



## United States Department of the Interior

### FISH AND WILDLIFE SERVICE

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Mr. Hannafious and Ms. Caramillo:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion (BO) on the effects of the Jicarilla Apache Nation Navajo River Water Development Plan (proposed action) on the federally endangered Colorado pikeminnow (*Ptychocheilus lucius*) (pikeminnow), razorback sucker (*Xyrauchen texanus*), and their designated critical habitat. The U.S. Army Corps of Engineers (Corps) and the Jicarilla Apache Nation (Nation) are joint action agencies for the proposed action. The duration of this action is from the acceptance of this BO, indefinitely, or until reinitiation becomes necessary.

The Corp's October 16, 2003, letter requested formal consultation, however, none of the effects determinations were "may affect, likely to adversely affect," the usual trigger for formal consultation. Although the biological assessment (BA) determined no effect to the pikeminnow or razorback sucker, the Service has determined that all depletions from the San Juan River system "may affect" pikeminnow, razorback sucker, and their designated critical habitat. Generally, the Service does not provide a biological opinion or conference report until the action agency has identified a "may affect" situation. In this case, (consistent with our 1998 Consultation Handbook) the Corps and the Nation agreed to allow consultation to proceed without a "may affect" determination from the Corps.

The proposed action constitutes a new depletion to the San Juan River. Therefore the Service

has determined that the correct effects determination for pikeminnow, razorback sucker, and their critical habitat, is “may affect, likely to adversely affect.” In accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR 402), this document transmits the Service’s BO for impacts to federally listed threatened and endangered species and their critical habitat as a result of the Corp’s proposed action. A complete administrative record of this consultation is on file at the Service’s New Mexico Ecological Services Field Office (NMESFO).

The Service concurs with the “may affect, not likely to adversely affect” determination for the threatened bald eagle (*Haliaeetus leucocephalus*) because the project description includes the following commitment:

In order to prevent or minimize any potential impacts to bald eagles, a qualified biologist will survey the Project area for wintering bald eagles between November 1 and March 1, prior to anticipated Project construction. Surveys will focus on areas of known use, such as the Navajo River and Dulce Lake. In addition, construction activities will be delayed if a bald eagle is observed perching within 0.5 mile of the construction area unless they enter the Project area during construction, in which case, it can be assumed the construction is not limiting their use of the Project area.

The Service concurs with the “may affect, not likely to adversely affect” determination for the endangered southwestern willow flycatcher (*Empidonax traillii extimus*) (flycatcher) because the project description includes the following commitments:

As part of the Project, the Nation has committed to monitor the potential effects of the Project on the riparian area downstream of the diversion. Prior to construction and for a five-year period following construction, the Nation will monitor surface water and groundwater elevations, as well as vegetation, along an approximate four-mile reach of the Navajo River downstream of the diversion to document potential impacts from the Project. This monitoring data will be used by the Nation and the Service to facilitate discussions about the minimization of impacts to native aquatic and riparian species.

The Nation will provide the monitoring results to the Service beginning in 2004 and continuing for five-years post project in order for the Service to evaluate the riparian conditions downstream of the project’s diversion point. The Service may request a review of the findings with the Nation in order to evaluate possible impacts that may be attributable to the project. The Nation will work with the Service to determine what actions the Nation may take in order to minimize impacts to potential flycatcher habitat including but not limited to, stream side restoration, assessing diversion rate and timing, as well as other options for minimizing impacts and improving the riparian area.

Further details regarding riparian monitoring was provided in the Riparian Monitoring Protocol received February 4, 2004 (David Evans and Associates, Inc. 2004). The Riparian Monitoring Protocol was developed to assure the proposed project would not negatively affect the riparian habitat of the Navajo River and is part of the proposed action.

The Corps and the Nation should contact the Service to verify that the above determination and concurrence are still valid if: 1) Future surveys detect listed, proposed or candidate species in

habitats where they have not been previously observed; 2) the proposed action is changed in a manner that, or new information reveals that, the listed species or their habitats are affected to an extent not considered in these evaluations; or 3) a new species is listed that may be affected by the proposed action. For the flycatcher, if the results from the monitoring plan indicate that the flycatcher or its habitats are being adversely affected by the proposed action, the Service should be contacted to determine if our concurrence with the not likely to adversely affect determination remains valid.

## Consultation History

On May 13, 2002, the Service received a request from David Evans and Associates, Inc. for a list of candidate, threatened, and endangered species. A short project description accompanied this request that described the proposed action as a 12,000 acre foot/year (af/y) depletion. We responded on May 20, 2002, with a species list. On March 2, 2003, we received a request from the Corps to include the Nation as a joint action agency. We agreed to this request in a May 20, 2003, letter to the Corps. On April 3, 2003, we commented on a Corps Clean Water Act, section 404, permit (2003-00086) dated March 4, 2003, for the proposed action.

We received another species list request from David Evans and Associates, Inc. on April 10, 2003, and responded on April 28, 2003. On July 10, we received another species list request from the Corps and responded on July 31, 2003. We received a request for formal consultation, and a BA on October 20, 2003, and initiated formal consultation on November 19, 2003. Additional information clarifying the proposed action was received through electronic mail on February 5, 2004. In addition to the above listed correspondence, we met with the Corps and Nation in April 2002, July 2003, January 2004, and discussed the project by telephone on a number of occasions.

## Action Area

The action area consists of: 1) Dulce Lake; 2) the pipeline from the Navajo River to Dulce Lake; 3) Navajo River from the diversion structure downstream to the San Juan River; 4) the San Juan River (including Navajo Reservoir) to the pool of Lake Powell (Figure 1 and 2). Any future use of the water that extends beyond this action area, or affects listed species that are not considered in this opinion, would require additional consultation.

## BIOLOGICAL OPINION

### Description of the proposed action

#### Physical structures

The Nation proposes to divert and transport water from the Navajo River to Dulce Lake. The Navajo River diversion would be located near the northern border of the reservation, upstream of the J-9 bridge crossing and the confluence with Amargo Creek (Figure 2). The intake structure would consist of a concrete box set about 6 meters (20 feet) off the left bank. Some channel and bank stabilization (i.e., armoring with gabions or rip rap) may be included in the project. The intake structure would be connected to the Navajo River by a rock gabion and screened system.

From the intake structure, water would be pumped to a settling pond located nearby, and from

there pumped into the pipeline for transport to Dulce Lake. Water would be pumped from the settling pond into a 24-inch pipe along J-9 Road. The pipeline turns south along US 64 and crosses Amargo Creek by hanging off the US 64 bridge. The pipeline continues along US 64 to an intermediate pump station and settling pond just south of Dulce. The pipeline then crosses US 64 and parallels an existing pipeline before returning to US 64 and terminating at Dulce Lake (Figure 2).

The proposed action would use more than 45,000 linear feet (13,000 meters) of pipe. Pipeline construction would involve the following components: 1) excavation; 2) bedding placement; 3) pipe placement; 4) covering the pipe with bedding; and 5) backfilling the trench. The width of disturbance would be between 40 and 65 feet (12-20 meters). The BA did not quantify habitat impacts other than 1.88 acres (0.4 hectares) of Corps jurisdictional wetlands.

### **Water diversions and depletions**

If Dulce Lake remains completely dry (as it was in 2003) when the proposed action is ready to begin diverting water, then it would take a diversion and depletion (no return flow to Navajo River) of approximately 1,200 af over a 10 month period to fill the lake to its 1,036 af capacity. In addition to this initial filling, the proposed action would use an additional approximate 300 af/y on average to supply water for historical irrigation and replace evaporative losses from Dulce Lake. As the Nation implements future applications of water, Dulce Lake would also provide storage and regulation space for future uses under full project development.

At full project development, the Nation intends to divert up to 12,000 af/y from the Navajo River, resulting in a depletion of 8,500 af/y on average. Of the 8,500 af/y average depletion, 6,654 af/y on average is considered a new depletion. The Nation plans to use 1,846 af/y of depletions on average (the remaining balance of 8,500 af/y minus 6,654 af/y) from its historic uses under the February 22, 1999 Partial Final Judgement and Decree in the San Juan River Adjudication (Decree). While 1,846 af/y depletion will be the average, the BA states that the Nation may choose to deplete up to 3,400 af/y of its 4,382 af/y historic and existing use water rights for this project in any given year (Decree).

Following the expiration of the Nation's minor subcontracts in 2005, the Nation will have an additional 770 af/y of depletions available to use for the proposed action. This 770 af/y is included in Table 1 within New Mexico, under "unspecified minor depletions." The Service considers this 770 af/y a historic depletion even though the water right is a future use right in the San Juan Basin Jicarilla Apache Tribe Water Rights Settlement Act of 1992 (PL102-441) and associated settlement contract (Settlement).

The Nation has a right to deplete up to 25,500 af/y from the Navajo River or the Navajo Reservoir Supply for its future uses (Settlement). According to the BA, the Nation currently has 8,530 af/y of depletions available (25,500 minus 16,200 af/y subcontract to PNM minus 770 af/y minor subcontracts in 2005) that it may choose to use for the proposed action. The 6,564 af/y on average new depletion comes out of the 8,530 af/y water rights mentioned above.

The proposed diversion and depletion regime presented in the BA is a variable amount of water diverted and depleted, (up to a 12,000 af/y diversion and 8,500 af/y depletion on average). Within these parameters, the maximum new depletion in any given year will depend on the "available water" in that year. Available water is a predicted volume of water in Navajo

Reservoir that will meet all water needs, including the Flow Recommendations for the San Juan River (Flow Recommendations) (Holden 1999), through pikeminnow and razorback sucker critical habitat. The Nation, as a member of the San Juan Recovery Implementation Program (SJRIP) and its Hydrology Committee, will introduce for Hydrology Committee's consideration, a method to calculate "available water." The Nation will endeavor to obtain the Hydrology Committee's review and adoption of such a methodology prior to the diversion of water that is considered a new depletion under this consultation.

The Nation would like to maintain a healthy fishery and riparian habitat within the Navajo River as it passes through the Nation's lands. The Nation is proposing a maximum diversion of 22 cubic feet per second (cfs), with a minimum instream flow of 30 cfs, to achieve fish, wildlife, and riparian management objectives. The minimum instream flow objective can be met under most proposed flow regimes. However, looking at flow duration analyses, and assuming that the Bureau of Reclamation operates its upstream San Juan-Chama Project diversion dams to divert all but the minimum bypass during low flow periods, some daily and monthly shortages to the proposed action may exist during low flow periods, as evidenced by the period of record. These shortages will result in reduced or no diversions on some days to maintain minimum flows. Minimum instream flows will take priority over the Nation's irrigation diversions during low flow periods.

Status of the species and critical habitat

### **Colorado Pikeminnow**

The pikeminnow is the largest cyprinid (member of the minnow family, Cyprinidae) native to North America, and it evolved as the top predator in the Colorado River system. It is an elongated pike-like fish that once grew as large as 1.8 meters (m) (6 feet) in length and weighed nearly 45 kilograms (100 pounds) (Behnke and Benson 1983); such fish were estimated to be 45-55 years old (Osmundson et al. 1997). Today, fish rarely exceed one meter (approximately 3 feet) in length or weigh more than 8 kilograms (18 pounds). The mouth of this species is large and nearly horizontal, with long slender pharyngeal teeth (located in the throat), adapted for grasping and holding prey. The diet of pikeminnow longer than 80 to 100 millimeters (mm) (3 or 4 inches [in]) consists almost entirely of other fishes (Vanicek and Kramer 1969). Males become sexually mature earlier and at a smaller size than females, though all are mature by about age 7 and 500 mm (20 in) in length (Vanicek and Kramer 1969, Seethaler 1978, Hamman 1981).

Adults are strongly counter-shaded with a dark, olive back, and a white belly. Young are silvery and usually have a dark, wedge-shaped spot at the base of the caudal fin.

Early fish collection records, archaeological finds, and other observations, indicate that the pikeminnow was once found throughout warmwater reaches of the entire Colorado River Basin down to the Gulf of California, including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, the San Juan River and some of its tributaries, and the Gila River system in Arizona (Seethaler 1978, Platania 1990). Pikeminnow apparently were never found in colder headwater areas. Seethaler (1978) indicates that the species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850s. By the 1970s they were extirpated from the entire lower Basin (downstream of Glen Canyon Dam) and from portions of the upper Basin as a result of major alterations to the riverine environment. Having lost approximately 75-80 percent of its former range, the pikeminnow was

federally listed as an endangered species in 1967 (32 FR 4001, Miller 1961, Moyle 1976, Tyus 1991, Osmundson and Burnham 1998).

Critical habitat is defined as the areas that provide physical or biological features that are essential for the recovery of the species. Critical habitat was designated for the pikeminnow in 1994, within the 100-year floodplain of the species' historical range in the following section of the San Juan River Basin (59 FR 13374) (Service 1993, 1994):

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 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.

The Service identified water, physical habitat, and the biological environment as primary constituent elements of critical habitat. This includes a quantity of water of sufficient quality, delivered to specific habitats, in accordance with a hydrologic regime required for the particular life stage of the species. The physical habitat includes areas of the Colorado River system 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, which when inundated provide access to spawning, nursery, feeding, and rearing habitats, are included. Food supply, predation, and competition are important elements of the biological environment.

### **Life History**

The life history phases that appear to be most limiting for pikeminnow populations include spawning, egg hatching, development of larvae, and the first year of life. These phases of pikeminnow development are tied closely to specific habitat requirements. Natural spawning of pikeminnow is initiated on the descending limb of the annual hydrograph as water temperatures approach or exceed 20°C (68°F) (Vanicek and Kramer 1969, Hamman 1981, Haynes et al. 1984, Tyus 1990, McAda and Kaeding 1991). Temperature at initiation of spawning varies by river. In the Green River, spawning begins as temperatures exceed 20-23°C (68-73°F); in the Yampa River, 16-23°C (61-68°F) (Bestgen et al. 1998); in the Colorado River, 18-22°C (64-72°F) (McAda and Kaeding 1991); in the San Juan River temperatures were estimated to be 16-22°C (61-72°F). Spawning, both in the hatchery and under natural riverine conditions, generally occurs in a 2-month period between late June and late August. However, sustained high flows during wet years may suppress river temperatures and extend spawning into September (McAda and Kaeding 1991). Conversely, during low flow years, when the water warms earlier, spawning may commence in mid-June.

Temperature also has an effect on egg development and hatching success. In the laboratory, egg development was tested at five temperatures and hatching success was found to be highest at 20°C (68°F), and lower at 25°C (77°F). Mortality was 100 percent at 5, 10, 15, and 30°C (41, 50, 59, and 86°F). In addition, larval abnormalities were twice as high at 25°C (77°F) than at 20°C (68°F) (Marsh 1985).

Experimental tests of temperature preference of yearling (Black and Bulkley 1985a) and adult (Bulkley et al. 1981) pikeminnow indicated that 25°C (77°F) was the most preferred temperature for both life phases. Additional experiments indicated that optimum growth of yearlings also occurs at temperatures near 25°C (77°F) (Black and Bulkley 1985b). Although no such tests

were conducted using adults, the tests with yearlings supported the conclusions of Jobling (1981) that the final thermal preference of 25°C (77°F) provides a good indication of optimum growth temperature for all life phases.

Most information on pikeminnow reproduction was gathered from spawning sites on the lower 20 miles (12.2 kilometers) of the Yampa River and in Gray Canyon on the Green River (Tyus and McAda 1984, Tyus 1985, Wick et al. 1985, Tyus 1990). Pikeminnow spawn after peak runoff subsides and spawning is probably triggered by several interacting variables such as day length, temperature, flow level, and perhaps substrate characteristics. Known spawning sites in the Yampa River are characterized by riffles or shallow runs with well-washed coarse substrate (cobble containing relatively deep interstitial voids (for egg deposition)) in association with deep pools or areas of slow non-turbulent flow used as staging areas by adults (Lamarra et al. 1985, Tyus 1990). Recent investigations at a spawning site in the San Juan River by Bliesner and Lamarra (1995) and at one in the upper Colorado River (Service unpubl. data) indicate a similar association of habitats. The most unique feature at the sites used for spawning, in comparison with otherwise similar sites nearby, is the lack of embeddedness of the cobble substrate and the depth to which the rocks are devoid of fine sediments; this appears consistent at the sites in all three rivers (Lamarra et al. 1985, Bliesner and Lamarra 1995).

Collections of larvae and young-of-year (YOY) downstream of known spawning sites in the Green, Yampa, and San Juan Rivers demonstrate that downstream drift of larval pikeminnow occurs following hatching (Haynes et al. 1984, Nesler et al. 1988, Tyus 1990, Tyus and Haines 1991, Platania 1990, Ryden 2003). Studies on the Green and Colorado Rivers found that YOY used backwaters almost exclusively (Holden 2000). During their first year of life, pikeminnow prefer warm, turbid, relatively deep (averaging 0.4 m [1.3 feet]) backwater areas of zero velocity (Tyus and Haines 1991). After about one year, young are rarely found in such habitats, though juveniles and subadults are often located in large deep backwaters during spring runoff (Service, unpublished data; Osmundson and Burnham 1998).

Pikeminnow often migrate considerable distances to spawn in the Green and Yampa Rivers (Miller et al. 1982, Archer et al. 1986, Tyus and McAda 1984, Tyus 1985, Tyus 1990), 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 recaptured in the San Juan River approximately 80 miles upstream in September 1987 (Platania 1990). Ryden and Ahlm (1996) report that a pikeminnow captured at river mile (RM) 74.8 (Lake Powell = RM 0, Navajo Dam = RM 226) made a 50-60 mile migration during the spawning season in 1994, before returning to within 0.4 river miles of its original capture location.

Although migratory behavior has been documented for pikeminnow in the San Juan River (Platania 1990, Ryden and Ahlm 1996), of 13 radio-tagged fish tracked from 1991 to 1994, 12 were classified as sedentary and only one as migratory (Ryden and Ahlm 1996). Miller and Ptacek (2000) followed 7 radio-tagged wild pikeminnow in the San Juan River and found these fish to also use a localized area of the river (RM 120 to RM 142). In contrast to pikeminnow in the Green and Yampa rivers, the majority of San Juan River pikeminnow reside near the area in which they spawn (Ryden and Ahlm 1996, Miller and Ptacek 2000). During their study, Ryden and Ahlm (1996) found that the San Juan River pikeminnow aggregated at the mouth of the Mancos River prior to spawning, a behavior not documented in other rivers in the upper Colorado River Basin. Miller and Ptacek (2000) also recorded 2 pikeminnow in both 1993 and

1994 at the mouth of the Mancos River prior to the spawning period.

Historical spawning areas for the pikeminnow in the San Juan River are unknown; however, Platania (1990) speculated that spawning likely occurred upstream at least to Rosa, New Mexico. Two locations in the San Juan River have been identified as potential spawning areas based on radio telemetry and visual observations (Ryden and Pfeifer 1994, Miller and Ptacek 2000). Both locations occur within the "Mixer" (RM 133.4 to 129.8), a geomorphically distinct reach of the San Juan River. The upper spawning location is located at RM 132 and the lower spawning location at approximately RM 131.1. Both locations consist of complex habitat associated with cobble bar and island complexes. Habitat at these locations is similar to spawning habitats described for the Yampa River and is composed of side channels, chutes, riffles, slow runs, backwaters, and slackwater areas near bars and islands. Substrate in the riffle areas is clean cobbles, primarily 7.6 to 10.2 centimeters (3 to 4 in) in diameter (Miller and Ptacek 2000). Spawning habitat at the lower spawning area, based on radio telemetry and visual observations, is composed of a fast narrow chute adjacent to a small eddy.

During 1993, radio-tagged pikeminnow were observed moving to potential spawning locations in the Mixer beginning around July 1. Fish were in the spawning areas between approximately July 12 and July 25. During this period, flows in the San Juan River were on the descending limb of the spring runoff. Temperatures increased from approximately 20 to 25°C (68 to 77°F) during the same time period. Observations in other years show a similar pattern. However, specific spawning times and the duration of the spawning period appear to vary from year to year. Information on radio-tagged adult pikeminnow during fall suggests that pikeminnow seek out deep water areas in the Colorado River (Miller et al. 1982, Osmundson and Kaeding 1989), as do many other riverine species. Pools, runs, and other deep water areas, especially in upstream reaches, are important winter habitats for pikeminnow (Osmundson et al. 1995).

On the Green River, tributaries are an important habitat component for pikeminnow (Holden 2000). Both the Yampa River and White River were heavily used by pikeminnow subadults and adults, apparently as foraging areas (Tyus 1991). The tributaries were the primary area of residence to which the adults returned after spawning. Tributaries to the San Juan River no longer provide habitat to adults because they are dewatered or access is restricted (Holden 2000). Pikeminnow utilized the Animas River in the late 1800s, and this river may still provide suitable habitat; however, the present pikeminnow population is downstream from the mouth of the Animas River about 50 miles (Holden 2000). Pikeminnow aggregated at the mouth of the Mancos River prior to spawning in the early 1990s (Ryden and Ahlm 1996, Miller and Ptacek 2000).

Very little information is available on the influence of turbidity on the endangered Colorado River fishes. Osmundson and Kaeding (1989) found that turbidity allows use of relatively shallow habitats ostensibly by providing adults with cover; this allows foraging and resting in areas otherwise exposed to avian or land predators. Tyus and Haines (1991) found that young pikeminnow in the Green River preferred backwaters that were turbid. Clear conditions in these shallow waters might expose young fish to predation from wading birds or introduced, sight-feeding, piscivorous fish. It is unknown whether the river was as turbid historically as it is today. For now, it is assumed that these endemic fishes evolved under natural conditions of high turbidity; therefore the retention of these highly turbid conditions is probably an important factor in maintaining the ability of these fish to compete with non-natives that may not have evolved



under similar conditions.

### **Population Dynamics**

Due to the low numbers of pikeminnow collected in the San Juan River, it is not possible to quantify population size or trends. Estimates during a seven-year research period between 1991 and 1997 suggest that there were fewer than 50 adults in a given year (Ryden 2000a). The ability of the pikeminnow to withstand adverse impacts to its populations and its habitat is difficult to discern given the longevity of individuals and their scarcity within the San Juan River Basin. At this stage of investigations on the San Juan River, the younger life stages are considered the most vulnerable to predation, competition, and habitat degradation through contamination. Population level response times to rebound from these impacts may take several years or more.

Between 1991 and 1995, 19 (17 adult and 2 juvenile) wild pikeminnow were collected in the San Juan River by electrofishing (Ryden 2000a). Wild adult pikeminnow were most abundant between RM 142 (the former Cudei Diversion) and the Four Corners at RM 119 (Ryden and Ahlm 1996), and they primarily use the San Juan River between these points (Ryden and Pfeifer 1993, 1994, 1995a, 1996). The multi-threaded channel, habitat complexity, and mixture of substrate types in this area of the river appear to provide a diversity of habitats favorable to pikeminnow on a year-round basis (Holden and Masslich 1997).

Successful reproduction was documented in the San Juan River in 1987, 1988, and 1992 through 1996, by the collection of larval and/or YOY pikeminnow. The majority of the YOY pikeminnow were collected in the San Juan River inflow to Lake Powell (Archer et al. 1995, Buntjer et al. 1994, Lashmett 1994, Platania 1990). Some YOY pikeminnow have been collected near the Mancos River confluence, 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, Snyder and Platania 1995). The collection of such young fish (only a few days old) at Mexican Hat in two different years suggests that perhaps another spawning area for pikeminnow exists somewhere below the Mixer (Platania 1996). Capture of a larval pikeminnow at RM 128 during August 1996 was the first larva collected immediately below the suspected spawning site in the Mixer (Holden and Masslich 1997).

Platania (1990) noted that, during 3 years of studies on the San Juan River (1987 - 1989), spring flows and pikeminnow reproduction were highest in 1987. He further noted catch rates for channel catfish were lowest in 1987. Subsequent studies (Brooks et al. 1994) found declines in channel catfish in 1993; these declines have been attributed to a successive series of higher than normal spring runoffs from 1991 through 1993. Recent studies also found catch rates for YOY pikeminnow to be highest in high water years, such as 1993 (Buntjer et al. 1994, Lashmett 1994).

Tissue samples from pikeminnow caught during research conducted under the SJRIP have been analyzed as part of a Basin-wide analysis of endangered fish genetics. The results of that analysis indicate that the San Juan River fish exhibit less genetic variability than the Green River and Colorado River populations, likely due to the small population size, but were very similar to pikeminnow from the Green, Colorado, and Yampa Rivers (Morizot in litt. 1996). These data suggest that the San Juan population is probably not a separate stock (Holden and Masslich 1997).

## **Competition and Predation**

Pikeminnow in the upper Colorado Basin live with about 20 species of warm-water non-native fishes (Tyus et al. 1982, Lentsch et al. 1996) that are potential predators, competitors, and vectors for parasites and disease. Backwaters and other low-velocity habitats in the San Juan River are important nursery areas for larval and juvenile pikeminnow (Holden 1999) and researchers believe that non-native fish species limit the success of pikeminnow recruitment (Bestgen 1997, Bestgen et al. 1997, McAda and Ryel 1999). Osmundson (1987) documented predation by black bullhead (*Ameiurus melas*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*) as a significant mortality factor for YOY and yearling pikeminnow stocked in riverside ponds along the upper Colorado River. Adult red shiner (*Cyprinella lutrensis*) are known predators of larval native fish in backwaters of the upper Basin (Ruppert et al. 1993). High spatial overlap in habitat use has been documented among young pikeminnow, red shiner, sand shiner (*Notropis stramineus*), and fathead minnow (*Pimephales promelas*). In laboratory experiments on behavioral interactions, Karp and Tyus (1990) observed that red shiner, fathead minnow, and green sunfish shared activity schedules and space with young pikeminnow and exhibited antagonistic behaviors to smaller pikeminnow. They hypothesized that pikeminnow may be at a competitive disadvantage in an environment that is resource limited.

Channel catfish (*Ictalurus punctatus*) has been identified as a threat to juvenile, subadult, and adult pikeminnow in the San Juan River. Channel catfish were first introduced in the upper Colorado Basin in 1892 (Tyus and Nikirk 1990) and are now considered common to abundant throughout much of the upper Basin (Tyus et al. 1982, Nelson et al. 1995). This species is one of the most prolific predators in the upper Basin and, among the non-native fishes, is thought to have the greatest adverse effect on endangered fishes due to predation on juveniles and resource overlap with subadults and adults (Hawkins and Nesler 1991, Lentsch et al. 1996, Tyus and Saunders 1996). Stocked juvenile and adult pikeminnow that have preyed on channel catfish have died from choking on the pectoral spines (McAda 1980, Pimental et al. 1985, Ryden and Smith 2002). Mechanical removal (electrofishing, seining) of channel catfish has not led to a positive population response in pikeminnow (Davis 2003). However, because the pikeminnow population is so low, documenting a population response would be extremely difficult.

## **Status and Distribution**

The pikeminnow was designated as endangered prior to the Act; therefore, a formal listing package identifying threats was not prepared. Construction and operation of main stem dams, non-native fish, and local eradication of native minnow and suckers in the early 1960s were recognized as early threats (Miller 1961, Holden 1991). The pikeminnow recovery goals (Service 2002a) summarize threats to the species as follows: stream regulation, habitat modification, competition with and predation by non-native fish, and pesticides and pollutants.

Major declines in pikeminnow populations occurred in the lower Colorado Basin during the dam-building era of the 1930s through the 1960s. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water use practices drastically modified the river's natural hydrology and channel characteristics throughout the Colorado River Basin. Dams on the main stem fragmented the river ecosystem into a series of disjunct segments, blocked native fish migrations, reduced water temperatures downstream of

dams, created lake habitat, and provided conditions that allow competitive and predatory non-native fishes to thrive both within the impounded reservoirs and in the modified river segments that connect them. The highly modified flow regime in the lower Basin coupled with the introduction of non-native fishes decimated populations of native fish.

In the upper Colorado Basin, declines in pikeminnow populations occurred primarily after the 1960s, when the following dams were constructed: Glen Canyon Dam on the main stem Colorado River, Flaming Gorge Dam on the Green River, Navajo Dam on the San Juan River, and the Aspinall Unit dams on the Gunnison River (Table 4). Some native fish populations in the upper Basin have managed to persist, while others have become nearly extirpated. River reaches where native fish have declined more slowly, exhibit hydrologic regimes that more closely resemble pre-dam conditions, adequate habitat for all life phases, and migration corridors that allow connectivity among habitats used during the various life phases.

A factor not considered when the pikeminnow was listed was water quality. Surface and ground water quality in the Animas, La Plata, Mancos, and San Juan River drainages have become significant concerns in recent years (Abell 1994). Changes in water quality and contamination of associated biota are known to occur in Bureau of 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 (Sylvester et al. 1988). Increased loading of the San Juan River and its tributaries with heavy metals; elemental contaminants such as selenium, salts, polycyclic aromatic hydrocarbons (PAHs); and pesticides has degraded water quality of the San Juan River in critical habitat (Abell 1994, Wilson et. al. 1995, Holden 1999).

### **Razorback Sucker**

Like all suckers (family Catostomidae, meaning “down mouth”), the razorback sucker has a ventral mouth with thick lips covered with papillae and no scales on its head. In general, suckers are bottom browsers, sucking up or scraping off small invertebrates, algae, and organic matter with their fleshy, protrusible lips (Moyle 1976). The razorback sucker is the only sucker with an abrupt sharp-edged dorsal keel behind its head. The keel becomes more massive with age. The head and keel are dark, the back is olive-colored, the sides are brownish or reddish, and the abdomen is yellowish white (Sublette et al. 1990). Adults often exceed 3 kg (6 lbs) in weight and 600 mm (2 ft) in length. Like pikeminnow, razorback suckers are long-lived, living 40-plus years.

Historically, razorback suckers 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 1983). Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and that commercially marketable quantities were caught in Arizona as recently as 1949. In the upper Colorado River Basin, razorback suckers were reported to be very abundant in the Green River near Green River, Utah, in the late 1800s (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 1930s and early 1940s. In the San Juan River drainage, the first documented razorback sucker from the river was documented in 1988 (Platania 1990); however, two adults were also collected from an irrigation pond attached to the river by a canal in 1976 (Platania 1990) and it is very likely that razorback sucker once occurred in the main stem as far upstream as Rosa, New Mexico (Ryden 1997).

A marked decline in populations of razorback suckers can be attributed to construction of dams and reservoirs, introduction of non-native fishes, and removal of large quantities of water from the Colorado River system. Dams on the main stem Colorado River and its major tributaries have fragmented populations and blocked migration routes. Dams also have drastically altered flows, water temperatures, and channel geomorphology. These changes have modified habitats in many areas so that they are no longer suitable for breeding, feeding, or sheltering. Major changes in species composition have occurred due to the introduction of non-native fishes, many of which have thrived due to man-induced changes to the natural riverine system. Habitat has been significantly degraded to where it impairs the essential functions of razorback sucker, such as reproduction and recruitment into the adult population.

On March 14, 1989, the Service was petitioned to conduct a status review of the razorback sucker. Subsequently, the razorback sucker was designated as endangered under a final rule published on October 23, 1991 (56 FR 13374). The final rule stated that “Little evidence of natural recruitment has been found in the past 30 years, and numbers of adult fish captured in the last 10 years demonstrate a downward trend relative to historic abundance. Significant changes have occurred in razorback sucker habitat through diversion and depletion of water, introduction of nonnative fishes, and construction and operation of dams”(56 FR 13374). Recruitment of razorback suckers to the population continues to be a problem.

Critical habitat was designated in 1994, within the 100-year flood plain of the razorback sucker's historical range in the following area of the upper Colorado River (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.

The primary constituent elements of critical habitat are the same as those listed for pikeminnow, described above.

### **Life History**

McAda and Wydoski (1980) and Tyus (1987) reported springtime aggregations of razorback suckers in off-channel habitats 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 Colorado Basin, captures of ripe specimens, both males and females, have been recorded in the Yampa, Green, Colorado, and San Juan Rivers (Valdez et al. 1982, McAda and Wydoski 1980, Tyus 1987, Osmundson and Kaeding 1989, Tyus and Karp 1989, Tyus and Karp 1990, Osmundson and Kaeding 1991, Platania 1990, Ryden 2000b). Because of the relatively steep gradient in the San Juan River and lack of a wide flood plain, razorback sucker are spawning in low velocity, turbid, main channel habitats. Aggregations of ripe adults have been documented in two locations. The capture of larval razorback sucker approximately 48 km (30 mi) upstream from the other sites suggests a third spawning location (Ryden, Service, in litt. 2004).

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. Both sexes mature as early as age four (McAda and Wydoski 1980). Fecundity, based on ovarian egg counts, ranges from 75,000-144,000 eggs (Minckley 1983). Several males attend each female; no nest is built. The adhesive eggs drift to the bottom and hatch there (Sublette et al. 1990). Marsh (1985) reported that percentage egg hatch was greatest at 20°C (68°F) and all embryos died at incubation temperatures of 5, 10, and 30°C (41, 50, and 86°F).

Because young and juvenile razorback suckers are rarely encountered, their habitat requirements in the wild are not well known, particularly in native riverine environments. However, it is assumed that low-velocity backwaters and side channels are important for YOY and juveniles, as it is to the early life stages of most riverine fish. 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 Colorado Basin (Tyus and Karp 1989, Osmundson and Kaeding 1991). Modde (1996) found that on the Green River, larval razorback suckers entered flooded bottomlands that are connected to the main channel during high flow. However, as mentioned earlier, because of the relatively steep gradient of the San Juan River and the lack of a wide flood plain, flood bottomlands are probably much less important in this system than are other low velocity habitats such as backwaters and secondary channels (Ryden, Service, in litt. 2004).

Reduction in spring peak flows eliminates or reduces the frequency of inundation of off-channel and bottomland habitats. The absence of these seasonally flooded riverine habitats is believed to be a limiting factor in the successful recruitment of razorback suckers in other upper Colorado River streams (Tyus and Karp 1989, Osmundson and Kaeding 1991). Wydoski and Wick (1998) identified starvation of larval razorback suckers, due to low zooplankton densities in the main channel and loss of floodplain habitats that provide adequate zooplankton densities for larval food, as one of the most important factors limiting recruitment. Maintaining low velocity habitats is important for the survival of larval razorback suckers.

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, Osmundson and Kaeding 1991, Tyus and Karp 1990). The diet consists primarily of algae, plant debris, and aquatic insect larvae (Sublette et al. 1990).

### **Population Dynamics**

Because wild razorback sucker are rarely encountered and they are a long-lived fish, it is difficult to determine natural fluctuations in the population. The existing scientific literature and historic accounts by local residents strongly suggest that razorback suckers were once a viable, reproducing member of the native fish community in the San Juan River drainage. Currently, razorback sucker is rare throughout its historic range and extremely rare in the main stem San Juan River. Until 2003, there was very limited evidence indicating natural recruitment to any population of razorback sucker in the Colorado River system (Bestgen 1990, Platania 1990, Platania et al. 1991, Tyus 1987, McCarthy and Minckley 1987, Osmundson and Kaeding 1989, Modde et al. 1996). In 2003, two juvenile (age-2) razorback sucker, 249 and 270 mm (9.8 and 10.6 in), thought to be wild-produced were collected in the lower San Juan River (RM 35.7 and

4.8) (Ryden, Service, in litt., 2004).

### **Competition and Predation**

Many species of non-native fishes occur in occupied habitat of the razorback sucker. These non-native fishes are predators, competitors, and vectors of parasites and diseases (Tyus et al. 1982, Lentsch et al. 1996, Pacey and Marsh 1999, Marsh et al. 2001). Many researchers believe that non-native species are a major cause for the lack of recruitment (e.g., McAda and Wydoski 1980, Minckley 1983, Tyus 1987, Muth et al. 2000). There are reports of predation of razorback sucker eggs and larvae by common carp (*Cyprinus carpio*), channel catfish, smallmouth bass (*Micropterus dolomeiui*), largemouth bass, bluegill (*Lepomis macrochirus*), green sunfish, and redear sunfish (*Lepomis microlophus*) (Jones and Sumner 1954, Marsh and Langhorst 1988, Langhorst 1989). Marsh and Langhorst (1988) found higher growth rates in larval razorback sucker in the absence of predators in Lake Mohave, and Marsh and Brooks (1989) reported that channel catfish and flathead catfish were major predators of stocked razorback sucker in the Gila River. Juvenile razorback sucker (average total length 171 mm [6.7 in]) stocked in isolated coves along the Colorado River in California, suffered extensive predation by channel catfish and largemouth bass (Langhorst 1989). Aggressive behavior between channel catfish and adult razorback sucker has been inferred from the presence of distinct bite marks on the dorsal keels of 4 razorback suckers that match the bite characteristics of channel catfish (Ryden, Service, in litt. 2004).

Lentsch et al. (1996) identified six species of non-native fishes in the upper Colorado River Basin as threats to razorback sucker: red shiner, common carp, sand shiner, fathead minnow, channel catfish, and green sunfish. Smaller fish, such as adult red shiner, are known predators of larval native fish (Ruppert et al. 1993). Large predators, such as walleye (*Stizostedion vitreum*), northern pike, and striped bass (*Morone saxatilis*) also pose a threat to subadult and adult razorback sucker (Tyus and Beard 1990).

### **Status and Distribution**

Currently, the largest concentration of razorback sucker remaining in the Colorado River Basin is in Lake Mohave. Estimates of the wild stock in Lake Mohave have fallen precipitously in recent years from 60,000 as late as 1991, to 25,000 in 1993 (Marsh 1993, Holden 1994), to about 9,000 in 2000 (Service 2002b). Until recently, efforts to introduce young razorback sucker into Lake Mohave have failed because of predation by non-native species (Minckley et al. 1991, Clarkson et al. 1993, Burke 1994). While limited numbers of razorback suckers persist in other locations in the Lower Colorado River, they are considered rare or incidental and may be continuing to decline.

In the upper Colorado Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic (lake-like) and riverine environments (Table 4). The largest populations of razorback suckers in the upper Basin are found in the upper Green and lower Yampa Rivers (Tyus 1987). Lanigan and Tyus (1989) estimated a population of 948 adults (95 percent confidence interval: 758 to 1,138) in the upper Green River. Eight years later, the population was estimated at 524 adults (95 percent confidence interval: 351 to 696) and the population was characterized as stable or declining slowly with some evidence of recruitment (Modde et al. 1996). 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 has declined

dramatically since 1974. Between 1984 and 1990, intensive collecting effort captured only 12 individuals in the Grand Valley (Osmundson and Kaeding 1991). The wild population of razorback sucker is considered extirpated from the Gunnison River (Burdick and Bonar 1997).

Scientifically documented records of wild razorback sucker adults in the San Juan River are limited to two fish captured in a riverside pond near Bluff, Utah in 1976, and one fish captured in the river in 1988, also near Bluff (Platania 1990). Large numbers were anecdotally reported from a drained pond near Bluff in 1976, but no specimens were preserved to verify the species. No wild razorback sucker were found during the 7-year research period (1991-1997) of the SJRIP (Holden 1999). Hatchery-reared razorback sucker, especially fish greater than 350 mm (13.8 in), introduced into the San Juan River in the 1990s have survived and reproduced, as evidenced by recapture data and collection of larval fish (Ryden 2000b).

Razorback suckers are in imminent danger of extirpation in the wild. The razorback sucker was listed as endangered October 23, 1991 (56 FR 54957). As Bestgen (1990) pointed out:

Reasons for decline of most native fishes in the Colorado River Basin have been attributed to habitat loss due to construction of mainstream dams and subsequent interruption or alteration of natural flow and physio-chemical regimes, inundation of river reaches by reservoirs, channelization, water quality degradation, introduction of non-native fish species and resulting competitive interactions or predation, and other man-induced disturbances (Miller 1961, Joseph et al. 1977, Behnke and Benson 1983, Carlson and Muth 1989, Tyus and Karp 1989). These factors are almost certainly not mutually exclusive, therefore it is often difficult to determine exact cause and effect relationships.

The razorback sucker recovery goals identified streamflow regulation, habitat modification, predation by non-native fish species, and pesticides and pollutants as the primary threats to the species (Service 2002b). Within the upper Colorado Basin, recovery efforts include the capture and removal of razorback suckers from all known locations for genetic analyses and development of brood stocks. Augmentation (stocking) may be the only means to prevent the extirpation of razorback sucker in the upper Colorado Basin. A genetics management plan and augmentation plan have been written for the razorback sucker (Crist and Ryden 2003, Ryden 2003).

### **Summary of Pikeminnow and Razorback Sucker Status and Distribution**

Pikeminnow and razorback sucker remain in danger of extinction in the wild, although SJRIP efforts have lessened this danger in the San Juan River. Both fish species evolved in large, unregulated river systems that have been modified by human activities. Dams have removed habitat, blocked movements, changed water temperature and river morphology, and enabled introduced species to flourish. In recent decades, progress has been made in understanding these species life histories and habitat needs. Despite concerted efforts to recover populations, the long-term prognosis for both pikeminnow and razorback sucker remains unknown. Rangewide, progress toward pikeminnow recovery has occurred in the Yampa and Green Rivers. Capture of two juvenile razorback suckers in 2003 provides the first indication of recruitment to the population in the San Juan River. Recruitment to reproductive age appears to be extremely limited for all populations. On the San Juan River both species have been stocked and individuals do persist. Razorback suckers have spawned in increasing numbers, and

pikeminnow have been documented spawning.

#### Environmental Baseline

The environmental baseline includes 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. All projects previously built or consulted on, and those State or private projects presently being built or considered that deplete water from the San Juan River Basin are in the environmental baseline for this proposed action. The baseline does not include the effects of the action under review.

Although the San Juan River was once a relatively small portion of the overall range of these species, the importance of this river to the species' populations has increased with the extensive loss of habitat from the lower Colorado Basin. In this section we discuss the status of the species in the action area, and factors affecting these species and their critical habitat, including dams and their effects on the riverine habitat, water quality, propagation programs for the species, water depletions, diversion structures, and non-native species.

#### Status of the species within the action area

Neither pikeminnow nor razorback sucker currently exist in the Navajo River. It is probable that the Navajo River was within the historic range for both pikeminnow and razorback sucker. Currently, the fish assemblage in the Navajo River is a mix of native suckers and chubs (including roundtailed chub, *Gila robusta*, a species listed as endangered by the State of New Mexico), and non-native trout.

Platania and Young (1989) summarized historic fish collections in the San Juan River drainage that indicate that pikeminnow once inhabited reaches above what is now the Navajo Dam and Reservoir near Rosa, New Mexico. Lake Powell and Navajo Reservoir resulted in the direct loss of approximately 161 km (100 mi) of San Juan River habitat for the two endangered fishes (Holden 2000). Since closure of Navajo Dam in 1963, the accompanying fish eradication program, and physical changes associated with the dam, wild pikeminnow have been eliminated from the upper San Juan River, both upstream of Navajo Dam as well as at least 25 river miles (RM) downstream of the dam (because of cold water temperature). Between 1987 and 1996, no wild pikeminnow adults were caught above Shiprock (approximately RM 150). Radiotelemetry studies conducted from 1991 to 1995 indicated that pikeminnow remained within a relatively small area of the river, between RM 110 to RM 142 (Holden 2000). However, pikeminnow captures now have extended upstream as far as the PNM weir (RM 166). During the seven-year research period (1991 to 1997) it was estimated that there were fewer than 50 adults in a given year (Ryden 2000a).

From 1991 to 1997, no wild adult razorback suckers were collected in the San Juan River and only one was caught during studies conducted in the late 1980s (Holden 2000). 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 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 razorback suckers handled in 1987, 8 were 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 10 individual specimens in the 1988 samples were recaptures from 1987. Also in 1988, a single adult tuberculate male razorback sucker was captured in the San Juan River near Bluff, Utah (RM 80) (Platania 1990, Platania et al. 1991). This was the first confirmed record of this species from the main stem San Juan River. The presence of this reproductively mature specimen suggested that razorback suckers were attempting to spawn within the riverine portion of the San Juan drainage. However, no wild razorback suckers have been collected on the San Juan River since 1988 (Dale Ryden, Service, pers. comm. 2002). A Schnabel multiple-census population model estimated that there were 268 razorback suckers in the San Juan River from RM 158.6 to 2.9 in October 2000 (Ryden 2001).

### **Factors affecting the species within the action area**

The factors described below affect pikeminnow, razorback sucker, and their critical habitat in the San Juan River from Navajo Dam to Lake Powell.

### **Flow Recommendations**

The Bureau of Reclamation is operating Navajo Reservoir to implement the Flow Recommendations (Holden 1999, Chapter 8), an action expected to positively affect most of the primary constituent elements of pikeminnow and razorback sucker critical habitat (with the exception of water temperature). As additional projects and depletions occur in the San Juan Basin, the amount of water available to the river will be reduced further. In addition, New Mexico may be in a period of prolonged drought (Liles 2000a), a situation that would place additional strain on the Bureau of Reclamation's ability to meet the Flow Recommendations. Dam operations that perfectly mimic the shape of the historic hydrograph cannot mimic the magnitude of the hydrograph due to the depletions in the basin and structural limitations at the dam (5,000 cfs limit). The largest spring peak flow to occur in the 40 years since the construction of Navajo Dam is 15,200 cfs (2.5 percent of the years) (measured at the USGS Bluff gauge, May 30, 1979). In the 49 years prior to dam construction there were spring peak flows greater than 15,200 cfs in 13 years (26 percent of the time). The Flow Recommendations predict that the pikeminnow and razorback sucker habitat needs can be met while allowing for the depletions in Table 1 to occur. Currently, the best available information analyzing predicted habitat responses to observed habitat responses indicates that some changes to the release hydrographs may be warranted to best utilize released water (Bliesner 2004). Operating Navajo Dam to mimic the natural hydrograph is currently the best action available to minimize the impacts associated with the dam, and is the result of research and recommendations from the SJRIP. A draft BO for the the Bureau of Reclamation's operation of the Navajo Unit, which includes meeting the Flow Recommendations as part of the proposed action, was issued on February 26, 2004.

### **Navajo Dam**

Navajo Dam was completed in 1963. The operation of the dam caused many downstream effects, and these effects are on-going. Dams cause many changes to the physical and biological components of a stream ecosystem (Williams and Wolman 1984). Some of these effects are making depletions easier to achieve, changing water temperature, reducing lateral channel migration, channel scouring, blockage of fish passage, transformation of riverine habitat into

lake habitat, channel narrowing, changing the riparian community, diminishing peak flows, changing the timing of high and low flows, and reducing connectivity between the river and its flood plain (e.g., Sherrard and Erskine 1991, Power et al. 1996, Kondolf 1997, Polzin and Rood 2000, Collier et al. 2000, Shields et al. 2000). Alteration in water temperature, blockage of fish passage, transformation of riverine habitat into lake habitat, and changes in the timing and magnitude of high and low flows, and changes in channel will be discussed in more detail below.

## **Depletions**

Significant depletions and redistribution of flows of the San Juan River have occurred as a result of water development projects, including the Navajo Indian Irrigation Project (270,000 af/y), the San Juan-Chama Project (110,000 af/y), Animas-La Platta (57,100 af/y), San Juan National Forest Programatic (34,656 af/y), Public Service Company of New Mexic contract with the Jicarilla Apache Nation (16,200 af/y), and a number of smaller depletions. Currently, average annual flows at Bluff, Utah, have been depleted by 30 percent (Holden 1999). By comparison, the Green and Colorado Rivers have been depleted approximately 20 percent (at Green River) and 32 percent (at Cisco), respectively (Holden 1999). These depletions have contributed to the decline in pikeminnow and razorback sucker populations. Depletions are expected to increase as full development of water rights and water projects occurs.

Water depletion projects that were in existence prior to November 1, 1992 (the inception of the SJRIP), are considered to be historic depletions. Projects that began after this date are considered new projects. On May 21, 1999, the Service issued a BO determining that new depletions of 100 acre feet (af) or less, up to a cumulative total of 3,000 af, would not: 1) limit the provision of flows identified for the recovery of the pikeminnow and razorback sucker, 2) be likely to jeopardize the endangered fish species, or 3) result in the destruction or adverse modification of their critical habitat. Consequently, any new depletions under 100 af, up to a cumulative total of 3,000 af, may be incorporated under the May 21, 1999, BO, but still require consultation in order to track the progression to 3,000 af.

The San Juan-Chama Project, which was initiated in 1971, diverts water from the Navajo and Little Navajo Rivers upstream of the proposed action. The San Juan-Chama Project diverts approximately half of the flow within the Navajo River during periods of high flow. Past San Juan-Chama project diversions averaging 110,000 af/y from the Blanco, Little Navajo, and Navajo Rivers are included in the baseline. San Juan-Chama diversions from the Navajo River have changed the river's hydrograph (David Evans and Associates 2003). The San Juan-Chama Project's past depletions are included in the baseline, while future depletions have not yet had section 7 consultation.

The depletions that make up the Environmental Baseline in the San Juan River where razorback sucker and pikeminnow are found are presented in Table 1. As noted in the Description of the Proposed Action portion of this BO, the historic depletions associated with the proposed action (up to 3,400 af/y) are also included in Table 1.

Baseline depletions that have completed section 7 consultations are presented in Table 2. These depletions have undergone section 7 analysis for their effects to the razorback and pikeminnow and their critical habitat. Not all the water that has been consulted upon for these projects is currently being used; however the total depletions anticipated were analyzed in each individual project's section 7 and is accounted for in the Environmental Baseline. For example, Navajo Indian Irrigation Project currently depletes about 160,000 af/y, with 270,000 af/y anticipated to

be depleted in the future. The entire 270,000 af/y depletions has undergone consultation.

### **Water temperature**

The cold water below Navajo Dam limits the distribution of the endangered fish in the San Juan River. Water released from Navajo Dam is 4°C (39°F) (except for short periods when the reservoir mixes), creating conditions that are not suitable for either pikeminnow or razorback sucker for approximately 70 km (45 mi) downstream (confluence with the Animas River). Although spawning could have occurred at the dam site before Navajo Dam was constructed, post-dam temperatures are too cold for successful pikeminnow spawning at this location (Miller, SJRIP Biology Committee, pers. comm. 2004). The threshold temperatures for spawning at Shiprock (approximately 125 km [78 mi] below the dam) occur about 2 weeks later on average than pre-dam (Holden 1999). There is speculation that the large volume of cold water in the upper Green River may be a major reason why larval pikeminnow drift so far downstream (Holden 2000).

Because the combination of a suitable spawning bar and suitable temperatures occur so far downstream on the San Juan, there is a greater chance that larval fish will drift into Lake Powell and be lost from the population. Dudley and Platania (2000) found that drifting larval pikeminnow would be transported from the spawning bar in the San Juan River to Lake Powell in about three days. For those larval fish not carried into Lake Powell, a delay in spawning (which reduces the amount of time YOY have to grow before winter) and overall colder water temperatures (resulting in slower growth) could lead to smaller, less fit YOY, and reduce survival. While this reasoning is biologically sound, because there are so few pikeminnow in the San Juan River, the consequences of lower water temperatures on survival and recruitment of pikeminnow have not been tested for this river.

### **Fish passage barriers**

Like other major dams on the Colorado River and its tributaries, Navajo Dam blocked all fish passage. Razorback sucker and pikeminnow that may have been trapped above the reservoir have all died or were killed during treatment with rotenone (Olson 1962, Holden 1999). Glen Canyon Dam, completed in 1963, isolated the San Juan populations of razorback sucker and pikeminnow from the lower Colorado River populations. In addition to the major dams, diversion structures constructed in the San Juan River have also created barriers to fish passage.

Since 1992 the SJRIP has been investigating the impact of, and removed fish passage barriers on the San Juan River. Ryden and Pfeifer (1993) identified five diversion structures between Farmington, New Mexico, and the Utah state line that potentially acted as barriers to fish passage at certain flows (Cudei, Hogback, Four Corners Power Plant, San Juan Generating Station, and Fruitland Irrigation Canal diversions). When radio telemetry studies were initiated on the San Juan River in 1991, only one radio-tagged pikeminnow was recorded moving upstream past one of the diversions. In 1995, an adult pikeminnow moved above the Cudei Diversion and then returned back downstream (Miller 1995). Other native fish had been found to move either upstream or downstream over all five of the weirs (Buntjer and Brooks 1997, Ryden 2000a). In 2001, Cudei Diversion (RM 142) was removed from the river and Hogback Diversion (previously an earth and gravel berm structure), which had to be rebuilt every year, was made into a permanent structure with a non-selective fish ladder. In 2002, channel catfish that were tagged downstream of the Hogback Diversion in spring and early summer were recaptured upstream of the structure in summer and fall (Jason Davis, Service, pers.comm.,

2002). It is highly likely that pikeminnow, razorback sucker, and other native fishes can negotiate the ladder. Removal of Cudei Diversion and installation of the fish ladder at Hogback Diversion improved access for native fishes over a 24.5 mile reach of river.

Until 2003, the PNM weir (RM 166) was also a barrier to fish passage. With the completion of the PNM selective fish ladder in 2003, passage is now possible past that structure. Between June and December 2003, 17,394 native fish used the passage including 9 pikeminnow and 4 razorback suckers (Albert LaPahie, Navajo Fish and Wildlife, unpublished report 2003). However, the Four Corners Power Plant (Arizona Public Service) Diversion at RM 163.3 can act as a fish barrier when the control gate for the structure is closed (Masslich and Holden 1996). Above the PNM weir, the Fruitland Irrigation Canal Diversion (RM 178.5) may block pikeminnow access during flows less than 2,000 cfs (typical for July-September). Fish may pass through a sluiceway during higher flows and during the winter at low flows when the sluice gates are left open (Masslich and Holden 1996).

### **Transformation of riverine into lake habitat**

Lake Powell inundated the lower 87 km (54 mi) of the San Juan River and Navajo Reservoir inundated another 43 km (27 mi). The two reservoirs reduced the potential range and habitat for the two endangered fishes from about 523 km (325 mi) to 362 km (225 mi) and inundated potential pikeminnow spawning areas in the upper San Juan River (Holden 2000). Although the loss of habitat is substantial, several other problems for native fishes resulted from the creation of lakes. The larvae of razorback sucker and pikeminnow drift downstream until they find suitable nursery habitat (backwaters or other low velocity areas) (Holden 2000). Because the river has been truncated 87 km (54 mi) on the lower end, there are many fewer stream miles available for nursery habitat. Some pikeminnow in the Green and Colorado River systems drift up to 322 km (200 mi) from spawning areas before finding nursery habitat, even though some used nursery areas only a few miles below the spawning areas (Trammel and Chart 1999). The majority of YOY pikeminnow that have been collected in the San Juan River have been at the inflow to Lake Powell (Buntjer et al. 1994, Lashmett 1994, Archer et al. 1995, Platania 1995). Because of the many predators present and lack of suitable habitat, it is unlikely that larvae survive in Lake Powell.

In 1961, prior to the filling of Navajo Dam, New Mexico Department of Game and Fish used rotenone "to eliminate trash fish species" from the Pine River (24 km [15 mi]), the Navajo River (9.6 km [6 mi]), and the San Juan River (120 km [75 mi]) (Olson 1962). Fourteen species of fish were eliminated in the treated section of river (Olson 1962). There were three drip stations on the San Juan that effectively killed all fish from the Colorado state line, near Rosa, New Mexico, down to Fruitland, approximately 64 km (40 mi) below Navajo Dam (Olson 1962). Included in the list of fish eliminated was pikeminnow (Olson 1962). The number of fish killed was not recorded because of the large scale of the project (Olson 1962). The intent of the project was to reduce (eliminate) competition and predation between native fish and the non-native trout fishery that was to be established.

Lake Powell is populated by several fish species not native to the Colorado River. As mentioned earlier, larval native fish that drift into Lake Powell are almost certainly lost to predation by largemouth bass, smallmouth bass, walleye, or crappie (*Pomoxis* sp.). Among the species present is striped bass, which migrates up the San Juan River as far upstream as the PNM weir (RM 166) (Davis 2003). Adult striped bass are piscivorous (Moyle 1976). In 2000, 432 striped

bass were captured during monitoring trips for pikeminnow and during trips to remove non-native fishes (Davis 2003). The contents of 38 stomachs were analyzed and native suckers were found in 41 percent (Davis 2003). This migratory predator is a threat to larval and juvenile native fish.

### **Changes in the timing and magnitude of flows**

Typical of rivers in the Southwest, the San Juan was originally characterized by large spring snowmelt peak flows, low summer and winter base flows, and high-magnitude, short-duration summer and fall storm events (Holden 1999) (Figure 2). Historically, mean monthly flows in the San Juan River were highly variable and ranged from a low of 44 cfs in September 1956, to a high of 19,790 cfs in May 1941 at the U.S. Geological Survey (USGS) Station gauge near Shiprock, New Mexico. For the 49 years of record prior to Navajo Dam, a peak spring flow greater than 15,200 cfs occurred 13 times (25 percent of the time). The highest spring peak flow recorded (daily mean) was 52,000 cfs (June 30, 1927).

The completion of Navajo Dam in 1963, and subsequent dam operations through 1991, altered the natural hydrograph of the San Juan River substantially (Holden 1999). There was an appreciable reduction in the magnitude, and a change in timing of the annual spring peak. In wet years, dam releases began early to create space in the reservoir to store runoff (Holden 1999). The peak discharge averaged 54 percent of the spring peak of pre-dam years. The highest mean monthly flow was 9,508 cfs (June 1979), a decrease of over 10,000 cfs compared to pre-dam years. Base flows were substantially elevated in comparison to pre-dam years. The median monthly flow for the base flow months (August-February) averaged 168 percent of the pre-dam period (Holden 1999). Minimum flows were elevated and periods of near-zero flow were eliminated with a minimum monthly flow during base-flow periods of 250 cfs compared to 65 cfs for the pre-dam period (Holden 1999). The hydrograph became much flatter during this period of time (Figure 2).

During the 1992 to 1997 research period, flows were manipulated to determine fish population and habitat responses when Navajo Dam was operated to mimic a natural hydrograph (Holden 1999). The intent of this period of experimental flow manipulations was to allow researchers an opportunity to develop flow recommendations. While a more natural hydrograph was maintained during this period of experimental flows, it did not necessarily match the flow recommendations that were later developed (Holden 1999). The experimental flow period, however, was more similar to the years that followed (1998 to present) than they were to the pre-experimental flow research period years (1992).

Since the Flow Recommendations were published (Holden 1999), Navajo Dam has been operated to meet the Flow Recommendations. A natural hydrograph has been mimicked but the pre-Navajo Dam peak magnitudes are no longer possible because of outlet restrictions at the dam (Figure 3). However, the more natural hydrograph is an improvement over pre-1992 hydrograph in that native fish receive the proper cues at the proper times to trigger spawning, more suitable habitat is available at the proper times for young fish, and over time, it is expected that suitable physical habitat characteristics for native fishes will be maintained.

### **Changes in channel morphology**

The quantity and timing of flows influence how the channel and various habitats are formed and maintained. Between the early 1960s and 1988, the San Juan River channel narrowed to 35 percent of the width measured in the 1930s (Holden 1999). However, it is hypothesized that the

channel width during the 1930s was much wider than the historical condition as large amounts of sediment entered the river in response to upland habitat degradation and erosion caused by overgrazing (Holden 1999). Adjustment of the channel to these early impacts may still be occurring. As the amount of sediment entering the river decreases as a result of better land management practices and natural healing of the landscape, it would be expected that the channel would become narrower.

Reduced peak flows after Navajo Dam was completed exacerbated the growth of exotic riparian vegetation (primarily salt cedar (*Tamarix ramosissima*) and Russian olive (*Eleagnus angustifolia*)). These non-native trees armored the channel banks and contributed to the creation of a narrower channel (Bliesner and Lamarra 1994). Modification of flows and non-native vegetation led to more stabilized channel banks, a deeper, narrower main channel, and fewer active secondary channels (Holden 1999).

Since 1992, when a natural hydrograph was mimicked, peak flows have been higher than in the pre-experimental research flow period (Figure 3). During this period of time, the amount of backwater habitat has decreased in four of six reaches (Bliesner 2004). However, the base year used to track backwater habitat (1991) may have had an unusually large amount of backwater habitat as a result of several above average wet years (Bliesner 2004). Other low velocity habitat, slackwater, and shoal areas have not changed significantly since 1992 (Bliesner 2004). Because backwaters are an important habitat for young native fishes (i.e., young stocked pikeminnow were found in backwaters 60 percent of the time and in other low-velocity habitats nearly 40 percent of the time (Holden 1999)), loss of backwaters remains a concern. The current drought and lack of high flows may also be contributing to the loss of backwater habitat.

One of the goals of the SJRIP was to develop flow recommendations that provided high levels of habitat quantity and quality timed to meet the life history needs of the pikeminnow and razorback sucker. The intent of the Flow Recommendations is to improve backwater and cobble bar habitat quantity and quality, and provide high habitat richness. Flows of 8,000 cfs or greater for a duration of 10 days were recommended for cobble-bar construction and maintenance (Holden 2000). Flows as low as 2,500 cfs appear sufficient to transport cobble on high gradient bars to develop clean locations for spawning (Bliesner and Lamarra 2000). Flows greater than 5,000 cfs lasting 21 days or more are adequate to clean backwaters of fine depositional material (Bliesner and Lamarra 2000). Projected backwater availability under various future conditions with the Flow Recommendations in place indicates that backwater habitats would be more abundant than pre-dam conditions for most scenarios (Holden 2000). Flows greater than 10,000 cfs are recommended to create and preserve islands, an important factor in creating habitat diversity (Holden 2000). At current population levels, habitat does not appear to be a limiting factor for either the razorback sucker or pikeminnow (Holden 2000). However, the habitat needs of larval fish has not been thoroughly explored, and further research may find specific habitat needs that are not being met or that are limiting (Holden 2000).

### **Water quality**

In addition to the physical changes from dams and water diversions, and biological changes from introduction of nonnative fish, chemical changes have occurred as a result of widespread irrigation and drainwater disposal in the Colorado River Basin (Felz et al. 1991, Engberg et al. 1998). Quartarone (1993) interviewed 111 people who recounted numerous experiences from the 1920s to the early 1950s and noted that in the late 1940s and early 1950s, Colorado

“whitefish” (as pikeminnow were called at the time) were becoming rare in the upper Colorado Basin. They believed that this rarity was the result of pollution in the rivers from dumping of raw sewage, railroad oil, and wastewaters.

Surface and groundwater quality in the Animas, La Plata, Mancos, and San Juan River drainages have become significant concerns (Abell 1994). Changes in water quality and contamination of associated biota are known to occur in Bureau of 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 (Sylvester et al. 1988). Increased loading of the San Juan River and its tributaries with heavy metals; elemental contaminants such as selenium, salts, polycyclic aromatic hydrocarbons (PAHs); and pesticides has degraded water quality of the San Juan River in critical habitat.

Information on existing water quality in the San Juan River has been derived from data gathered by the Department of the Interior (DOI) as part of its National Irrigation Water Quality Program investigation of the San Juan River area in Colorado, New Mexico, and Utah; results from Bureau of Reclamation's water quality data for the Animas-La Plata Project; and ongoing contaminant monitoring and research conducted as part of the SJRIP. Some of this information has been presented in Blanchard et al. (1993), Abell (1994), Wilson, et al. (1995), Thomas et al. (1998), and other references cited in Simpson and Lusk (1999). Thomas et al. (1998) found that concentrations of most potentially toxic elements analyzed from the San Juan River drainage in their study, other than selenium, were generally not high enough to be of concern to fish, wildlife, or humans.

PAHs are compounds that 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). Wilson et al. (1995) reported that concentrations of PAHs were elevated in the Animas River, but no identification of source location or activity has been made. The San Juan River below Montezuma Creek also had elevated levels of PAHs; and seasonal increases in PAH concentrations were detected in the “Mixer” area of the river. PAH levels in the bile of common carp and channel catfish were high in one fish and moderate in several other fish in samples from the San Juan River. The presence of PAH metabolites in bile of every fish sampled suggested some level of exposure to hydrocarbons (Wilson et al. 1995). Service analyses of PAH contamination of aquatic biota of the San Juan River, and liver tissue examinations of fish in the river, raised concerns regarding the exposure of these organisms to contaminants introduced into the Basin through the intensive development of energy resources in the area. However, PAHs do not appear to be a limiting factor to native fishes in the San Juan at this time (Holden 2000).

Selenium (a trace element) occurs naturally in many soil types, and is abundant in the drier soils of the West. Selenium enters surface waters through erosion, leaching and runoff. Sources of selenium, both anthropogenic and natural, in the San Juan River have been reported by O'Brien (1987), Blanchard et al. (1993), and Thomas et al. (1998). Selenium, although required in the diet of fish at very low concentrations, may be adversely affecting endangered fish in the upper Colorado River Basin (Hamilton et al. 2004). Excess dietary selenium causes elevated concentrations of selenium to be deposited into developing eggs, particularly the yolk. If concentrations in the egg are sufficiently high, deformed embryos develop as a result of dysfunctional proteins and enzymes and they would likely perish in the wild.

Selenium concentrations in the San Juan River Basin are of particular concern because of selenium's documented effects on fish and wildlife reproduction and survival and high levels detected in some locations within the Basin (Blanchard et al. 1993, Wilson et al. 1995, Thomas et al. 1998). Selenium concentrations can be elevated in areas where irrigation occurs on soils that derive from or overlie Upper Cretaceous marine sediments. Thomas et al. (1998) found that water samples from DOI project irrigation-drainage sites developed on Cretaceous soils contained a mean selenium concentration about 10 times greater than those in samples from DOI project sites developed on non-Cretaceous soils. Percolation of irrigation water through these soils and sediments leaches selenium into receiving waters. Other sources of selenium include power plant fly ash and oil refineries. Water depletions, by reducing dilution effects, can increase the concentrations of selenium and other contaminants in water, sediments, and biota (Osmundson et al. 2000).

Tributaries to the San Juan River carry higher concentrations of selenium than found in the main stem river immediately upstream from their confluence with the San Juan. Increased selenium concentrations may also result from the introduction of ground water to the main stem of the river along its course. 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 as it travels downstream. For example, concentrations of selenium in water samples collected from the main stem of the San Juan River exhibited a general increase in concentration levels with distance downstream from Archuleta, New Mexico, to Bluff, Utah, (less than 1 µg/L [micrograms per liter] to 4 µg/L) (Wilson et al. 1995). The safe levels of selenium concentrations for protection of fish and wildlife in water are considered to be less than 2 µg/L and toxic levels are considered to be greater than 2.7 µg/L (Lemly 1993, Maier and Knight 1994, Wilson et al. 1995). In 1995, Colorado's Water Quality Control Commission reduced the chronic selenium standard from 17 µg/L to 5 µg/L. The Service recommended the level be lowered to 2 µg/L (Service 1998).

Because selenium bioaccumulates in the aquatic food chain, an inorganic selenium level as low as 2 µg/L or an organic level of 1 µg/L in water may be of concern. Sediment levels above 4 µg/g (micrograms per gram) may be at levels considered toxic to fish and wildlife (USDI 1998). Organic selenium may be derived from living or dying plants and animals as free seleno-amino acids (Lemly 1996b). Seasonally high water flows can dilute selenium concentrations confounding interpretation of effects on fish and wildlife reproduction and survival depending on when water samples were taken. Thus sediment and biotic analyses are critical to understanding selenium effects on fish and wildlife.

Guidelines for toxic levels of selenium in fish and wildlife are discussed below and can be found in the references cited. Selenium toxicity thresholds in fish and wildlife tissues are as follows: 4 µg/g dry weight in whole body fish, 8 µg/g dry weight muscle tissue, 10 µg/g for fish eggs, 3 µg/g for invertebrates (eaten by fish and wildlife) (Lemly 1996b), and 6 µg/g for waterbird eggs (USDI 1998). Selenium concentrations in whole body fish above 4 µg/g dry weight have been associated with mortality, reduced growth, and reproductive failure (Hamilton et al. 2002a, Hamilton et al. 2002b, Hamilton et al. 2002c, Hilton et al. 1980, Hodson and Hilton 1983, Ogle and Knight 1989, Cleveland et al. 1993, Lemly 1996a, Lemly 1996b, Hamilton et al. 1998, and USDI 1998). The selenium concentrations that may adversely affect razorback sucker and pikeminnow within the upper Colorado River Basin have not been specifically defined. It is widely accepted by most scientists that selenium affect levels vary by species (Lemly 1996b, Skorupa 1998).



Thomas et al. (1998) found that selenium concentrations in algae, odonates (dragonflies and damselflies), and mosquitofish collected from aquatic habitats underlain by Cretaceous soils were significantly greater than in those collected from similar habitats underlain by non-Cretaceous soils. Median selenium concentrations were less than 2 µg/g for plant samples, less than 7 µg/g for invertebrate samples, and less than 6 µg/g for whole-fish samples collected from aquatic habitats underlain by non-Cretaceous soils. Similar samples collected from aquatic habitats underlain by Cretaceous soils contained median selenium concentrations two to five times greater.

Sediments and biota associated with the San Juan River have shown elevated selenium levels. The highest concentrations of selenium in common carp and flannelmouth sucker (*Catostomus latipinnis*) occurred in the river from Bloomfield to Farmington, New Mexico (Blanchard et al. 1993). Subsequent investigations (Wilson et al. 1995, Thomas et al. 1998) have detected elevated levels of selenium in habitats associated with irrigation drainage returns and in the Mancos River. Selenium levels in whole body fish occasionally exceeded the toxic effects threshold of 4 µg/g dry weight (Lemly 1996b) and may pose a threat to predatory fish that consistently feed in the regions with elevated selenium.

An investigation of irrigation projects along the San Juan River below Navajo Reservoir found elevated selenium concentrations in water and biota. Blanchard et al. (1993) reported that selenium was elevated in a drain located on the east part of the Hogback Irrigation Project near Shiprock, New Mexico, which is the source water for a backwater of the San Juan River. Of the irrigation projects evaluated in the San Juan River area, the highest median selenium concentrations in aquatic plants and animals were collected from the east Hogback irrigation drain (Thomas et al. 1998). Concentrations of selenium in the east Hogback Drain were 11 to 21 µg/L in water, 11 to 17 µg/g in invertebrates, and 27 to 42 µg/g in fish.

The general health of the San Juan River fish community was investigated by Hart and Major (1995) in response to reports of lesions by Blanchard et al. (1993) and fishery biologists. A 2.7 percent overall incidence of abnormalities (lesions, deformities, tumors, parasites, etc.) was reported in fish sampled from 1992 to 1994. The majority of fish with abnormalities were flannelmouth suckers. An unusually high incidence of abnormal lesions on fish in the San Juan River, especially in flannelmouth sucker, has been attributed to pathogens requiring inducement by stressors such as high contaminant concentrations, malnutrition, or poor water quality (Abell 1994). The highest incidence of abnormalities was found in the river section just below the east Hogback Drain.

The SJRIP arranged for toxicity tests to be conducted in order to determine the effects of environmental contaminants in water (Hamilton and Buhl 1997), and in diet and tissues (Buhl and Hamilton 1998) of the razorback sucker and pikeminnow in the San Juan River. The waterborne toxicity tests showed a potential threat to endangered fishes from waterborne concentrations of copper and contaminant mixtures created to simulate the water quality conditions of two irrigation drains (Hamilton and Buhl 1995, 1997). However, the results of the dietary toxicity test and accumulation study were equivocal.

The razorback sucker occurs and spawns just downstream from the mouth of McElmo Creek (Dale Ryden, Service, pers. comm. 2001). Analysis of selenium levels in water, sediment, and biota in the McElmo Creek drainage has been conducted and indicates that water levels of selenium are typically high (from 3 to 9 µg/L) (Butler et al. 1995). Contaminant levels in

McElmo Creek are of concern to the razorback sucker and possibly the pikeminnow. Selenium levels from a pond fed by another tributary to the San Juan River (Woods Creek) were in the “high” hazard category for invertebrates and fish eggs (Butler et al. 1995).

Because riverine systems are open systems where concentrations can vary considerably over time in relation to flow (as opposed to a closed system like a lake where concentrations tend to remain steady or increase), and because results from the 7-year research period were inconclusive, selenium concentrations are not currently seen as a limiting factor to native fishes in the San Juan River (Holden 2000). However, Seethaler et al. 1979 suggested that irrigation and pollution were contributing factors to razorback sucker and pikeminnow population declines, and Hamilton (1999) hypothesized that historic selenium contamination of the upper and lower Colorado River basins contributed to the decline of these endangered fish by affecting their overall reproductive success.

### **Propagation and stocking**

#### **Colorado pikeminnow**

Because of the extremely low numbers of wild pikeminnow and poor recruitment into the population, a stocking program was initiated to augment pikeminnow numbers. This augmentation program has been successful. Experimental stocking of 100,000 YOY pikeminnow was conducted in November 1996, to test habitat suitability and quality for young life stages (Lentsch et al. 1996). Monitoring in late 1996 and 1997, found these fish scattered in suitable habitats from just below the upstream stocking site at Shiprock, New Mexico, to Lake Powell. During the fall of 1997, the fish stocked in 1996 were caught in relatively high numbers and exhibited good growth and survival rates (Holden and Masslich 1997). In August 1997, an additional 100,000 YOY pikeminnow were stocked in the river. In October 1997, the YOY stocked two months previously were found distributed below stocking sites and in relatively large numbers nearly 10 miles above the Shiprock stocking location. The 1997 stocked fish were smaller in size than those stocked in 1996, but apparently could move about the river to find suitable habitats (Holden and Masslich 1997).

In July 1998, 10,571 YOY pikeminnow were stocked at Shiprock but only one was found through March 1999, in the lower San Juan River (Archer et al. 2000). In July 1999, 500,000 larval pikeminnow were stocked just below Hogback Diversion (RM 158.6). The larvae were found 157 miles below the stocking site 62 hours later and were never recaptured again. High flows in 1999, likely washed them into Lake Powell (Jackson 2001). In June 2000, 105,000 larvae were stocked just below Cudei Diversion (RM 142). Despite more normal flows in 2000, only four larvae were found and three had floated 64 miles downstream two days after stocking. No larvae stocked in 2000 were found during a sampling trip four weeks later, but a pikeminnow fitting the size class of the 1999 stocking was found. During an October 2000, sampling trip three pikeminnow that were likely stocked in 1999, were captured but, again, no larvae stocked in 2000 were found (Jackson 2001). In October 2002, approximately 210,418 age-0 pikeminnow were stocked, half at RM 180.2 and half at RM 158.6. In November 2003, another 176,933 age-0 and age-1 were stocked at numerous sites between RM188 and RM 148 (Ryden, Service, in litt. 2004).

Forty-nine pikeminnow adults were stocked at the Highway 371 bridge (RM 180.2) in 1997; however, these fish did not remain in the stretch of river above the PNM weir (RM 166.6) for

more than a few months (Miller and Ptacek 2000). In 2001, 148 adult pikeminnow were stocked at RM 180.2. These fish went below PNM weir shortly thereafter but 7 of these adults used the PNM fish ladder in 2003 (Ryden, Service, in litt. 2004). Another stocking of adults at RM 180.2 occurred in 2002 but the movement and distribution of these fish are not yet known (Dale Ryden, Service, pers. comm. 2002). In 2002, three pikeminnow were collected during adult monitoring; all three fish were stocked as adults in April 2001 (Ryden 2003). In 2003, 32 juvenile pikeminnow were collected during adult monitoring; these fish had been stocked as juveniles in October 2002 (Ryden, Service, in litt. 2004). In total, over 1,000,000 pikeminnow have been stocked from 1996 to 2002 (Ryden 2003).

### **Razorback sucker**

Although the evidence indicates that razorback suckers were once abundant in the San Juan River at least up to the Animas River (Platania and Young 1989), wild razorback suckers, if they still exist, are extremely rare in the river. Because of the limited total number of razorback sucker and the poor recruitment, a stocking program was begun to supplement the population. This augmentation program has been successful. Between 1994 and 2003, a total of 7,863 hatchery raised razorback suckers were stocked into the San Juan River (Ryden 2003 Service, in litt. 2004). Some fish that were stocked as early as 1994, are still being collected during annual sampling (Ryden 2001). Larval razorback suckers have been collected each year since 1998, indicating that the stocked fish are successfully spawning in the San Juan River (Ryden 2003). In addition, in 2000, larval razorback sucker were collected upstream of the only known spawning site, indicating that spawning is occurring at more than one location in the San Juan River (Ryden 2001).

In March 1994, 15 radio-tagged razorback suckers were stocked in the San Juan River at Bluff, Utah (RM 79.6); near Four Corners Bridge (RM 117.5); and above the Mixer in New Mexico (136.6). In October 1994, an additional 16 radio-tagged adults and 656 PIT-tagged fish were stocked in the same locations and at an additional site just below the Hogback Diversion in New Mexico (RM 158.5). 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 (RM 158.6) to 38.1 river miles above Lake Powell (Dale Ryden, Service, pers. comm. 2002). In September 1995 and October 1996, 16 and 237 razorback suckers were stocked, respectively. Results of the monitoring efforts indicated that the San Juan River provides suitable habitat to support subadult and adult razorback sucker on a year-round basis (Ryden and Pfeifer 1996). This led the SJRIP to initiate a 5-year augmentation program for the razorback sucker in 1997 (Ryden 1997). Between September 1997, and November 2001, 5,896 subadult razorback sucker were stocked below Hogback Diversion Dam. Furthermore, an additional 25 subadults were stocked in 2002 (Service, unpubl. data). As of 2001, about 2 percent of the fish stocked from 1994 to 2001 were recaptured and 40 adult or subadult razorback suckers were recaptured in 2002 (Service, unpubl. data). In 2002, 23 razorback suckers (21 adults, 2 subadults) were collected, all stocked fish (Ryden 2003).

Four ripe male razorback suckers collected at RM 100.2 in spring 1997, appeared to be part of a spawning aggregation. Three other razorback suckers were positively identified within the aggregation of fish but could not be captured. Several of the collected fish had moved up or down the river to the general location of the aggregation, suggesting some focus, such as

spawning, for the aggregation (Ryden 2000b). In 1998, two larval razorback suckers were collected between Montezuma Creek and Bluff, Utah, downstream of the 1997 aggregation site (Ryden 2000c). In April of 1999, two ripe male razorback suckers and one gravid female were collected within a few feet of the 1997 aggregation. All three fish were from the November 1994 stocking. All of the adult razorback suckers suspected to be spawning were part of the 939 fish stocked between 1994 and 1996. Between May 4 and June 14, 1999, 7 larval razorback suckers were collected below the suspected spawning site (Ryden 2000c). In spring 2000, 129 larval razorback suckers were collected, in spring 2001, 50 were collected, and in 2002, 812 were collected (Brandenburg et al. 2002). Larval razorback suckers were collected in the San Juan River between RM 8.1 and 124.8 (University of New Mexico, unpubl. data). Larvae collected at RM 124.8 demonstrate that stocked razorback sucker are spawning upstream of the known spawning location at RM 100.2. This information indicates that the stocked fish are spawning and producing larval fish.

### **Diversion structures**

There are numerous points of diversion on the San Juan River for irrigation and energy production. In addition to acting as fish passage barriers (as discussed earlier), most of these structures do not have screens or other devices to prevent fish from entering (Holden 2000). Although anecdotal, Quartarone and Young (1995) present many stories from senior citizens that recalled seeing or catching razorback suckers from irrigation ditches, sometimes in very large numbers. Trammell (2000) reported that after stocking 500,000 larval pikeminnow below Hogback diversion structure, 63 larvae were collected from the Cudei diversion canal. This number represented 0.013 percent of the total stocked. Catch rate was 4.39 pikeminnow/100 m<sup>3</sup> of water sampled. As the populations of pikeminnow and razorback sucker increase, these structures could be a source of mortality if passage into them remains open.

### **Non-native fish**

Non-native fish in the San Juan River include rainbow trout (*Oncorhynchus gairdneri*), brown trout (*Salmo trutta*), striped bass, walleye, channel catfish, black bullhead, yellow bullhead, largemouth bass, smallmouth bass, green sunfish, longear sunfish (*Lepomis megalotis*), bluegill, white crappie, fathead minnow, red shiner, and common carp (Buntjer 2003). Channel catfish was first introduced in the upper Colorado Basin in 1892 (Tyus and Nikirk 1990), and is thought to have the greatest adverse effect on endangered fishes due to predation on juveniles and resource overlap with subadults and adults (Hawkins and Nesler 1991, Lentsch et al. 1996, Tyus and Saunders 1996). Adult and juvenile pikeminnow that have preyed on channel catfish have died from choking on the pectoral spines (McAda 1980, Pimental et al. 1985, Quartarone and Young 1995, Ryden and Smith 2002, SJRIP Biology Committee meeting notes October 3, 2003). Mechanical removal of non-native fish (seining and electrofishing) from the San Juan began in 1995, but was not instituted as a management tool until 1998 (Smith and Brooks 2000). Removal efforts have focused on channel catfish and common carp because they are the most abundant non-native fishes and are known predators on native fish and eggs (Davis 2003).

From 1999 to 2001, 18,260 channel catfish and 9,547 common carp were removed from the river (Davis 2003). Over this period of time, catch rates did not decrease for either species but the mean length of channel catfish caught decreased (Davis 2003). The advantages of reducing the mean size of channel catfish caught is that they are not thought to be piscivorous until they reach a length of about 450 mm (17.7 in), and fecundity (number of eggs) is much greater in larger fish (Davis 2003). An increase in the number of smaller fish could potentially lead to an increase in

competitive or aggressive interactions with native fish. However, it is expected that continued removal efforts will eventually reduce the numbers of smaller channel catfish as well (Davis 2003).

The primary method used to capture non-native species is electrofishing. In 1999, one, three-day trip was made and non-natives were removed from Hogback diversion structure to the PNM weir. In 2000, two trips were made and in 2001 and 2002, 10 trips were made each year through this same section. In 2003, non-natives were removed from a second reach, RM 166.6 down to Shiprock (RM 148). During non-native fish removal, razorback sucker and pikeminnow are also shocked and captured. Electrofishing has been shown to have negative effects on trout (Kocovsky et al. 1997, Nielsen 1998). While no direct mortality has been documented, there may be adverse effects to the fish from repeated shocking and handling.

### **Summary of Environmental Baseline**

The completion of Navajo Dam in 1963, and subsequent dam operations through 1991, reduced the magnitude and timing of the spring peak flows. The peak discharge averaged 54 percent of pre-dam years, and base flows were substantially elevated. Construction and subsequent operation of Navajo Dam led to a number of adverse effects to the razorback sucker and pikeminnow including allowing additional depletions, water temperature changes, a reduction in lateral channel migration, channel scouring, blockage of fish passage, transformation of riverine habitat into lake habitat, channel narrowing, changes in the riparian community, diminished peak flows, changes in the timing of high and low flows, and a loss of connectivity between the river and its flood plain. Since 1992, the SJRIP and Reclamation's operation of Navajo Dam to mimic the San Juan's natural hydrograph, have been successful in helping minimize the adverse effects of Navajo Dam and reestablish the razorback sucker and pikeminnow to the San Juan River.

It is the intent of the SJRIP to provide demographically and genetically viable populations of the pikeminnow and razorback sucker in the San Juan River (Holden 2000). Demographically viable populations are self-sustaining with natural recruitment and an appropriate size and age-structure. Genetically viable populations are of sufficient size that inbreeding is not a concern (Holden 2000). The 1995 Long Range Plan identified tasks and milestones for each of these objectives. A total of 51 tasks were listed, of which 22 were identified as milestones. Of these, 42 tasks and 14 milestones have been completed or are ongoing (SJRIP Biology Committee 2002). A summary of those tasks and milestones is presented in Table 5.

Razorback sucker and pikeminnow populations in the San Juan River are more secure today than they were through the 1980s and 1990s and that the threat of extinction has been reduced. Of the two species, the razorback sucker population appears to be benefiting more from management efforts. The number of razorback sucker larval fish caught appears to be increasing (Brandenburg et al. 2002). However, survival to the juvenile stage, indicating recruitment to the population, has not yet been documented.

### **Effects of the action**

We have analyzed the effects of the depletions, diversions, and physical conveyance structures of this proposed action. However, the proposed action includes non-binding future water uses that may have effects to listed species that are currently unknown and therefore are not analyzed in this BO. Those future uses, and resulting effects, cannot be determined at this time. At such time future uses are determined, the Service should be contacted to determine if further

consultation may be required. The proposed action is not anticipated to have any adverse effect to listed species in or along the Navajo River, or from construction of the water delivery system.

#### 1) Depletions

As described in the Environmental Baseline, depletions from the San Juan River system reduce the total amount of water available to the river. Less water may adversely affect pikeminnow and razorback sucker by reducing the type and amount of habitat available to each life stage of fish, concentrating contaminants, impacting spawning by reducing the spring hydrograph, and potentially increasing competition and predation due to crowding. The proposed action constitutes a new depletion of 6,654 af/y and a historic depletion of up to 3,400 af/y. The total depletion will average 8,500 af/y. For example, if all of the new depletion water is put into the project, then the Nation would use 1,846 af/y of the historic depletion amount to meet the 8,500 af/y. If the new depletion cannot be fully used, then the Nation may increase the historic depletion amount up to 3,400 af/y to meet the 8,500 af/y average. As a result of a San Juan Basin Hydrology Model analysis (Appendix B), it has been determined that the Flow Recommendations can be met with this new depletion of 6,654 af/y. The 3,400 af/y historic depletion is already accounted for in Table 1.

#### **Effects of the action on pikeminnow and razorback sucker critical habitat**

Since the proposed action will not impact the Bureau of Reclamation's ability to operate Navajo Reservoir and Dam to meet the Flow Recommendations, we do not anticipate additional effects to pikeminnow or razorback sucker critical habitat beyond those discussed in the Environmental Baseline and Conclusion.

#### **Cumulative effects**

Cumulative effects include: The effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this 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 Act. Cumulative effects include:

- 1) Ongoing depletions and diversions from the San Juan River Basin that do not have a Federal nexus and therefore have not completed section 7 consultation. We believe most of these depletions are accounted for in Table 1, and are therefore considered in meeting the Flow Recommendations. There are irrigation ditches and canals below Navajo Dam that could entrain pikeminnow and razorback sucker: Citizens, Hammond, Fruitland, San Juan Generating Station, Jewett Ditch, Four Corners Power Plant Diversion, and Hogback. Increased urban and suburban use of water, including municipal and private uses. Further use of surface water from the San Juan River will reduce river flow and decrease available habitat for the razorback sucker and pikeminnow. Livestock grazing may adversely impact razorback sucker and pikeminnow by removal of water for drinking and the reduction in soil water holding capacity in the floodplain, and resulting reduction in base flows.
- 2) Increases in development and urbanization in the historic floodplain that result in reduced peak flows because of the flooding threat. Development in the floodplain makes it more difficult to transport large quantities of water that would overbank and create low velocity habitats that the razorback sucker and pikeminnow need for their various life history stages.
- 3) Contamination of the water (i.e., sewage treatment plants, runoff from feedlots, and residential development). A decrease in water quality could adversely affect the razorback

sucker and pikeminnow and their critical habitat.

- 4) Gradual change in floodplain vegetation from native riparian species to non-native species (i.e., Russian olive). Channel narrowing leads to a deeper channel with higher water velocity. Pikeminnow and razorback sucker larvae require low velocity habitats for development. Therefore, there will be less larval habitat available for both species.
- 5) The presence of striped bass and walleye in Lake Powell constitutes an ongoing threat to pikeminnow and razorback sucker in the San Juan River.
- 6) Increased boating, fishing, off-highway vehicle use, and camping in the San Juan River is expected to increase as the human population increases. Potential impacts include angling pressure, non-point source pollution, increased fire threat and the potential for harassment of native fishes.
- 7) Coalbed Methane Development: The San Juan Basin in southwestern Colorado and northwestern New Mexico is rich in coalbed methane and development of this resource has increased rapidly in the last ten years. There are currently more than 3,000 coalbed methane wells in the San Juan Basin in the Fruitland Coal Formation. Historically, one well per 320 acres is allowed; however, the Colorado Oil and Gas Conservation Commission recently approved an increase of well spacing to one per 160 acres. Potentially, more than 700 additional wells may be drilled; approximately 250 could occur on private or State land. It was estimated that the wells would be drilled by 2013 but, because of slow groundwater movement, water depletion effects on the San Juan River fish and their habitat may not occur until at least 2025.

Coalbed methane development requires the extraction of groundwater to induce gas flow. The 3M Project (mapping, modeling, and monitoring), initiated in 1998, analyzed the effects of groundwater extraction from the Fruitland Formation. This study was conducted by the Colorado Oil and Gas Conservation Commission in cooperation with the Southern Ute Indian Tribe, the Bureau of Land Management, the U.S. Forest Service, and industry. The mapping and modeling studies were completed in 2000, and results are presented in the Colorado Geological Survey's Open File Report 00-18. Modeling results are available at the Colorado Oil and Gas Conservation Commission's website and through the Bureau of Land Management's San Juan Public Lands Center. A follow-up project was funded by the Ground Water Protection Research Foundation, and the report is available through the Bureau of Land Management.

The Fruitland Formation and the underlying Pictured Cliffs Sandstone were shown to be an aquifer system. In general terms, the groundwater produced from near-outcrop coalbed methane wells is recent recharge water that would, under pre-coalbed methane conditions, discharge to the Animas, Pine, Florida and Piedra Rivers. These rivers are tributary to the San Juan River.

Coalbed methane wells occur on Federal, State, tribal and private lands. The Bureau of Land Management is currently preparing an Environmental Impact Statement to address coalbed methane development on the Southern Ute Indian Reservation. The Bureau of Land Management is also preparing a separate Environmental Impact Statement to address coalbed methane development on Federal lands. Water depletions associated with coalbed methane development on tribal and Federal lands will be addressed during future section 7 consultation with the Bureau of Land Management. There will not be future section 7 consultations for coalbed methane development on private or State lands if there is no

Federal action associated with these wells. Therefore, water depletions associated with coalbed methane development on private and State lands are considered a cumulative effect that is reasonably certain to occur within the action area.

The Ground Water Protection Research Foundation Project used a groundwater model and a reservoir model to determine water budgets and depletions associated with coalbed methane development. Three areas around the Animas, Pine, and Florida Rivers were modeled using 3-D multi-layer models to account for aquifer-river interactions and the effects of coalbed methane development. Baseline conditions were simulated with a single-phase ground water flow model (MODFLOW), and predictive runs were made using two-phase flow models (EXODUS and COALGAS). The predictive model run results are summarized in Table 3.

The model results show that prior to coalbed methane development, the Fruitland Formation discharged approximately 205 af/year to the San Juan River. Modeling shows approximately 74 af/y is currently being depleted with existing wells and predicts the maximum depletions to be approximately 200 af/y (Cox et. al. 2001).

The RiverWare model, which is used to evaluate hydrologic conditions on the San Juan River and its tributaries, requires a defined project to determine project compatibility with the San Juan River Flow Recommendations. Because future coalbed methane development on State and private land is not a defined project and the depletions associated with it are relatively small and not specifically quantified, the RiverWare model is not an appropriate tool to use to determine the compatibility with the Flow Recommendations. However, on May 21, 1999, the Service issued a BO that addressed the impacts of future Federal projects that individually involve small water depletions that total 3,000 af/year. It was determined in that BO that these small depletions would not diminish the capability of the system to meet the flow levels, durations, or frequencies outlined in the San Juan River Flow Recommendations. While the coalbed methane development on State and private lands was not addressed in the small depletion BO, because this development does not involve future Federal actions, coalbed methane development does involve small individual depletions similar to the projects addressed by the small depletion BO. Therefore, the Service concludes that an additional future depletion of approximately 200 af/year from the San Juan River associated with coalbed methane development on State and private land, would not significantly impact the ability to meet the Flow Recommendations.

Future section 7 consultations in the San Juan River Basin will need to consider the cumulative effects of coalbed methane development on State and private land using the best scientific information available to determine the water depletions associated with development.

## Conclusion

After reviewing the current status of the pikeminnow and razorback sucker, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the proposed action, as described, is not likely to jeopardize

the continued existence of the pikeminnow and razorback sucker and is not likely to adversely modify their designated critical habitat. Furthermore, the probable success of the SJRIP is not



compromised by the proposed project.

The effects of the proposed action extend the full length of the San Juan River occupied by the two endangered fish in perpetuity. Because of this, it is essential that the SJRIP continue with at least the same level of agency commitment, intensity, and funding to be able to monitor and counteract the effects of this proposed action and other projects that deplete water from the basin. As full implementation of projects increases in the basin leading to greater depletions, the SJRIP will need to determine if, and when, conditions which currently are not detrimental to the endangered fishes (e.g., water quality) become limiting. Continued long-term monitoring is essential, but initiating new studies may also be needed.

### Incidental Take Statement

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of an incidental take statement.

The Service recognizes that depletions to the San Juan River constitute an adverse effect to pikeminnow and razorback sucker and their critical habitat. However, since the proposed depletion does not impact SJRIP actions, or the Bureau of Reclamation's ability to meet the Flow Recommendations, we do not anticipate that the proposed action will incidentally take any threatened or endangered species.

### Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

- 1) The Service recommends that the Corps, subject to the Nation's approval, provide funding and technical assistance to the Nation to evaluate and implement, if feasible, creation of flycatcher habitat adjacent to wetlands that form around the perimeter of the proposed intermediate settling pond to be located south of Dulce, and in any other suitable locations in the action area.

**Reinitiation Notice**

This concludes formal consultation on the proposed project. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) The amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The SJRIP is expected to result in a positive population response for the pikeminnow and razorback sucker in the San Juan River. If a positive population response for both species is not realized as measured by the criteria developed by Bureau of Reclamation dated July 6, 2001 (Table 5), this would be considered new information that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion. In such an instance, reinitiation of section 7 consultation would be required for all projects dependent on the SJRIP, including the Navajo River Water Development Plan.

If reinitiation is necessary, the Service will follow the procedures regarding reinitiation of consultation pursuant to the “Principles for Conducting Endangered Species Act Section 7 Consultations on Water Development and Water Management Activities Affecting Endangered Fish Species in the San Juan River Basin” (Appendix C). In addition, the SJRIP Integration Report was not ready for the Service to use in its assessment of the SJRIP while preparing this BO. If new information is presented in the Integration Report that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, reinitiation of this consultation would be required.

Please contact Lyle Lewis of the NMESFO at 505-761-4714, if you have any questions about this biological opinion and refer to consultation number 2-22-02-F-402.

Sincerely,

/s/

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cc:

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# **Appendix A**

## **Tables and Figures**

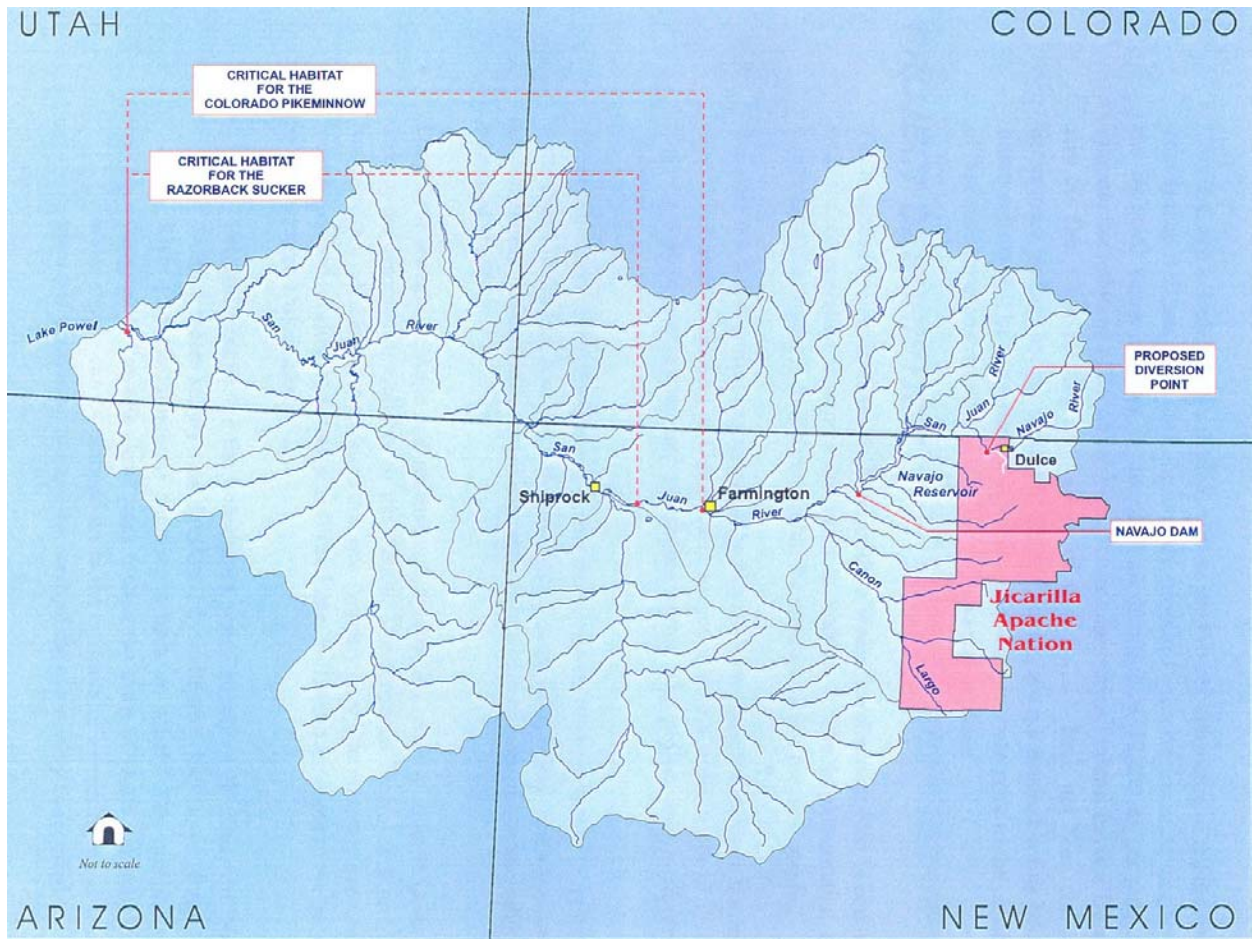


Figure 1 (Image copied from biological assessment) Action area of effects includes from the diversion point at the Navajo River, along the pipeline to and including Dulce Lake (see Figure 2). Effects continue from the diversion point on the Navajo River downstream to the San Juan River (including Navajo Reservoir) to Lake Powell. Flow recommendations are targeted for the 180 miles of the San Juan River between the Animas River confluence and Lake Powell.

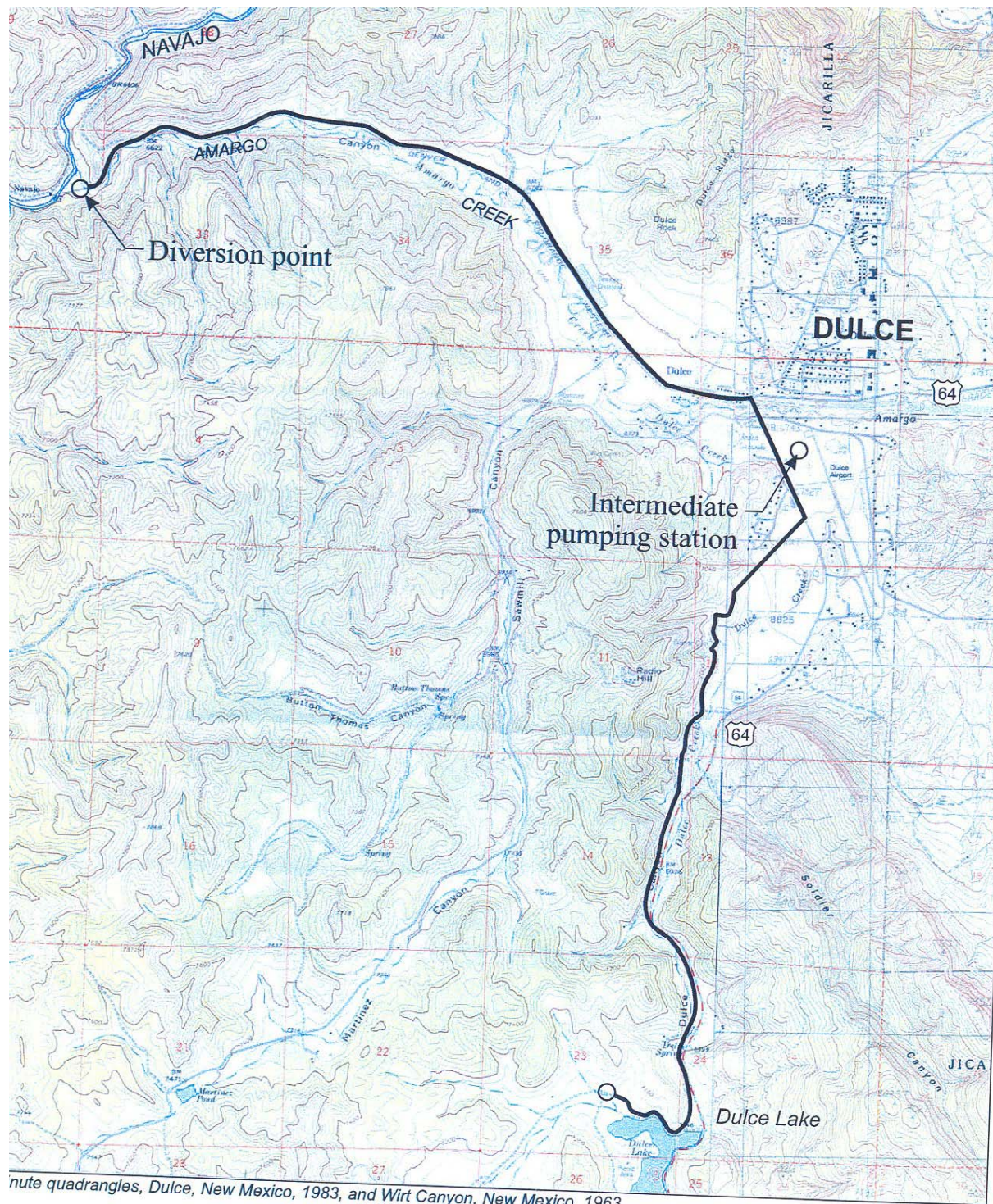


Figure 2. (Image copied from biological assessment) Depiction of a portion of the action area showing the diversion point, pipeline, town of Dulce, NM., and Dulce Lake.

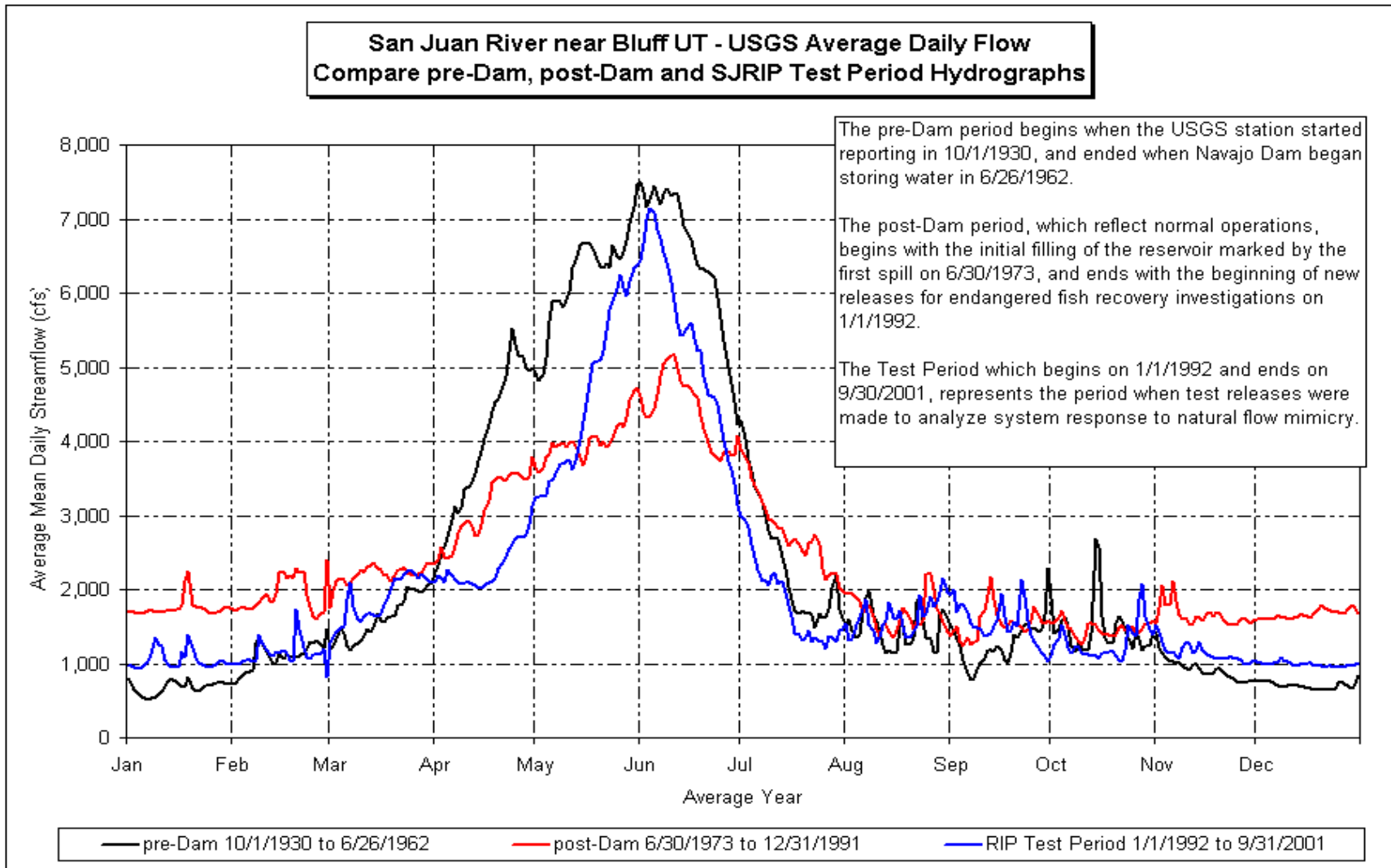


Figure 3. . Graph comparing pre-Navajo Dam, post-Navajo Dam (pre-Flow Recommendations), and proposed action flow of San Juan River past the Bluff gage.

Table 1 Summary of San Juan River Basin depletions (modified from May 2003 draft Navajo Dam re-operations Biological Assessment) 7,8,9

| Depletion Category                           | (acre-feet/year) | Footnotes |
|--|------------------|-----------|
| <b>New Mexico Depletions</b>                 |                  |           |
| <u>Navajo Lands irrigation depletion</u>     |                  |           |
| Navajo Indian Irrigation Project             | 280,600          | 1         |
| Hogback                                      | 12,100           | 2         |
| Fruitland                                    | 7,898            | 2         |
| Cudei  | 900              |           |
| Chaco River offstream depletion              | 2,832            | 3         |
| Whiskey Creek offstream depletion            | 523              | 3         |
| Subtotal                                     | 304,853          |           |
| <u>Non-Navajo Lands irrigation depletion</u> |                  |           |
| Above Navajo Dam - private                   | 738              |           |
| Above Navajo Dam - Jicarilla                 | 2,190            |           |
| Animas River                                 | 36,711           |           |
| La Plata River                               | 9,739            |           |
| Upper San Juan                               | 9,137            |           |
| Hammond Area                                 | 10,268           |           |
| Farmers Mutual Ditch                         | 9,532            |           |
| Jewett Valley                                | 3,088            |           |
| Westwater                                    | 110              |           |
| Subtotal                                     | 81,513           |           |
| Total NM Irrigation Depletion                | 386,366          |           |
| <u>Non-irrigation depletions</u>             |                  |           |
| Navajo reservoir evaporation                 | 27,428           |           |
| Utah International                           | 39,000           |           |
| San Juan power plant                         | 16,200           | 4         |
| Industrial diversions near Bloomfield        | 2,500            |           |
| Municipal and industrial uses                | 8,454            |           |
| Scattered rural domestic uses                | 1,400            | 3         |
| Scattered stockponds and livestock uses      | 2,200            | 3         |
| Fish and wildlife                            | 1,400            | 3         |
| Total NM Non-Irrigation Depletion            | 98,582           |           |
| San Juan-Chama Project exportation           | 107,514          |           |
| Unspecified minor depletions                 | 4,500            | 5         |
| Animas-La Plata Project                      | 13,600           |           |
| Total New Mexico Depletion                   | 610,562          |           |
| <b>Colorado Depletions</b>                   |                  |           |
| <u>Upstream of Navajo Reservoir</u>          |                  |           |
| Upper San Juan                               | 10,858           |           |
| Navajo-Blanco                                | 7,865            |           |
| Piedra                                       | 8,098            |           |
| Pine River                                   | 71,671           |           |
| Subtotal                                     | 98,492           |           |
| <u>Downstream of Navajo Reservoir</u>        |                  |           |
| Florida                                      | 28,607           |           |
| Animas                                       | 25,113           |           |
| La Plata                                     | 13,049           |           |
| Mancos                                       | 19,532           |           |

| Depletion Category                         | (acre-feet/year) | Footnotes |
|--|------------------|-----------|
| McElmo Basin imports                       | -11,769          |           |
| Subtotal                                   | 74,532           |           |
| Animas-LaPlata Project                     | 43,533           |           |
| Total Colorado depletions                  | 216,557          |           |
| Colorado and New Mexico combined depletion | 827,119          |           |
| Utah depletion                             | 9,140            | 3 6       |
| Arizona depletion                          | 10,010           | 3         |
| Grand Total                                | 846,269          |           |

1 Includes 10,600 acre-feet/year (afy) of annual groundwater storage. At equilibrium depletion drops to 270,000 afy.

2 Accounts for 16,420 afy transferred from Hogback, including the Hogback Extension, and Fruitland Projects to NIIP.

3 Indicates offstream depletion accounted for in calculated natural gains. Scattered rural domestic and stockpond and livestock uses in N.M. include the Jicarilla Apache Nation's 2,187.16 af of decreed reserved water rights for historic and existing uses for net evaporation.

4 Water contract with the Jicarilla Apache Nation (Public Service of New Mexico)

5 3,000 afy of depletion from 1999 Intra-Service consultation, a portion of which may be in Colorado. 770 afy from Jicarilla minor subcontracts.

6 1,705 afy San Juan River depletion, 7435 afy offstream depletion.

7. The State of New Mexico does not necessarily agree with the depletions shown in terms of constituting evidence of actual water use, water rights, or water availability under the Compact. The SJRIP Hydrology Committee uses a hydrology model disclaimer that reads in part "The model data methodologies and assumptions do not under any circumstances constitute evidence of actual water use, water rights, or water availability under Compact apportionments and should not be construed as binding on any party."

8. The New Mexico Interstate Stream Commission (NMISC) and the San Juan Water Commission (SJWC) believe there are inconsistencies in depletion calculations (communications from NMISC and SJWC dated April 8 and March 21, 2002, respectively).

9. It should be noted that full development of State compact water and Indian trust water is not included in this table. Only existing projects and projects with ESA and NEPA compliance are included in the depletion table.



Table 2. Water depletion consultations in the Environmental Baseline.

| Consultation #                              | Date      | name  | depletion (af) | Duration            | Comment   | current depletion |
|---|-----------|---|----------------|---------------------|---|-------------------|
| CO-95-F-028                                 | 5/17/1996 | Los Pinos River intake COE (CO)                                   | 225.00         | none given          | Southern Ute Indian Tribe project, part of Animas-La Plata baseline. Jeopardy. No take anticipated. RPA: Reoperation of Navajo Dam to mimic the natural hydrograph of the San Juan River, as agreed to as a result of the ALP consultation. | 225               |
| CO-98-F-002                                 | 3/4/1998  | Mancos Water Conservancy BoR (CO)                                 | 200.00         | 25 (expires 2020)   | Jeopardy. No take anticipated. RPA: Reoperation of Navajo Dam to mimic the natural hydrograph of the San Juan River, as agreed to as a result of the ALP consultation.  | 200               |
| Minor Depletions I                          | 5/21/1999 | minor depletions  | 3,000.00       | 5 years             | batched in 3,000 af blocks. One block is full   | 3,000             |
| 2-22-91-F-241, 2-22-92-F-080, 2-22-99-F-381 | 7/14/1999 | Completion of Navajo Indian Irrigation Project                    | 270,000.00     | none given          | Not Likely to Adversly Affect based in part on reoperation of Navajo Reservoir  | 204,000.00        |
| CO-00-F-016                                 | 6/19/2000 | Animas-La Plata Project   | 57,100.00      | perpetual           | non-jeopardy. Inability to meet the Flow Recommendation is trigger for re-initiation. Take considered with implementation of Recovery Program. None anticipated as a result of proposed action.   | 0.00              |
| 2-22-00-I-469                               | 2/15/2001 | Public Service Company of NM Water Contract with Jicarillas - BOR | 16,200.00      | 01/01/06 - 12/31/27 | Originally a BOR contract with PNM. NLAA based on construction of San Juan Generating Station fish passage, reoperation of Navajo Dam, and Reclamations participation in the SJBRIP   | 16,200.00         |

| <b>Consultation #</b> | <b>Date</b> | <b>name</b>   | <b>depletion (af)</b> | <b>Duration</b> | <b>Comment</b>  | <b>current depletion</b> |
|-----------------------|-------------|---|-----------------------|-----------------|---|--------------------------|
| CO-01-F-052           | 6/6/2002    | Red Mesa Reservoir -COE (CO)                            | 2,199.00              | none given      | Covered in April 25, 1996 Jeopardy biological opinion (1202 AF/yr historic and 997 AF/yr new) RPA 50,000 \$ to Utah for hatchery pond. [New B.O. issued 6/6/02. Non-jeopardy. Take considered with implementation of Flow Recs. None anticipated as a result of proposed action.] | 1,202.00                 |
| CO-02-F-017           | 10/21/2002  | Lake Capote Dam Replacement Project - BIA (CO)          | 108.00                | Perpetual       | Non-jeopardy. Take considered with implementation of Flow Recs. None anticipated as a result of proposed action.  | 0.00                     |
| GJ-6-CO-03-F-010      | 11/24/2003  | Williams Creek-Squaw Pass – FS (CO)                     | 202.00                | Perpetual       | Non-jeopardy. Take considered with implementation of Flow Recs. None anticipated as a result of proposed action.  | 202.00                   |
| CO-96-F-003           | 3/7/1996    | Programmatic Opinion - Forest Service, Colorado         | 34,656.32             | none given      | An additional 283.87 af new depletion is shown in minor depletion log. / Jeopardy. No take anticipated. RPA: Reoperation of Navajo Dam to mimic the natural hydrograph of the San Juan River, as agreed to as a result of the ALP consultation.                                   | 34,656.00                |
| CO-02-F-016           | 9/3/2002    | Bigbee #2 Lateral Project – Alpine Lakes Ranch- FS (CO) | 334.00                | none given      | Non-Jeopardy. No take anticipated.: Reoperation of Navajo Dam to mimic the natural hydrograph of the San Juan River, as agreed to as a result of the ALP consultation.  | 336.00                   |
| Minor Depletions II   | ongoing     | minor depletions  | 2,485.00              | 5 years         | batched in 3,000 af blocks. One block is full   | 2,500.00                 |
| CO-03-F-008           | 3/15/2004   | Three Springs Development                               | 514                   | none given      | 2 historic depletions of 249 and 265  | 514                      |
| total depletions      |             |   | 387,225.32            |                 |   | 263,035.00               |

Table 3. Surface Water Depletions from Coalbed methane development: Model Summaries

| River   | Pre-CBM Discharge (AF/yr) | Current Depletion (AF/yr) | Maximum Depletion (AF/yr) | Year when Max Depletions Begin |
|---------|---------------------------|---------------------------|---------------------------|--------------------------------|
| Animas  | 66                        | 41                        | 66                        | 2045                           |
| Pine    | 61                        | 31                        | 61                        | 2025                           |
| Florida | 17.5                      | 2                         | 12.5                      | 2050                           |
| Piedra* | 60                        | 0                         | 60                        | **                             |
| Total   | 204.5                     | 74                        | 199.5                     |                                |

\*Piedra River depletions are estimated based on discharges simulated from the 3M Project and the depletions modeled in the Ground Water Protection Research Foundation Project at other rivers.

\*\*Maximum depletions at the Piedra will depend on the pace of coalbed methane development in the northeastern portion of the San Juan Basin.

Table 4. Status of pikeminnow and razorback sucker outside the San Juan River.

| <u>Species Status</u> | RIVER  |   |   |
|-----------------------|--|---|---|
| SPECIES               | MIDDLE GREEN (includes the Yampa river from Craig to Echo Park, White River from Taylor Dam to Green River confluence, and the mainstem Green River from Split Mountain to Sand Wash)                    | LOWER GREEN (Sand Wash to Colorado River confluence)  | COLORADO  |
| Colorado pikeminnow   | About 3,500, based on data collected in 2000.  | Population estimates initiated in 2001; data being analyzed and estimates continuing in 2003. | About 700, based on data collected in 2000.             |
| Razorback sucker      | <100 wild adults; population being augmented through stocking; augmentation is being expanded with excess fish stocked into selected floodplain depressions; stocked fish are returning to spawning bar. | Few adults; population being augmented through stocking.                                      | Few adults; population being augmented through stocking |



**San Juan  
Recovery  
Implementation  
Program**

| <b>Studies</b>   | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|--|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| et al. 2000)   |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| Young-of-the-Year Survey in the Lower San Juan River (Lashmett 1994, 1995) |      |      |      |      |      |      | x    | x    |      |      |      |      |      |      |      |      |      |
| Small bodied fish monitoring (Probst et al. 2000)                          |      |      |      |      |      |      |      |      |      |      |      | x    | x    | x    | x    | x    | x    |
| Early Lifestage - Nursery Habitat (Archer et al. 2000)                     |      |      |      |      |      |      |      |      | x    | x    | x    |      |      |      |      |      |      |
| Drift Netting (Platania et al. 2000)                                       |      |      |      |      |      |      |      |      | x    | x    | x    |      |      |      |      |      |      |
| Larval Seigning (Plantania et al. )  |      |      |      |      |      |      |      |      |      |      |      | x    | x    | x    | x    | x    | x    |
| Secondary Channel Ichthyofaunal Characterization (Propst and Hobbes 2000)  |      |      |      |      | x    | x    | x    | x    | x    | x    | x    |      |      |      |      |      |      |
| Nonnative Fish Interactions  |      |      |      |      | x    | x    | x    | x    | x    | x    | x    |      |      |      |      |      |      |



