farmington, New Mexico

WET

Water Year 1949 (units = cfs)				
Month	Section 7 Baseline	ALP Depletions	Post-Project Conditions	Percent Change
October	987	-141	846	-14
November	939	-82	857	-9
December	896	-49	847	-5
January	864	-49	815	-6
February	1149	-59	1089	-5
March	1155	-115	1039	-10
April	2647	-348	2299	-13
May	6474	-120	6354	-2
June	9977	-277	9700	-3
July	3750	-514	3236	-14
August	849	-291	558	-34
September	617	-42	575	-7

The Project will cause discrete, identifiable, additive, adverse impacts to the San Juan River endangered fishes. As shown in the flow analysis, the Project will cause flow depletions which, in addition to existing projects, will further alter historical flow regimes.

Since 1963, the operation of all existing projects, especially Navajo Dam, has significantly altered flows of the San Juan River resulting in a decrease in average spring peaks and a doubling of average winter base flows. The Project would further reduce the remaining spring runoff within occupied habitat. The flow analysis shows depletions of up to 61 percent in May of the representative dry year. The fact that the Project would further deplete flows during peak runoff is of concern to the Service because this period is of great significance geomorphically and ecologically. This is the most dynamic period in the cycle, and it precedes the very critical spawning period of the endangered fishes. Observations clearly demonstrate that the spawning activities of these fish are synchronized with and are undoubtedly influenced by the spring runoff period (Archer et al. 1986, Archer and Tyus 1984, Tyus and Karp 1989). The Service believes that peak spring flows are very important for maintaining channel geomorphology, providing access to off-channel habitats, stimulating spawning migrations, and preserving suitable spawning substrates.

While the precise volume and duration of flows required for maintaining and/or improving important physical and biological needs are unknown, it appears that spawning and recruitment are limiting to the survival and recovery of Colorado squawfish and razorback sucker in the San Juan River and throughout the Upper Basin. Furthermore, enhancement of existing conditions is necessary to enhance or promote spawning and recruitment. Given that existing projects have significantly dewatered the San Juan River, the annual removal of an additional 149,220 acre-feet of water associated with the Project further reduces the probability of ever achieving necessary streamflow for future maintenance and recovery of the physical and biological integrity of the San Juan River.

Water quality

Surface and ground water quality in the Animas, La Plata, Mancos, and San Juan River drainages have become significant concerns (Brogden et al. 1979). While the selenium data collected to date may not be conclusive, potential selenium contamination in project-affected rivers and newly created reservoirs and the subsequent bioaccumulation in the food chain could become a problem for the predatory Colorado squawfish, as well as the razorback sucker. Backwaters in the San Juan River can capture irrigation return flows with inorganic selenium creating a potential for selenium to be incorporated into primary producers and passed up the food chain (Abell 1994).

Changes in water quality and contamination of associated biota are known to occur in similar Reclamation projects in the San Juan drainage (i.e., irrigated lands on the Pine and Mancos Rivers) where return flows from irrigation make up a portion of the river flow or other aquatic sites downstream (Sylvester et al. 1988). Increased loading of the San Juan River and its tributaries with soil salts, elemental contaminants, and pesticides from irrigation return flows could potentially degrade water quality and cause harm to the endangered fishes.

The potential increases in selenium concentration in the waters of the San Juan River caused by the proposed action could adversely affect the aquatic biota of the system, including the Colorado squawfish and razorback sucker. Selenium is of particular concern due to its tendency to concentrate in low velocity habitats that are important habitats for Colorado squawfish and razorback suckers. Operation of the Project could result in some increased selenium as a result of increased irrigation return flows from seleniferous soils and reduced flows in the San Juan River. Until more data are available, any appreciable increase in the concentration of selenium available for bioaccumulation in prey species or in whole body contamination of the endangered fish species within critical habitat is considered an adverse modification of critical habitat.

In the Service's preliminary analyses of PAH data collected from assays of the San Juan River Basin, the Animas River, near its confluence with the San Juan River, contained by far the highest concentrations of PAHs. Whether or not this is attributable to local sources, or unidentified PAH hotspots upstream in the Animas River watershed is unknown at this time.

Very little information is available on the influence of turbidity on the endangered Colorado River fishes. It is assumed, however, that turbidity is important, particularly as it affects the interaction between introduced fishes and the endemic Colorado River fishes. Because these endemic fishes have evolved under natural conditions of high turbidity, it is concluded that the retention of these highly turbid conditions is an important factor for these endangered fishes. Reduction of turbidity may enable introduced species to gain a competitive edge which could further contribute to the decline of the endangered Colorado River fishes.

Water clarity may affect the toxicity of PAHs. Certain PAHs (e.g., flouranthene) are photoactivated by ultraviolet light and become much more toxic than the nonactivated compound. Tests on larval/fry Colorado squawfish, razorback sucker, and other fish species at the National Biological Service's Midwest Science Center have indicated that in the presence of ultraviolet light, the toxicity of a particular concentration of PAH compound can increase by an order of magnitude or more (Mount 1995).

Physical Habitat

Seasonally flooded habitats such as vegetated shorelines, side channels, mouths of ephemeral washes, and tributaries have been identified as important during runoff as staging areas for Colorado squawfish and razorback sucker (Ryden and Pfeifer 1995a, 1995b, Miller 1994). Bliesner and Lamarra (1994) found that overbank flooding occurs in the San Juan River at approximately 5,000 cfs and the area of inundation increases with higher flows. Full Project depletions would reduce volume and duration of peak flows during spring runoff in wet to average years and could reduce these seasonally flooded habitats. Studies are not yet complete, so specific impacts to these habitats cannot be identified.

Reduction of runoff flows due to project operation also could impact the maintenance of spawning habitat. Current studies are ongoing to try to determine the relationship between annual hydrograph and the availability of spawning substrates.

Biological Environment

Data collected by Osmundson and Kaeding (1991) indicated that during low water years nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers. No specific data is available relating nonnative fishes with flow regimes on the San Juan River, however, Reclamation concluded in the biological assessment that depletions by the Project that reduce peak spring flows may contribute to enhancement of nonnative species.

In summary, the proposed project would reduce the amount of water delivered to critical habitat; alter the hydrologic regime; and increase water quality problems by reducing dilution. Without actions taken to offset impacts, further flow reductions in the San Juan River are likely to jeopardize the continued existence of the Colorado squawfish and razorback sucker and adversely modify or destroy their critical habitat. The San Juan River is an essential component of the Colorado River Basin and is needed to ensure maintenance of populations of Colorado squawfish and razorback sucker in the event populations are lost in the Green River subbasin and/or Colorado River subbasin. Any additional losses or further degradation of remaining San Juan River habitats, resulting in further reductions in distribution and abundance of Colorado squawfish and razorback sucker, will exacerbate problems the species is currently experiencing in the San Juan River and throughout the remainder of the Upper Basin. Protection and enhancement of the San Juan River is needed to provide additional protection against possible extinction of the Colorado squawfish and razorback sucker while reducing total dependency on the Colorado and Green Rivers systems for survival and recovery. The San Juan River subbasin, isolated from the Colorado and Green Rivers subbasins, provides a third population of wild fish, contributing an additional essential buffer against a catastrophic event (such as an oil spill) elsewhere in the basin.

Bald eagle

There are several potential impacts to bald eagles that could result from project construction and operation. Impacts to the existing cottonwood riparian forests on the Animas and La Plata Rivers and impacts to future cottonwood recruitment could affect the primary habitat used by bald eagles in the project area. Reclamation conducted studies to determine project impacts to wetland and riparian areas in the project area. A vegetation inventory was conducted on the riparian corridors of the Animas and La Plata and Mancos Rivers and all vegetation within a one mile corridor was classified using photo interpretation. An assessment of project impacts to riparian corridor vegetation communities was conducted.

The results of the riparian impact studies conducted by Reclamation on the Animas River predicts no impact to existing vegetation due to reduction in groundwater levels, but it indicated there may be limited reduction in cottonwood recruitment potential on low terraces between Flora Vista and the San Juan River. On the La Plata River, impacts to existing vegetation from reductions in ground water should be minimal (less than 10 acres). On the La Plata River, between the La Plata Diversion Dam and the Southern Ute Diversion Dam (SUDD) some impacts to the riparian forest may occur from erosion due to the importation of sediment free water from Ridges Basin Reservoir. On the La Plata River below the Southern Ute Diversion Dam, if flow management strategies are implemented, no impacts to cottonwood recruitment is anticipated. Loss of cottonwood trees associated with irrigation canals could occur when canals are abandoned due to project implementation.

The combination of pumping water (with suspended sediment) from the Animas River that has high levels of selenium into Ridges Basin, where high levels of selenium are present in some soils, could cause a potential contaminant bioaccumulation problem in the food chain (Rick Krueger, USFWS, pers. comm.).

The reasonable and prudent alternative outlined above for Colorado squawfish and razorback sucker allows for the construction and operation of Stage A only. No impacts to riparian vegetation used by bald eagles on the Animas or La Plata Rivers is anticipated for Stage A. However, there maybe some bioaccumulation of contaminants in the prey base associated with Ridges Basin Reservoir. Some impacts may occur to cottonwood recruitment in riparian areas used by eagles during Stage B and Phase II of the project. Also, some loss of cottonwood trees may occur with canal abandonment. The Service has considered these impacts and developed conservation recommendations to reduce impacts to bald eagles. It is the Service's biological opinion that the Project, as described herein, is not likely to jeopardize the continued existence of the bald eagle.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Endangered Species Act.

One private activity that is likely to occur in the future and could affect bald eagles is the increased housing development in rural areas in La Plata County, Colorado. Development in the floodplain is occurring now and is expected to increase in the future. Reclamation's surveys found that bald eagles did not use areas where there is a lot of residential development. Roost sites, potential nest sites, and areas of general use by bald eagles could all be adversely affected by private development activity. The Service is not aware of any future State actions that could affect bald eagles.

The Service is not aware of any future State, local, or private projects, that would not require a Federal action, that may affect Colorado squawfish or razorback sucker.

REASONABLE AND PRUDENT ALTERNATIVE

The Service believes, based on the analysis of the hydrological and biological information, that implementation of all the following elements will avoid the likelihood of jeopardizing the continued existence of Colorado squawfish and razorback sucker; and avoid destruction or adverse modification of critical habitat. Reclamation agrees to carry out all of the elements of the reasonable and prudent alternative. These actions will serve as a reasonable and prudent alternative so long as they are completed and/or implemented before Project depletions occur.

1. After reviewing baseline hydrological conditions and how Reclamation could operate Navajo Dam to mimic the natural hydrograph, the Service determined that an initial depletion not to exceed 57,100 acre-feet for the Project is not likely to jeopardize the continued existence of the Colorado squawfish or razorback sucker nor adversely modify or destroy their critical habitat, assuming the implementation of all elements of the reasonable and prudent alternative. This depletion is that portion of the Project available from the construction of Phase 1, Stage A. Only those Project features which result in a depletion of 57,100 acre-feet (Phase I, Stage A) will be constructed and operated pursuant to this biological opinion. However, the Animas-La Plata Project <u>depletion</u> can not exceed an annual maximum of 57,100 acre-feet in any year, as calculated at the Bluff gage (located

at Mexican Hat), until all the elements of this reasonable and prudent alternative are completed and/or implemented. However, if Reclamation can provide a minimum winter flow out of Navajo Dam of approximately 300 cfs on a recurring basis such that the flexibility of operation necessary to mimic a natural hydrograph can be maintained as demonstrated by the model runs showing an availability of up to 300,000 acre-feet of water for spring release for endangered fishes 96 percent of the time (as per the 1991 biological opinion), then and only then can Stage A be operated with 57,100 acre-feet as an average annual depletion. This is a requirement for the research period. Development of preliminary flow recommendations (provided hydrolgic conditions allow) are planned to occur in 1998 after the conclusion of the research. Navajo Dam operations would then be based on these flow recommendations.

2. Reclamation has agreed to contribute funding to the San Juan River Basin Recovery Implementation Program, including funding for research necessary to complete the objectives of the approximate 7-year research effort on the San Juan River and its tributaries. The research is being conducted by knowledgeable endangered species and habitat experts and is designed to allow for testing of hypotheses. The ultimate goal of this research is to characterize those factors which limit native fish populations in the San Juan River and to provide management options to conserve and restore the endangered fish community. In order to complete the research objectives, Reclamation agrees to provide all requested test flows (test flows are based on hydrologic conditions for each water year). These test flows will include winter releases from Navajo Dam of approximately 300 cfs for two weeks in early 1996, and for a 4 month duration in 1996/1997 winter season (provided hydrologic conditions are appropriate). The 4-month test should begin on or about November 1 and extend through February 28, with ramping sufficient to avoid stranding fish in isolated pools or shoals. The research period is scheduled for completion in 1997, provided hydrologic conditions allow all test flows to be completed. Preliminary flow recommendations, based on research results, will be developed in 1998. After the preliminary recommendations are developed, the Service and Reclamation will reinitiate section 7 consultation to determine whether additional depletions are permissible for the Animas-La Plata Project.

3. Reclamation will continue to operate Navajo Dam under study guidelines developed under element 2 for the research period. Test flows will continue to be provided to re-create a wide range of flow conditions including high flows similar to 1987, which are hypothesized to benefit reproduction and recruitment in the endangered fish community. Release schedules will be determined by the Service and Reclamation based on recommendations of the San Juan Recovery Implementation Program's Biology Committee and the available water supply after meeting baseline depletions. These release schedules shall recognize the limitations on the outlet works facilities and the Corps of Engineers Water Control Manual. The current channel capacities in the Water Control Manual are: 5,000 cfs below Navajo Dam, 16,800 cfs at

Farmington (below Animas River confluence), and 17,600 cfs at Shiprock.

4. The following procedure will be used to implement flow recommendations developed by the San Juan Recovery Implementation Program's Biology Committee (with oversight by the Coordination Committee) for the research period. The Navajo Dam Operating Committee shall advise the Biology Committee on available water to meet the needed flow requests for the research effort during any particular year. The representative from Bureau of Reclamation-Navajo Dam Operations, shall meet with the Biology Committee in January to present information on the projected water availability of the current water year (1 April-30 November) and storage capacity of Navajo Reservoir. The Biology Committee shall develop the desired criteria for releases for the current water year (April through November). The Navajo Dam Operating Committee shall meet sometime before March 10 of each year to analyze this input and determine if the release conditions can be met, considering senior water rights and water supply. Any other considerations to be addressed should be compiled at this time and a report prepared by the Operating Committee for the Biology Committee. The report will be presented to the Biology Committee in March by a representative of the Operating Committee in time to finalize release targets for the current water year. Disputes among representatives that cannot be resolved at the Biology Committee level shall be referred to the San Juan Recovery Implementation Program's Coordination Committee.

5. Reclamation shall cooperate with the Biology Committee and Navajo Dam Operating Committee to determine the release hydrograph for spring flows and shall follow the agreed upon hydrograph without deviation, except under emergency conditions or where deviation is required to stay within the Corps of Engineers flood operating rules.

6. At the termination of the biological studies undertaken during the research period, year-round flow recommendations based on the best scientific and commercial data then available will determine the manner and extent to which Navajo Dam shall be operated to mimic a natural hydrograph (see Appendix A) for the life of the Animas-La Plata Project. The year-round flow recommendations are to be developed by the San Juan River Basin Recovery Implementation Program's Biology Committee and approved by the Coordination Committee, Service and Reclamation.

7. The binding agreements (Appendix B) to legally protect the reservoir releases (for both the study period and for the life of the Animas-La Plata Project) to and through the endangered fish habitat to Lake Powell that were executed in support of the 1991 biological opinion for the Animas-La Plata Project will continue with all force and effect. The Bureau of Reclamation will continue to participate in and contribute funding for the San Juan Recovery Implementation Program that was established by cooperative agreement on November 1,

1992 (Appendix C) in accordance with funding agreements that are reached among Recovery Program participants.

Discussion

The jeopardy and adverse modification conclusion in this biological opinion is based on full Project development which would result in an average annual depletion of 149,220 acre-feet of water. To offset the likelihood of jeopardy and adverse modification of critical habitat, the reasonable and prudent alternative presented herein includes construction and operation of the Phase I, Stage A of the Project, which would initially result in an annual depletion of 57,100 acre-feet, a considerably smaller depletion. However, even this smaller depletion is biologically acceptable only if all elements of the reasonable and prudent alternative are fully implemented. Therefore, Phase I, Stage A could not exceed 57,100 acre-feet until all elements are fully implemented. This would require that Reclamation operate Navajo Dam to provide the flexibility to mimic a natural hydrograph as directed by the Biology Committee and as demonstrated by the model runs that show availability of 300,000 acre-feet of water 96 percent of the water years for the endangered fishes. In order to achieve this, a low winter flow (about 300 cfs), if hydrologic conditions permit, below Navajo Dam would be required. Therefore, until low winter flows, below the existing low of 500 cfs become part of Navajo Dam operations, Phase I, Stage A could not exceed an annual depletion of 57,100 acre-feet.

The operation of the full scale Project (Figures 1-18, Appendix A) would result in a significant reduction of spring peak flows through the endangered fish habitat in the San Juan River, while the operation of the Project in accordance with the reasonable and prudent alternative takes much less water on a fairly steady basis throughout the year. When one compares the initial depletion of the Project to the hydrograph of existing conditions with the Navajo Dam operated to mimic a natural hydrograph (Figures 1-18, Appendix A), there is negligible change to the hydrograph shape and/or timing of spring peak flows with the reoperation of the Navajo Dam. This is important in order to provide the gradual ascending and descending limbs of the spring peaks. The water from Navajo Reservoir storage is still available 96 percent of the water years to provide the same shape, timing, and frequency, assuming a low winter flow of approximately 300 cfs.

Ongoing research is an important feature of the reasonable and prudent alternative. It was sufficient new information from research conducted as a result of the 1979 biological opinion that led to the reinitiation of section 7 consultation for the Project in 1989. It is the implementation of research which will provide the Service with further information about the biological needs of the fish specific to the San Juan River Basin and how these needs can best be met. The future development of water in the San Juan River Basin, including the proposed remaining depletions of the Project, will be highly dependent on the outcome of the biological studies which are required as part of this reasonable and prudent alternative. In making future decisions about endangered species, the Service must use the best scientific and commercial data available. Ongoing research results will provide that necessary data.

Winter releases from Navajo Dam have maintained flows at or above 500 cfs through winter months during most years since 1962 in the San Juan River at Archuleta. The median pre-dam (1931-1962) winter flow (November through February) at Archuleta was about 250 cfs. This increase in base flow at Archuleta, combined with increased irrigation return flows in the winter, has provided a median flow below Shiprock of over 1,400 cfs during the post-dam period compared to a median flow of 660 cfs pre-Navajo Dam. Releases from Navajo Dam of approximately 300 cfs would produce an average winter base flow of approximately 650-700 cfs near Bluff, Utah. The San Juan Recovery Implementation Program's Biology Committee finds it necessary to test a winter low flow in critical habitat for Colorado squawfish and razorback sucker, prior to making a final recommendation on minimum winter flows. The hydrographs provided by Reclamation that illustrate implementation of the reasonable and prudent alternative, show winter releases from Navajo Dam of 300 cfs. Therefore, the Service finds it appropriate to provide winter test flows of approximately 300 cfs during the research period.

The winter low flow test as required in Element 2 above would require releases from Navajo Dam to be ramped down from 500 cfs to about 300 cfs in more than 6 hours, but less than 24 hours. Flows would not be allowed to fall below 500 cfs in endangered fish habitat, as measured at the Shiprock and/or Four Corners gage. The 4-month test would allow some assessment of biological response and should be replicated in a subsequent year, to be valid.

In 1991, it was determined that the minimum study period necessary to conduct the required studies was approximately 7 years. Any inability to deliver the flows under the third element of the reasonable and prudent alternative would likely prolong the research period. To date, the range of flows necessary to complete the research have not been available for testing and not all of the releases have been synchronous with the peaks of the Animas River, as requested.

During the research study period, it was anticipated that Navajo Dam would be operated under a variety of scenarios (wet, average, and dry) to mimic a natural hydrograph. However, to date, a dry year scenario has not yet been available. Because of this, all planned research can not be completed. The objective is to re-create a high spring peak flow providing a gradually ascending limb followed by a gradually declining recession limb to low, stable flows throughout the summer, fall, and winter. The Service and the biological experts believe that this is the best opportunity available to bring the endangered fish back from the brink of extirpation in the San Juan River. By returning the river to a more natural hydrograph and raising the spring peak flows, the Service believes there will be an increase in reproduction and recruitment of the endangered fish in the San Juan River. This operation of Navajo Dam is the most important feature of the reasonable and prudent alternative both for the research period and the long term.

In order for there to be an annual average depletion of 57,100 acre-feet of water from the Project, there must be a guarantee that, based on the results of the research program and dependent upon prevailing hydrology, Navajo Dam will be operated to mimic the natural hydrograph for the life of the Animas La-Plata Project. Under section 7(a)1, Reclamation has agreed to reoperate

Navajo Dam for the recovery of the endangered fishes. Releases for the endangered fish will be legally protected to and through endangered fish habitat to Lake Powell. However, until all research is completed, the required water delivery schedule for the life of Navajo Dam (in terms of hydrograph shape, timing, volume, and frequency) is unknown. Final year-round flow recommendations will be determined at the conclusion of the research.

Under present conditions, computer simulations predict that by providing a 300 cfs minimum winter flow, 300,000 acre-feet would be available 96 percent of the time, thus providing maximum flexibility to mimic a natural hydrograph (shape, timing, and frequency). However, under full depletions (adding in all future proposed projects up to each State's full compact allotment), the 300,000 acre-feet of water from the Navajo Reservoir would be available only 33 percent of the time, which indicates that the ability to provide all four elements of a natural hydrograph (shape, timing, volume, and frequency) would be severely restricted. The research, therefore, is directed towards determining how Navajo Reservoir releases can best be used in terms of mimicking the natural hydrograph. This information will be utilized by the Service in coordination with Reclamation to determine reservoir releases needed for the endangered fishes.

The seventh element is legal protection of releases from Navajo Dam and Reservoir to and through endangered fish species habitat. It is not enough to only release water from Navajo Dam. There also must be guaranteed delivery of the water so that it provides the habitat improvement necessary to maintain and increase the endangered fish population in the San Juan River. To ensure legal protection of releases for listed fish, a Memorandum of Understanding and Supplemental Agreement have been developed and executed (Appendix B).

The Recovery Implementation Program for the San Juan River is now developed and Reclamation is providing funding for the research effort through the Recovery Implementation Program. Funding of the research and all other recovery activities for the endangered fish of the San Juan River has become a shared responsibility of the participating parties in the Recovery Implementation Program.

A conservation recommendation has been developed to address water quality concerns in the San Juan River that could cause impacts to the endangered fishes.

INCIDENTAL TAKE

Section 9 of the Endangered Species Act, as amended, prohibits any taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct) of listed species without a special exemption. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered taking within the bounds of the Endangered Species Act provided that such taking is in compliance with the incidental take statement.

With protective provisions included in the reasonable and prudent alternative contained herein, the Service does not anticipate that construction and operation of the proposed Project will result in any incidental take of Colorado squawfish or razorback sucker. The Service anticipates that a small number (not to exceed 3 adults Colorado squawfish or 3 adult razorback sucker) of endangered fish could be taken as a result of the research program which is part of the reasonable and prudent alternative to preclude jeopardy. Incidental take would be associated with activities, such as capture, holding, or transporting fish, required by the research program, but would be covered by threatened and endangered species collection permits and would require immediate notification and cessation of any activity resulting in a take until further Service review.

The following reasonable and prudent measure is necessary and appropriate to minimize take and is required for all research funded or implemented by Reclamation.

> A permit which will include measures to reduce take will be obtained in accordance with 50 CFR 17.22 and 32 from the Fish and Wildlife Service.

In order to be exempt from the prohibitions of section 9 of the Endangered Species Act, the applicant must comply with the following terms and conditions which implement the reasonable and prudent measure described above.

1. Every effort will be made to prevent mortality of young-of-the-year fishes. Only those fish that cannot be accurately identified in the field may be sacrificed.

2. The following electrofishing procedures will be implemented.

   a. Electrofishing equipment should be calibrated each year under controlled laboratory conditions. Wave forms should be measured to ensure that spiked wave forms are not being produced and that no reversal of polarity is encountered.

   b. Only persons with field or formal training in electrofishing methods and one or more field seasons of experience are authorized to use this method.

   c. Electrofishing should use direct current (D.C.) only. When pulsed D.C. current is used, rectangular wave forms at pulse frequencies of 40 pulses per second or less should be used.

   d. Electrofishing should be restricted to waters in which conductivity measures less than 1,000 micro mhos per cm.

   e. All tissue collection shall follow the protocol outlined in the report titled "Razorback Sucker Genetic Survey--Tissue Sampling Protocol."

f. The handling and transportation of any endangered fishes will follow the procedures outlined in the report titled "A Protocol for the Handling and Transport of Wild Endangered Fish in the Upper Colorado River Basin."

If during the course of the action the amount or extent of the incidental take exceeds 3 adult Colorado squawfish or 3 adult razorback sucker as permitted above, Reclamation must reinitiate formal consultation with the Service and provide detailed circumstances surrounding the take.

The Service does not anticipate that the proposed Project will result in any incidental take of bald eagles. Accordingly, no incidental take is authorized. Should any take occur, Reclamation must reinitiate formal consultation with the Service and provide detailed circumstances surrounding the take.

CONSERVATION RECOMMENDATIONS

The Service has concerns regarding selenium, PAHs and other contaminants in the Animas River that could be transported through the proposed diversion to Ridges Basin Reservoir and concentrated in the impounded waters, deposited sediments, and aquatic vegetation. The information provided in support of Reclamation's request for reinitiation of consultation on the Project was insufficient to fully assess the potential of the Animas-La Plata Project to concentrate, transport, and increase availability of environmental contaminants to fish and wildlife resources of concern. Therefore, the Service recommends that a comprehensive environmental contaminant sampling and monitoring program be implemented by Reclamation at the Durango Pumping Plant, Ridges Basin Reservoir, Ridges Basin Pumping Plant, Southern Ute Reservoir, and at selected water transport and delivery sites. This program should be fully coordinated and integrated with ongoing contaminant investigations linked with the San Juan Recovery Implementation Program. Following compilation of sufficient information, and concurrence by the Service, if the Animas-La Plata Project is shown to increase the availability of environmental contaminants to fish and wildlife, Reclamation should prepare and implement a remediation plan.

The Service has developed the following conservation recommendations to avoid impacts to bald eagles.

1. The Service recommends that a bald eagle management plan be developed and implemented. The management plan should include the Animas-La Plata project area as well as the San Juan River drainage. The plan should be a cooperative effort between Reclamation, the Service, Colorado Division of Wildlife, New Mexico Game and Fish Department, Native American Tribes, Bureau of Land Management, National Park Service, and local land owners. Reclamation should take the lead in organization and development of the plan. The plan should emphasize habitat management and protection, this could involve acquisition of important habitats, conservation easements, and instream flow designations for improvement of cottonwood recruitment. Implementation of the plan is limited by the available funding from the participants.

2. The following flow management strategies should be implemented on the La Plata River to reduce impacts to future cottonwood recruitment:

   a. A minimum baseflow of 8 cfs should be provided at the Southern Ute Diversion Dam to maintain the alluvial aquifer for support of floodplain wetlands and riparian vegetation.

   b. When flows in the La Plata River reach 250 cfs at the Southern Ute Diversion Dam during May and June (the cottonwood seeding period), all flows should be bypassed until flows drop below 250 cfs.

   c. A monitoring program should be implemented to evaluate the extent of cottonwood seedling establishment. If monitoring verifies widespread reproduction and likely recruitment, diversion during spring flood flows for several years may be acceptable. This may help seedlings reach a size sufficient to withstand high flows. The monitoring program should be incorporated into the bald eagle management plan.

3. Reclamation should determine which canals in the project area provide important bald eagle habitat (cottonwood trees), and develop a strategy to avoid loss of these trees, such as providing water in the canals during the growing season.

4. Reclamation should develop a long term monitoring program that evaluates water quality in the Animas, La Plata, and Mancos Rivers. Also, Reclamation should determine if heavy metals and selenium contamination become bioaccumulated in the food chain and become deleterious to bald eagles.

If new information becomes available regarding impacts to riparian or wetland vegetation, cottonwood recruitment, or environmental contaminants; or should there be any changes to the Project which alter the operation of the Project from that which is described in this biological opinion and which may affect bald eagles in a manner or to an extent not considered in this biological opinion (see 50 CFR, Part 402.16), formal section 7 consultation should be reinitiated.

CONCLUSION

This concludes our biological opinion on the impacts of the proposed Project. The Service has determined that the impacts of the Project are likely to jeopardize the continued existence of the Colorado squawfish and razorback sucker and adversely modify or destroy their critical habitat. A reasonable and prudent alternative which offsets jeopardy and adverse modification to critical habitat of the Colorado squawfish and razorback sucker has been identified as a result of this consultation.

The reasonable and prudent alternative includes: (1) an Animas-La Plata Project that results in an initial depletion of 57,100 acre-feet (Phase I, Stage A only), (2) research to determine endangered fish habitat needs, (3) operation of the Navajo Dam to provide a wide range of flow conditions for the endangered fish, including low winter flows, (4) a procedure to implement flow recommendations, (5) a commitment to release peak flows out of Navajo Dam as agreed upon with the Biology and Navajo Dam Operating Committees, (6) a guarantee that, based on the results of the research program and dependent upon the prevailing hydrology, Navajo Dam will be operated for the life of the Animas-La Plata Project to mimic a natural hydrograph, Reclamation has agreed under section 7 (a) 1 to reoperate Navajo Dam for recovery of endangered fishes and (7) legal protection for the reservoir releases instream to and through the endangered fish habitat to Lake Powell. In order to preclude jeopardy and adverse modification, all seven elements must be implemented.

The Service has further determined that the proposed Project is not likely to jeopardize the continued existence of the bald eagle, but has developed conservation recommendations to help offset impacts.

This opinion was based upon the best scientific and commercial data available as described herein. If new information becomes available, new species listed, or should there be any changes to the Project which alter the operation of the Project from that which is described in this biological opinion and which may affect any endangered or threatened species in a manner or to an extent not considered in this biological opinion (see 50 CFR, Part 402.16), formal section 7 consultation shall be reinitiated. Section 7 consultation also must be reinitiated if there is failure to carry out any portion of the reasonable and prudent alternative upon which this opinion is based.

Section 7(d) of the Endangered Species Act requires that Reclamation shall not make any irreversible or irretrievable commitment of resources which would preclude the formulation of reasonable and prudent alternatives until consultation on listed species is completed. Therefore, adoption of the reasonable and prudent alternative described above is not a violation of section 7(d) of the Endangered Species Act.

Thank you for your cooperation in the formulation of this opinion and your interest in conserving endangered species.

cc: Mailing List

Terry Terrell

Mailing List

KEN BEEGLES
DIVISION OF WATER RESOURCES
PO BOX 1880
DURANGO CO 81302-1880

LEONARD BURCH, CHAIRMAN
SOUTHERN UTE INDIAN TRIBAL COUNCIL
116 CAPOTE DR
PO BOX 737
IGNACIO CO 81137

RON D BLIESNER, PRESIDENT
BUREAU OF INDIAN AFFAIRS CONSULTANT
KELLER-BLIESNER ENGINEERING
78 EAST CENTER
LOGAN UT 84321-4619

CHARLES A CALHOUN
REGIONAL DIRECTOR
BUREAU O RECLAMATION--UPPER CO REGION
125 SOUTH STATE ST RM 6107
SALT LAKE CITY UT 84138-1109

JOHN CAWLEY
DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
PO BOX 26567
ALBUQUERQUE NM 87125-6567

CAROL DeANGELIS, AREA MANAGER
BUREAU OF RECLAMATION
WESTERN COLORADO AREA OFFICE
PO BOX 60340
GRAND JUNCTION CO 81506-8785

MARK EDWARDS
MIB 6312
OFFICE OF THE SOLICITOR
DEPT OF THE INTERIOR
1849 C STREET NW
WASHINGTON DC 20240

PETER EVANS
COLORADO WATER CONSERVATION BOARD
1313 SHERMAN ST ROOM 721
DENVER CO 80203

JOEL FARRELL
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
1235 LA PLATA HIGHWAY
FARMINGTON NM 87401-1808

LOU GALLEGOS
OFFICE OF THE GOVERNOR
STATE CAPITOL
SANTA FE NM 87503

SHERRY GALLOWAY, CHAIRMAN
SAN JUAN WATER COMMISSION
800 MUNICIPAL DR
FARMINGTON NM 87401

ALBERT HALE, PRESIDENT
THE NAVAJO NATION
PRESIDENT'S OFFICE
HIGHWAY 264, TRIBAL HILL DR
PO BOX 9000
WINDOW ROCK AZ 86515

ELBERT HAMBLIN
LA PLATA CONSERVANCY DISTRICT
PO BOX 336
LA PLATA NM 87418

STEVE HARRIS, PRESIDENT
ANIMAS-LA PLATA WATER CONSERVANCY
841 EAST SECOND AVE
PO BOX 475
DURANGO CO 81302

PATRICK HAYES, AREA DIRECTOR
BUREAU OF INDIAN AFFAIRS
PO BOX 26567
ALBUQUERQUE NM 87125-6567

PAUL HOLDEN
BIO/WEST INC.
1063 WEST 1400 NORTH
LOGAN UT 84321

J DAVID HOLM, DIRECTOR
WQCD-DO-B2
COLORADO DEPT OF HEALTH
4300 CHERRY CREEK DR S
DENVER CO 80222-1530

DANIEL ISRAEL, SPECIAL COUNSEL
UTE MOUNTAIN UTE TRIBE
11 SUNDIAL CIR STE 16
PO BOX 2800-181
CAREFREE AZ 85377

MIKE JOHNSON
THE NAVAJO NATION
WATER RESOURCE MANAGEMENT
PO BOX 140
FORT DEFIANCE AZ 86504

BOB KARKOW
DOI - BUREAU OF INDIAN AFFAIRS
NAVAJO INDIAN IRRIGATION PROJECT
304 N AUBURN STE B
FARMINGTON NM 87401

JUDY KNIGHT-FRANK, CHAIRMAN
UTE MOUNTAIN UTE TRIBE
GENERAL DELIVERY
TOWAOC CO 81334

LEO LENTSCH
UTAH DIV WILDLIFE RESOURCES
1596 WEST NORTH TEMPLE
SALT LAKE CITY UT 84116

DARIUS C LILE, DIRECTOR
COLORADO WATER CONSERVATION BOARD
1313 SHERMAN ST ROOM 721
DENVER CO 80203

SCOTT LOVELESS
OFFICE OF THE REGIONAL SOLICITOR
DEPT OF THE INTERIOR
125 SOUTH STATE ST ROOM 6201
SALT LAKE CITY UT 84138-1102

JERRY MARACCHINI, DIRECTOR
NEW MEXICO DEPT OF GAME & FISH
PO BOX 25112
SANTA FE NM 87504

SAM MAYNES, ATTORNEY
MAYNES, BRADFORD, SHIPPS AND SHEFTEL
835 E SECOND AVE
DURANGO CO 81301

SCOTT McELROY
GREEN, MEYER & McELROY
1007 PEARL ST STE 220
BOULDER CO 80302-5124

BILL MILLER
W.J. MILLER AND ASSOCIATES
1401 RIVERSIDE AVE STE 3
FORT COLLINS CO 80524

WILLIAM J MILLER
NEW MEXICO INTERSTATE STREAM COMMISSION
PO BOX 25102
SANTA FE NM 87504-5102

STEPHANIE ODELL
FARMINGTON DISTRICT OFFICE
BUREAU OF LAND MANAGEMENT
1235 LA PLATA HIGHWAY
FARMINGTON NM 87401

OFFICE OF THE REGIONAL SOLICITOR
DEPARTMENT OF THE INTERIOR
BUILDING 1 STE 200
2400 LOUISIANA BLVD NE
ALBUQUERQUE NM 87110-4316

JIM PIATT, CHIEF
NEW MEXICO ENVIRONMENTAL DEPT
SURFACE WATER QUALITY BUREAU
1490 ST FRANCIS DR
PO BOX 26110
SANTA FE NM 87502

TOM PITTS
HALL, PITTS AND ASSOCIATES, INC
535 NORTH GARDFIELD AVE
LOVELAND CO 80537-5548

STANLEY POLLACK, ASST ATTORNEY GENERAL
THE NAVAJO NATION
DEPT OF JUSTICE
NATURAL RESOURCES UNIT
PO DRAWER 2010
WINDOW ROCK AZ 86515-0417

DAVE PROPST
NEW MEXICO DEPT OF GAME & FISH
VILLAGRA BUILDING
PO BOX 25112
SANTA FE NM 87504

DAVE RUITER/WES WILSON 8WM-EA
ENVIRONMENTAL PROTECTION AGENCY
999 18 ST SUITE 500
DENVER CO 80202-2466

HAL SIMPSON
OFFICE OF THE STATE ENGINEER
1313 SHERMAN ROOM 818
DENVER CO 80203

PATRICK J SCHUMACHER
SOUTHERN DIVISION MANAGER
BUREAU OF RECLAMATION--WESTERN CO OFC
PO BOX 640
DURANGO CO 81302-0640

ERIC STEIN, GENERAL COUNSEL
UTE MOUNTAIN UTE TRIBE
MIKE WASH ROAD/TRIBAL OFFICE COMPLEX
PO BOX GG
TOWAOC CO 81334

TED STEWART, EXEC. DIRECTOR
UTAH DEPT OF NATURAL RESOURCES
1636 W NORTH TEMPLE RM 310
SALT LAKE CITY UT 84116-3156

LESTER K TAYLOR, ATTORNEY
JICARILLA APACHE TRIBE
NORDHAUS, HALTOM, TAYLOR & TARADASH
500 MARQUETTE NW STE 1050
ALBUQUERQUE NM 87102

BOB TOWRY, REGIONAL MANAGER
COLORADO DIVISION OF WILDLIFE
2300 S TOWNSEND AVE
MONTROSE CO 81401

THOMAS TURNEY, STATE ENGINEER
NEW MEXICO OFFICE OF THE STATE ENGR
PO BOX 25102
SANTA FE NM 87504-5102

MARGOT ZALLEN
OFFICE OF THE REGIONAL SOLICITOR
DEPARTMENT OF THE INTERIOR
755 PARFET ST ROOM 151
LAKEWOOD CO 80215

MIKE ZGAINER
COLORADO DIVISION OF WILDLIFE
151 EAST 16TH ST
DURANGO CO 81301

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HYDROLOGY FOR THE ANIMAS-LA PLATA PROJECT

APPENDIX A

Hydrology for the Animas-La Plata Project

I. INTRODUCTION

In 1991 the Fish and Wildlife Service and the Bureau of Reclamation developed an alternative to the Animas-La Plata Project that would offset the likelihood of jeopardy and adverse modifications to critical habitat of the endangered Colorado squawfish and razorback sucker. Based on the 1991 opinion, Reclamation reconfigured the Project into stages to accommodate the 57,100 AF depletion (Stage A) as part of the reasonable and prudent alternative. Reclamation asked the Service to reconsult on the revised project. The following narrative updates the hydrological analysis accomplished for the 1991 opinion.

A. Animas-La Plata Project

The reasonable and prudent alternative in the 1991 Biological Opinion for the Animas-La Plata Project was based on these key items: (1) a redistribution of releases from Navajo Dam to mimic a natural hydrograph, (2) a 7-year period of research flows and funded fish research, and (3) protection of the flows to Lake Powell. The 1995 consultation retains these elements, but updates the current hydrologic conditions in the basin with new computer modeling. This narrative describes the changes that have occurred in the past 4 years and their effect on San Juan River flows. These include: (1) changes in the Animas-La Plata Project affecting diversions, depletions, and return flows, (2) minor depletions in the basin allowed under the San Juan Recovery Implementation Plan (SJRIP), (3) the consultation on Navajo Indian Irrigation Project Blocks 7 and 8, and (4) reductions in return flows of Dolores River Basin imported water into McElmo Creek. The following four sections describe in detail the current Project and subsequent operational and depletion changes.

1. Changes in the Animas-La Plata Project (diversions, depletions, and return flows)

   Since 1991, the Animas-La Plata Project has been revised to accommodate the potential constraints of the limited allowable depletion of the 1991 Opinion. Stage A includes the construction of Ridges Basin Reservoir, the inlet pipeline, the Durango Pumping Plant, a smaller Ridges Basin Pumping Plant, the Shenandoah and La Plata Rural, and the Durango M&I pipelines. These facilities represent the only delivery system associated with the depletion of 57,100 AF.

   Stage A also contains a commitment to increase October and November Animas River fish bypass flows from 125 cfs to 160 cfs. These modifications allow the project to deliver Municipal and Industrial

(M&I) benefits if an annual depletion of the project is limited to 57,100 AF.

The design capacity for the Durango Pumping Plant under the 57,100 AF scenario is 70 cfs. This means that under full operating head (full reservoir) the pumps can pump 70 cfs, but when there is not full head (reservoir not full) the pumps can pump up to 79 cfs. This reduces the peak withdrawals during high streamflow months compared to the 1991 proposal. The hydrologic effects of these changes in the model are very minor with respect to San Juan River flows at Farmington, Shiprock, and Bluff. A separate hydrologic model of Animas and La Plata drainages incorporated these changes. Output from this model was then applied to the entire San Juan Basin model.

2. Minor San Juan Basin Depletions under the SJRIP

As part of the RIP, minor depletions up to a total of 3,000 AF are allowed in the basin prior to the completion of the 7-year research period. Since 1991, these depletions have consisted largely of small private uses and now total about 1,500 AF. Although these actual points of diversion are known, due to the small quantities involved and the difficulty in tying them to specific nodes in the model, one-third of this total was assumed to occur above Navajo Dam and two-thirds just below Farmington. This represents an over conservative assumption but since the depletions quantities were small, this simplification will not materially affect the projected flows at the three San Juan River gages. The total depletion of these uses will average less than 3 cfs through the year.

3. Navajo Indian Irrigation Projects (NIIP) Blocks 7 and 8

Since the 1991 Opinion was issued, the NIIP has received section 7 clearance for construction of facilities to deliver water to lands served by Blocks 7 and 8 of NIIP. No additional depletion of San Juan River Basin water resulted since baseline depletions associated with the Hogback and Fruitland diversions were exchanged for the additional NIIP depletion. Water for NIIP was delivered out of Navajo Reservoir through the existing NIIP canal headworks. This diversion was modeled accordingly.

4. Reduction of Dolores River Basin Return Flows into McElmo Creek

The potential to reallocate additional water supplies for instream flow purposes below McPhee Dam on the Dolores River has resulted in a modification of the expected transbasin diversions out of the Dolores Basin into the San Juan Basin. Consequently, the return flows from this irrigation water will also decrease.

The nature of the decrease in diversions is tied to the instream flow needs below McPhee Dam. During dry years, additional releases are desired to maintain the trout fishery immediately downstream of the dam. Rather than allocate additional supplies in all years, a decision has been made by the Dolores District to short irrigation supplies in dry years. For the San Juan Basin imports, this amounts to a decrease in diversions of about 3,000 AF. The decrease in return flow is about 15 percent of that value, or 450 AF. However, due to the uncertainty of the solution to the instream flow issue, an assumed decrease of 3,000 AF was applied to the McElmo Creek return flows, reducing it from 25,000 AF down to 22,000 AF. Spread over the irrigation season, this amounts to a decrease of about 10 cfs.

B. Navajo Dam Operation

The SJRIP Biology Committee and the Navajo Dam Operating Committee currently sponsor three joint meetings per year, in January, April, and August. These meetings are open to the public and anyone interested in the operation of Navajo Reservoir is welcome to attend these meetings. The purpose of these joint meetings is to discuss the operation of Navajo since the previous meeting and to come to a consensus on how Navajo would be operated under varying inflow scenarios until the next meeting. For example, the meeting held in January of each year would discuss the operation of Navajo from August through December and would set the release schedule from January through April. The research needs associated with the 7-year research plan are the focus of these meetings.

Several possible future Navajo inflow scenarios are evaluated and releases are planned in response to these inflows. Inflows corresponding to 10 percent, 50 percent, and 90 percent exceedance levels are typically used in this analysis. Since hydrologic conditions can change dramatically, adjustments to planned releases are common. Changes in forecasted runoff are the driving factors in these situations. Changes in releases are coordinated with involved parties.

Downstream flood control constraints were an issue during the past several years, potentially limiting the releases from Navajo Dam. The 1991 Opinion contains a provision for a high spring release, which the computer analysis was modeled as a 300,000 AF release during the months of May and June. This assumed a maximum dam release of 5,000 cfs for a 1 month period spread between these 2 months. The Corps of Engineers had proposed a draft revised Water Control Manual (WCM) for Navajo Dam to reduce channel capacity to 5,000 cfs from Navajo Dam to Farmington and 12,000 cfs from Farmington (below Animas River confluence) through Shiprock. The Service expressed concern regarding the proposed 12,000 cfs restriction at Farmington and after conversations with the Corps of Engineers and on-site inspections (by the Corps), the Corps has decided that they will retain the current WCM (1970) of 16,800 cfs at Farmington, 17,600 cfs at Shiprock, and propose a reduction to 5,000 cfs between the dam and Farmington.

II. BACKGROUND

The hydrology analysis that supports the jeopardy and adverse modification conclusion of the full Animas-La Plata Project is presented in the Project Effects section of the Opinion. The analysis of the full Project looked at the historic flow regime (pre-Navajo Dam), the current or baseline flow, and the flow with the full Animas-La Plata Project for a series of wet, average, and dry years. The analysis of Stage A will consider the historic flow regime, and the baseline flow with Navajo Reservoir operated to mimic the natural hydrograph (Figures 1-18). Stage A development allows the project to deliver M&I benefits if the total depletion of the project is limited to an average annual depletion of 57,100 AF.

Key water management options underlying the reasonable and prudent alternative remain the same as under the 1991 reasonable and prudent alternative and need to be described accurately and completely. These options have a direct, major effect on the magnitude and timing of the flows that are available to provide habitat in the San Juan River for the endangered Colorado squawfish and razorback sucker. These options are described below and form the basis for the development of the reasonable and prudent alternative.

A. Regulation of Releases for Trout

During the initial filling period of Navajo Dam (1962-1965), there were periods when the releases from Navajo Dam were below 500 cfs. Since 1965 releases of less than 500 cfs from Navajo Dam have occurred only on a very infrequent basis. With the establishment of an excellent trout fishery in the tailwater, Reclamation has attempted to maintain releases of at least 500 cfs. No formal minimum flow exists.

Fishery biologists do not have sufficient data to define a minimum flow regime below the dam, but have estimated, based upon their knowledge and judgement, that a minimum flow of 300 cfs should be adequate. Maintaining a flow of 500 cfs can require up to 360,000 AF per year, depending upon spills and required releases.

At the present level of depletions, and including a depletion of 57,100 AF for the Animas-La Plata Project, providing a 500 cfs flow for trout does not affect the number of years that a high spring release can be made for the endangered fish. However, spring spills in advance of the peak provide a more "natural" flow pattern; these spills are reduced if 500 cfs is provided year-around for the trout. The graphs presented in this report represent Reclamation's ability to operate Navajo Reservoir to mimic the natural hydrograph over the life of the Project while providing for a minimum trout flow of 300 cfs.

The reasonable and prudent alternative proposed by the Service finds it appropriate to provide winter test flows of 250-300 cfs during the research period.

B. Release of Water for Colorado Squawfish and Razorback Sucker

The primary feature of the reasonable and prudent alternative proposed by the Service and concurred by Reclamation is the operation of Navajo Reservoir to release water during the spring peak runoff to reproduce, as closely as possible, the natural flow pattern that existed prior to the construction of Navajo Dam. This commitment has both short-term research and long-term operation implications.

The 7-year research period is designed to allow biologists to test the relationship between varying hydrographs and the reproductive and recruitment success of endangered fish. This will involve the testing of a wide range of flows. Depending on the natural contribution of tributaries such as the Animas River, varying volumes of water will be required to be delivered from Navajo Dam.

At the end of the approximately 7-year research period, the Navajo Dam and Reservoir would be used to mimic a natural hydrograph for the life of Navajo Dam based upon the research. Mimicry of the natural hydrograph consists of high spring flows that provides a gradually ascending limb followed by a gradually declining recession limb to low, stable flows throughout the summer, fall, and winter. Based on results of the hydrologic modeling and consideration of biological information, it was determined that an additional 57,100 AF depletion would not appreciably affect Reclamation's ability to mimic the natural hydrograph under current levels of development on the San Juan River.

C. Computer Modeling of Water Availability

An important part of providing suitable habitat conditions for the endangered fish is the assurance that water will be available at the end of the 7-year research period should the research indicate that storage water from Navajo Reservoir is needed to supplement the spring peak flows.

A computer model was prepared which simulated the hydrologic conditions on the San Juan River, both at current depletion levels and with additional future depletions. Annual releases for endangered fish from 100,000 AF to 500,000 AF were modeled, and the results were studied by fishery biologists familiar with the endangered fish and the San Juan River.

Releases as high as 500,000 AF could be provided in a significant number of years, but the water level in Navajo Reservoir would be lower in general more of the time than it would be for smaller annual releases. This would result in lower spring spills that contribute to more natural flow patterns most of the time and higher spring flows a smaller percentage of the time. Service biologists, after review of this data believe that, under the current level of depletion and with the Animas-La Plata Project depleting 57,100 AF annually, an annual release of 300,000 AF most closely resembles the natural spring flow pattern.

1. Attempt to Mimic Natural Hydrograph

The Service believes, based upon current biological information, that the magnitude, flow pattern, and frequency of the natural hydrograph was likely a significant factor in maintaining a healthy fish population historically throughout the Colorado River Basin.

Therefore, one of the factors that is included in this reasonable and prudent alternative is an attempt to "mimic" the natural hydrograph.

Since development began in the San Juan River Basin, and particularly since the construction of Navajo Dam, the natural pattern has been disrupted by the storage of the peak runoff and subsequent release of water through the summer, while return flows, flood control releases, and trout releases have contributed to higher base flows in the fall and winter. Storage in Navajo Reservoir has been high during the period because all of the Reservoir yield has not yet been committed. The high storage level results in releases at times that may not be beneficial for the endangered fish. Therefore, the main objective of the operation of Navajo Reservoir is to increase the spring and early summer peak flows by reducing the fall and winter flows and utilizing the active storage capacity of Navajo Reservoir.

2. Modeled in May and June

One of the key elements of the reasonable and prudent alternative (RPA) was the release of a block of water from Navajo Dam during the spring to mimic or replicate the pattern of natural unregulated flows. Iterative modeling was performed with various combinations of minimum flows for trout and spring releases for squawfish, varying between 100 and 500 cfs and 100,000 and 500,000 AF respectively. These combinations produced spring releases that occurred with differing long term frequencies. Biologists associated with the San Juan River selected the combination of 300 cfs and 300,000 AF for use in the RPA, which at the current level of depletions in the basin resulted in high spring releases during 96 percent of the years modeled.

During the 1991 modeling, this volume was released in the month of June, producing releases of 5,000 cfs for the entire month. During wet years, reservoir spills often occur during the month of May, resulting in full reservoir conditions. Maximum releases (for the RPA) during the following month of June often caused a significant drawdown of the reservoir, affecting storage and releases in succeeding years. Biologists believed that the pattern could be better if divided between the months of May and June, but the computer model was incapable of depicting such a distribution at the time.

In the 1995 modeling, the computer algorithms were modified to allow the endangered fish a volume of 300,000 AF to be spread equally between May and June. In wet years, if the reservoir naturally spilled due to hydrologic conditions, these spills were included as part of the 150,000 AF released for the endangered fish, thus reducing slightly the total volume released during the year. This affects the reservoir in succeeding years as a result of generally fuller reservoir storage conditions, but produces a more naturally shaped hydrograph. The percentage of years that the spring release would be made has not changed. Graphs of the flows at Farmington, Shiprock, and Bluff for 6 representative years illustrate the changes in flow between these two modeling efforts and also include all of the depletion changes in the basin (Figures 1-18).

3. Delivered when Navajo Storage Over 660,000 AF

When the storage in Navajo Reservoir drops below 660,000 AF, the Reservoir cannot deliver water into the Navajo Indian Irrigation Project. The computer model used in this analysis did not release the 300,000 AF for the endangered fish when it would cause the storage in Navajo Reservoir to drop below 660,000 AF. For the current level of depletion (including the reasonable and prudent alternative to the Animas-La Plata Project), this cut-off target does not affect the number of years that the release for endangered fish is made.

If and when the level of depletions increases (through future project depletions), some balancing of benefits will be required. Lowering the level at which releases are discontinued will allow the release of water for endangered fish in more years, but the Reservoir will spill less frequently resulting in a sharper "spike" in the hydrograph. Keeping this target level will preserve the gravity diversion for Navajo Indian Irrigation Project and preserve a more "natural" shape of the hydrograph, but will reduce the number of years that releases can be made.

D. Stage A at 57,100 AF

Stage A as presented to the Service by Reclamation includes the construction of Ridges Basin Reservoir, the inlet pipeline, the Durango Pumping Plant, a smaller Ridges Basin Pumping Plant, the Shenandoah and La Plata rural, and the Durango M&I pipelines. These facilities represent the only delivery system associated with the depletion of 57,100 AF that will be built under the reasonable and prudent alternative.

E. Interim Operation of Stage A

When Ridges Basin Reservoir reaches approximately 168,00 AF capacity the system would be declared operational. M&I water could be immediately delivered to New Mexico and the city of Durango, and through the La Plata Rural and Shenandoah Pipelines.

New Mexico's San Juan Water Commission water supply would be picked up using existing diversions on the Animas and San Juan Rivers. Similarly, the Navajo water supply could be delivered from the San Juan River at existing diversions near the town of Shiprock, New Mexico. Most of this supply for New Mexico would come from the direct flows from the River. An average of only 1,400 AF yearly (9,000 to 0 acre-feet range) would be supplied from the Reservoir, down Basin Creek and to the San Juan River via the Animas River.

Approximately 50 percent of the New Mexico M&I supply of 38,400 AF would return to the San Juan River as return flows. This would mean a total net depletion of about 19,200 AF.

The city of Durango would begin receiving its 2,500 AF of M&I supply from the Durango Pumping Plant either as a direct flow from the River or from the Reservoir through the inlet conduit when pumps were not running. Approximately 50 percent of this supply would return to the Animas as return flows for a net depletion of 1,250 AF per year.

The Ridges Basin Pumping Plant (maximum capacity of 9.5 cfs) would pump water to the La Plata Rural and Shenandoah Pipelines, depending on demands. Eventually, 4,000 AF per year would be pumped for the domestic water needs with 1,000 AF returning to the Animas River and 1,000 AF returning to the La Plata drainage as return flows for a net depletion of 2,000 AF annually.

F. Place of use

Stage A includes the delivery of 41,700 AF in Colorado, of which 32,500 AF are designated for the Southern Ute and Ute Mountain Ute Tribes. It is anticipated that this diversion will result in a depletion of 34,600 AF. This also includes the diversion of 38,400 AF in New Mexico, of which 7,600 AF are designated for the Navajo Nation. It is anticipated that this diversion will result in a depletion of 19,200 AF. The total diversion in both States is 80,100 AF, resulting in a total depletion of 53,800 AF. In addition, a depletion of 3,300 AF will occur as a result of evaporation from Ridges Basin Reservoir. Thus the net annual depletion to the San Juan River as a result of the reasonable and prudent alternative will be 57,100 AF. Reclamation's operation study for both the 1991 opinion and this analysis of Stage A was conducted using depletion schedules which vary from Month to Month and year to year. The result is model outputs are in the form of average annual depletions and not net depletions, Figure 21 shows the depletion pattern for Stage A depletions range from a low of 22,000 AF to a high of 68,000 AF with a annual average of 57,100 AF with rounding error of approximately 100 AF. Figure 22 shows that 57,100 AF would be exceeded over 60% of the time when calculated as an average annual depletion. However, the RPA restricts the depletion to a maximum of 57,100 AF in any year until all elements of the RPA are completed (the research is completed, year-round flow recommendations are determined, and Reclamation provides 300,000 AF for endangered fish 96% of the time).

Table 1 describes the Municipal and Industrial (M&I) components of the Project. Water supply projects with on-line reservoirs normally store spring peak flows in high water years for redistribution during low flow periods. Since the Animas-La Plata Project is fed by an off-stream reservoir, and the demand is less than the supply, the pattern of depletions is directly related to demand.

Table 1

Animas-La Plata Project
Water Demand, Supply and Depletions
(Acre-Feet)

	Demand	Supply	Depletion
Irrigation			
Colorado			
Non-Indian	73,440	69,930	55,860
Southern Ute	3,400	3,130	2,510
Ute Mountain Ute	26,300	25,430	20,340
	103,140	98,490	78,710
New Mexico			
Non-Indian	12,500	11,810	9,450
Ute Mountain Ute	900	830	660
	13,400	12,640	10,110
Municipal and Industrial			
Colorado			
Animas-La Plata	9,200	9,200	4,600
Southern Ute	26,500	26,500	24,000
Ute Mountain Ute	6,000	6,000	6,000
	41,700	41,700	34,600 *
New Mexico			
San Juan Water Commission	30,800	30,800	15,400
Navajo Nation	7,600	7,600	3,800
	38,400	38,400	19,200 *
Reservoir Evaporation			
Ridges Basin			3,300 *
Southern Ute			3,300
Total Project Demand, Supply and Depletion	196,640	191,230	149,220
*Phase I Stage A Project Demand, Supply and Depletion	80,100	80,100	57,100

Discussion

Stage A, including the key water management decisions discussed earlier, was analyzed using the same hydrologic model that was used for the analysis of the full Animas-La Plata Project. The period of record selected for the analysis was 1935 to 1962. From this period, two wet, two dry, and two average years were selected for analysis based upon water volumes during the spring runoff. Wet years selected were 1938 and 1949, dry years were 1946 and 1951, average years were 1936 and 1945. Figures 1-18 at the end of this appendix showing the flow patterns at three locations resulting from the implementation of the reasonable and prudent alternative.

1. Reoperated at Current (baseline) Level of Depletion

   The first step in the analysis is to investigate the opportunities for improving the flow pattern by reoperating Navajo Dam. The level of depletions is identical to the Section 7 baseline (listed in Table 2) in the Biological Opinion. Under this scenario, the minimum release below Navajo Dam for trout was reduced to 300 cfs and a 300,000 AF release for endangered fish was made in May and June. Under this scenario, the release for endangered fish was able to be made in 96 percent of the years.

   a. Magnitude of Peaks Compared to Historic

      The level of depletion in the San Juan River Basin has increased since the pre-Navajo Dam era and Navajo Dam is storing water during the peak runoff; therefore, the peaks are lower than historic. During wet years, for instance, the historic peaks in 1938 and 1949 were 11,478 cfs and 12,566 cfs respectively. Under the current level of depletion, Navajo Dam can be operated to achieve peaks of 9,317 cfs and 10,460 cfs respectively. These peaks are comparable to the 1987 peak of 9,026 cfs (Figure 20).

      During average years, the historic peaks in 1936 and 1945 were 6,905 cfs and 7,419 cfs respectively. Under the current level of depletion, Navajo Dam can be operated to achieve peaks of 6,905 cfs and 7,419 cfs respectively. While comparable to the historic spring peaks, these flows are significantly less than the 1987 spring peak.

      In dry years, the spring peak can be enhanced significantly with storage releases from Navajo Dam. Historic peaks in 1946 and 1951 were 3,427 cfs and 3,169 cfs respectively. Under the current level of depletion, Navajo Dam can be operated to achieve peaks of 4,552 cfs and 4,217 cfs respectively. These peaks are higher than historic peaks for dry years and may represent an improvement to habitats in dry years or could be spread out over a longer period.

   b. Shape of Hydrograph (ascending/descending limbs)

      During wet years, Navajo Dam is refilling, and the ascending limb of the hydrograph falls short of historic flows (see figures). Since this storage provides the bulk of the flows in average and dry years, it is not practical to restrict spring storage in wet years. The descending limb in wet years closely approximates the historic flows.

During average years, the ascending limb of the hydrograph more closely approximates the historic pattern, but some increased use and/or storage is reflected in the flows received at the habitat area. The descending limb in average years closely approximates the historic flow pattern.

In dry years, only the minimum release for trout is in the stream until the slug release in May and June. This results in a very steep ascending limb of the hydrograph. Once again, the descending limb closely approximates the historic flow pattern.

The flows in 1987 were far from typical, even under historic conditions. The very high winter flows (almost five times higher than in our typical wet years) provided a strong base flow that built gradually to a high peak. This flow pattern resulted from a high level of Navajo Reservoir prior to the spring peak caused by lack of demand at present for Navajo yield. When a yearly spring release is made under the reasonable and prudent alternative, this atypical situation is very unlikely to recur. The descending limb in 1987 reverted to its typical flow pattern.

2. During 7-year Test Period (with the initial depletion of 57,100 AF for the Animas-La Plata Project)

This scenario describes the result of operating the system in accordance with the reasonable and prudent alternative. The level of depletions includes the section 7 baseline (reoperated as described above) with the initial depletion of 57,100 AF annually associated with the construction of stage A. As with the reoperated scenario, the minimum release from Navajo Dam for trout will be 300 cfs and 300,000 AF will be released for endangered fish in June whenever possible. The release for endangered fish was able to be made in 96 percent of the years.

a. Magnitude of Peaks Compared to Historic

The level of depletions in the San Juan River Basin has increased since the pre-Navajo Dam era, Navajo Dam is storing water during the peak runoff, therefore, the peaks are lower than historic. During wet years, for instance, the historic peaks in 1938 and 1949 were 11,478 cfs and 12,566 cfs respectively. Under the current level plus initial Animas depletions, Navajo Dam can be operated to achieve peaks of 9,203 cfs and 10,527 cfs respectively. These peaks are still comparable to the 1987 peak of 9,026 cfs.

During average years, the historic peaks in 1936 and 1945 were 6,905 cfs and 7,419 cfs respectively. Under the current level plus initial Animas depletions, Navajo Dam can be operated to achieve peaks of 5,465 cfs and 5,582 cfs respectively. Under average conditions flows are moderately less than historic spring peaks and are likewise significantly less than the 1987 spring peak.

In dry years, the spring peak can be enhanced significantly with storage releases from Navajo Dam. Historic peaks in 1946 and 1951 were 3,427 cfs and 3,169 cfs respectively. Under the current level plus Animas M&I depletions, Navajo Dam can be operated to achieve peaks of 4,457 cfs and 4,122 cfs respectively. These peaks are comparable to historic peaks in an average year, but are higher than historical peaks for dry years.

b. Shape of Hydrograph (ascending/descending limbs)

Examining the hydrograph developed for current level and current level plus Animas, there is no change in the shape of the hydrograph. The only change evident is a reduction in volume equal to the initial Animas-La Plata Project depletions each month.

4. Under Full San Juan River Basin Depletion

Although there is no commitment in this Biological Opinion and reasonable and prudent alternative for future Section 7 consultations, it is useful in this analysis to look at flow pattern under full depletion. Full depletion, for this analysis, is defined as full development of compact allotments by Colorado, Utah, and New Mexico (not full Animas-La Plata). Under this scenario, only 290 cfs can be provided as a minimum release from Navajo Dam for trout. As with the other scenarios, 300,000 AF will be released for the endangered fish in June whenever possible. The endangered fish release can be made only 33 percent of the time under these assumptions.

This flow scenario is somewhat misleading. Until the research required under the reasonable and prudent alternative is completed and the biologists can quantify the amount and timing of the flows needed to establish a self-sustaining endangered fish population, a realistic flow scenario cannot be developed. For example, reducing the flow releases in dry years to adult maintenance levels would increase the number of years that spring peaks could be augmented.

a. Magnitude of Peaks Compared to Historic

The level of depletions in the San Juan River Basin has increased since the pre-Navajo Dam era, Navajo Dam is storing water during the peak runoff, therefore the peaks are lower than historic. During wet years, for instance, the historic peaks in 1938 and 1949 were 11,478 cfs and 12,566 cfs respectively. Under full depletions, Navajo Dam can be operated to achieve peaks of 8,920 cfs and 10,425 cfs respectively. These peaks are still comparable to the 1987 peak of 9,026 cfs.

During average years, the historic peaks in 1936 and 1945 were 6,905 cfs and 7,419 cfs respectively. Under full depletions, Navajo Dam can be operated to achieve peaks of 6200 cfs and 7391 cfs respectively.

In dry years, under the full level of depletion, the spring peak cannot be enhanced with storage releases from Navajo Dam. Historic peaks in 1946 and 1951 were 3,427 cfs and 3,169 cfs respectively. Under full depletions, the spring peak flows were 1,525 cfs and 1,187 cfs respectively. These peaks are considerably lower than the historic peaks in a dry years.

b. Shape of hydrograph (ascending/descending limbs)

While there is little change in the snape of the hydrograph between current depletion and current depletions plus Animas M&I there is a noticeable change when full depletions are considered. With full depletions the shape of the hydrograph is altered significantly, the hydrograph shifts downwards in every month except May and June when a large spike is evident. The spike is only obtainable 33 percent of the time and consequently the preservation of a natural hydrograph with a high June peak would be a significant change which will be evaluated during the study period.

When the spike is evident, it has a steep ascending and descending limbs because the flows in the months before and after the peak have been reduced significantly to store water in Navajo Reservoir to accommodate depletions.

When the peak is not evident, the flows are lower in all months of the year with only a small peak, which is mainly provided by unregulated tributaries.

Under full development there is also an increase in the peaks in dry years, which will also need further study.