APPENDIX C

Part III
Draft Biological Opinion

DRAFT

United States Department of the Interior

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Cons. # 2-22-01-F-532

Memorandum

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

From: Field Supervisor, U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, New Mexico

Subject: DRAFT Biological Opinion for the Navajo-Gallup Water Supply Project, U.S. Bureau of Reclamation, Durango, Colorado

This transmits the U.S. Fish and Wildlife Service's (Service) draft biological opinion (BO) on the effects of actions associated with the Bureau of Reclamation's (Reclamation) Navajo-Gallup Water Supply Project. The duration of this action will be from the acceptance of the final BO to whatever time that reinitation may be necessary. This draft BO concerns the effects of the action on the federally endangered Colorado pikeminnow (*Ptychocheilus lucius*) (pikeminnow) and its designated critical habitat, the federally endangered razorback sucker (*Xyrauchen texanus*) and its designated critical habitat, the endangered southwestern willow flycatcher *(Empidonax traillii extimus*) (flycatcher), the threatened Mesa Verde cactus (*Sclerocactus mesae-verdae*), and the threatened bald eagle (*Haliaeetus leucocephalus*). Reclamation determined that the proposed action "may affect, is likely to adversely affect" the pikeminnow, the razorback sucker and the Mesa Verde cactus; and "may effect, is not likely to adversely affect" the flycatcher and the bald eagle. The proposed action will have no adverse modification of critical habitat for pikeminnow or razorback sucker. The Service concurs with Reclamation's determination of "may effect, is not likely to adversely affect" the bald eagle and flycatcher.

The current BO does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in Gifford Pinchot Task Force v. USDI Fish and Wildlife Service (CIV No. 03-35279) to complete the following analysis with respect to critical habitat. This consultation analyzes the effects of the action and its relationship to the function and conservation role of razorback sucker and pikeminnow critical habitat to determine whether the current proposal destroys or adversely modifies critical habitat. This document represents our biological opinion for the razorback sucker and pikeminnow and their designated critical habitat in accordance with section 7 of the Act.

In accordance with section 7 of the Act, 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 as a result of the Reclamation's proposed action. A complete administrative record of this consultation is on file at the Service's New Mexico Ecological Services Field Office.

If you have questions regarding this consultation, please contact David Campbell, at (505) 761-4745.

Wally Murphy
Field Supervisor

Attachment

cc:
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DRAFT

Endangered Species Act – Section 7 Consultation
DRAFT Biological Opinion

Navajo-Gallup Water Supply Project
New Mexico

Agency:	U.S. Bureau of Reclamation
Consultation Conducted By:	U.S. Fish and Wildlife Service, New Mexico Ecological Services Field Office
Date Issued:	
Approved by: Field Supervisor	Wally Murphy
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Introduction

This document prepared by the U.S. Fish and Wildlife Service (Service) includes a Biological Opinion (BO) and incidental take statement in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402. The administrative record for this consultation is on file at the New Mexico Ecological Services Field Office, Albuquerque, New Mexico.

Background and Consultation History

The Bureau of Reclamation (Reclamation) is proposing to construct a water supply project that would divert water from the San Juan River and Navajo Reservoir to the Navajo Nation, Jicarilla Apache Nation, and City of Gallup.

On August 29, 2005, the Service received a letter and draft Biological Assessment (BA) from Reclamation requesting initiation of formal section 7 consultation under the ESA. The BA documented Reclamation's finding that the proposed action is "likely to adversely affect" pikeminnow, razorback sucker, Mesa Verde cactus, flycatcher, and bald eagle and the critical habitat for pikeminnow. However, the letter failed to request formal section 7 consultation on the effects of the proposed project on razorback sucker critical habitat.

On September 16, 2005, the Service requested a conference call with Reclamation to discuss and clarify information provided in the BA.

On September 22, 2005, the Service responded to Reclamation with a letter requesting that Reclamation clarify its intention regarding inclusion of razorback sucker critical habitat in this formal consultation.

This BO is based on information provided in the current BA; electronic mail and telephone conversations between our staffs; data in our files; data presented in the Recovery Plan (USDI Fish and Wildlife Service 1984); literature review; and other sources of information including the final rules to federally list the cactus as threatened (USDI Fish and Wildlife Service 1979; 44 FR 62472). A notice of intent to prepare an environmental impact statement (EIS) and project scoping under the National Environmental Policy Act of 1969, as amended (NEPA) began in March 2000 (59 FR 16219). A draft EIS has not been completed and released for public comment. A complete administrative record of this consultation is on file at this office. We received all the information necessary for formal consultation on December 1, 2006.

Description of the Proposed Action

Action Area

The Service has defined the action area considered in this BO for the proposed action to be from the diversion points at the Navajo Indian Irrigation Project (NIIP) main canal at Cutter Reservoir and at the Public Service Company of New Mexico (PNM) diversion dam on the San Juan River downstream to Lake Powell. The action area also includes one-half mile around the main water treatment plants located at each diversion location, the 19 forebay tanks, the 24 pumping plants, the 5 regulating tanks and approximately 25 community storage tanks; and one-half mile on either side of the 267 miles of pipeline.

The action area includes most of the Navajo Nation in New Mexico and the Window Rock area of Arizona, the Jicarilla Apache Nation in New Mexico, and Gallup. By the year 2040 the project would serve an estimated 203,000 people in the Navajo Nation, 1,300 people in the Jicarilla Apache Nation, and 47,000 people in Gallup.

Proposed Action

The Navajo-Gallup Water Supply Project (NGWSP) is proposed to deliver treated municipal water to selected Navajo communities, a portion of the Jicarilla Apache Nation and the City of Gallup, New Mexico. The project is planned with adequate capacity to serve approximately 203,000 people (43 Chapters) in the Navajo Nation, 1,300 people in the Jicarilla Apache Nation, and approximately 47,000 people in Gallup, the projected populations as of year 2040. The service area for the proposed pipeline includes most of the New Mexico portion of the Navajo Nation, the Navajo Nation in the Window Rock area within Arizona, the Jicarilla Apache Nation and the City of Gallup, New Mexico (Figure 1). The water supply will be from the San Juan River with surface return flow in the San Juan basin and groundwater recharge to the San Juan, Rio San Jose and Rio Puerco Basins. For water balance considerations, the groundwater recharge is not assumed to return to surface flow in any of the basins due to the distance from the surface water bodies and existing pumping within the basins that keep the water surface elevation in the aquifers from rising to levels that would allow surface discharge.

Reclamation examined 12 alternatives for the NGWSP. The proposed preferred alternative is called the San Juan River Public Service Company of New Mexico 2040 Alternative, with diversion points from the NIIP main canal at Cutter Reservoir and at the PNM diversion dam on the San Juan River. A treatment plant would be located at each diversion location, along with main pumping plants supplying water to 267 miles of pipeline. The system would consist of 19 forebay tanks, 24 pumping plants, 5 regulating tanks and approximately 25 community storage tanks. The general project layout and service area are shown in Figure 1.

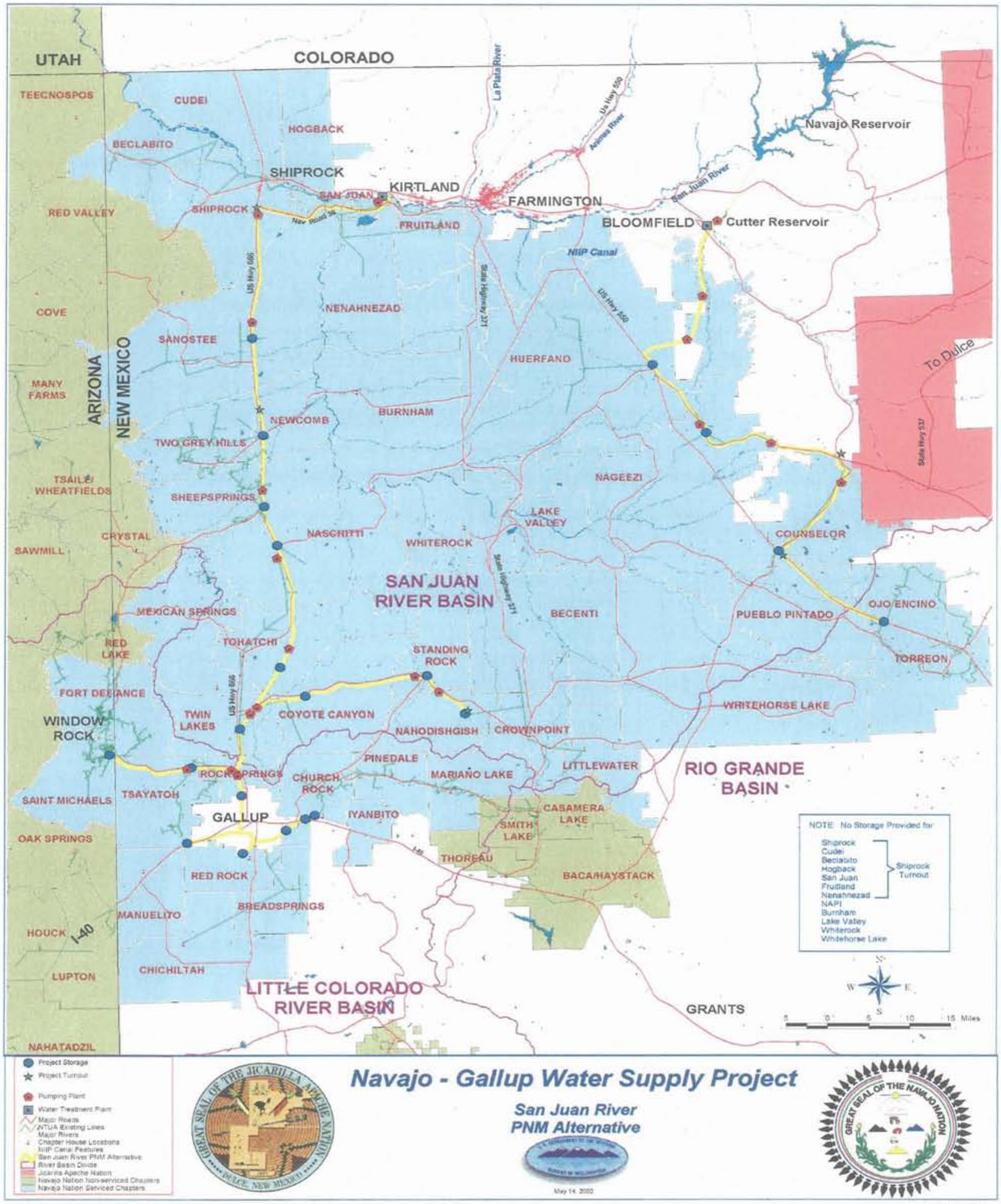

Figure 1.—Navajo Gallup Water Supply Project Service Area and Project Layout.

Cutter Lateral

The Cutter Lateral would serve Huerfano, Nageezi, Counselor, Pueblo Pentado, Ojo Encino, Torreon and Whitehorse Chapters in the eastern portion of the Navajo Nation and a portion of the western Jicarilla Apache Nation, delivering up to 4,645 acre-feet per year. The Cutter Lateral would obtain water from the Cutter Reservoir, a feature of the NIIP main canal (Figure 1).

The treatment and pumping plant would have a footprint of about 3-4 acres located downstream of Cutter Dam in a previously disturbed area. The plant would have a capacity of 5.39 million gallons per day (mgd) or 8.34 cubic feet per second (cfs). Facilities would include mixing and flocculation tanks, three ultrafiltration units, three ultraviolet light (UV) disinfection units, a 112,000 gallon subsurface pumping plant forebay, two wastewater polishing ponds, chemical storage buildings, an operations and maintenance (O&M) building and a 4-unit pumping plant. The associated electrical control equipment necessary to power and control the electrically driven pumps and other ancillary equipment would also be contained on this site.

The plant would feed approximately 89 miles of buried pipeline ranging in diameter from 10 to 24 inches. There would be 5 re-lift pumps along the route to maintain required delivery pressure, along with three community storage tanks and two regulating tanks. Much of the pipeline route is paralleled with an overhead electrical transmission line to power the pumping plants. A 230/69 kilovolt (KV) substation would provide power from the existing 230 KV PNM transmission line.

Each re-lift pump would consist of a forebay tank, pumping plant, air chamber, chlorination building, electrical control and ancillary equipment. The typical footprint would be about one acre, enclosed in a chain link fence. Each site would be totally contained with no open water.

Storage tank locations typically would include the storage tank (size varies depending on location), chlorination building, pumping plant, air chamber, electrical control and ancillary equipment in an enclosed yard. The typical footprint is about one acre.

San Juan Lateral

The San Juan Lateral would have its diversion point at the existing PNM diversion dam (Figure 1). The pumping plant intake would be located just upstream of the PNM intake on the north bank of the San Juan River. It will supply the main pipeline, delivering up to 33,118 acre-feet per year to the 36 Navajo Nation Chapters and the City of Gallup, New Mexico.

Water would be diverted through a self-cleaning fish screen with 3/32 inch openings and a through-screen velocity of less than 0.5 feet per second to a sump where low-head pumps would lift the raw water into settling ponds for removal of suspended sediment. The remaining treatment and pumping plant facilities would be as described for the Cutter Lateral, except that the capacity is greater at 38.25 million gallons per day (mgd) (59.19 cfs). There would be seven ultrafiltration units, seven UV disinfection units, and a 797,000 gallon clear well. There would be two settling ponds and two sediment drying beds at this site that are required to handle the elevated suspended sediment concentration. The associated buildings and ancillary equipment listed for the Cutter Lateral would also be required at this site, although of a larger size. The total footprint at this site is expected to be about 18 acres, much of which is previously disturbed in a sparsely inhabited trailer park.

The San Juan Lateral pumping plant would feed approximately 145 miles of buried pipeline ranging in diameter from 12 inch to 48 inch. The buried pipeline would cross the San Juan River just upstream of the treatment plant and ascend to the mesa on the south side of the river. From there it would proceed west following Navajo Highway 64 to U.S. Highway 491, following the highway route through the City of Gallup to connect to 5 Navajo chapters on the southern border of the city. The project facilities serving the Gallup area are called the Gallup Regional System and consist of 1 new pumping plant and upgrades to 5 storage tanks and 32 miles of pipeline. There would be 7 re-lift stations along the main line, with 3 on the Dalton Pass branch and 2 on the Window Rock branch. Along the route there would be 17 storage tanks (plus 5 community storage tanks in the Gallup Regional System), 3 regulating tanks, with additional junctions to Shiprock, Burnham and Gallup water supply systems and a turnout to NIIP. The electrical transmission line parallels the pipeline over much of its route.

Impacts from Construction

Pipeline Construction Impacts

The pipeline and accompanying facilities would permanently impact 27 acres of vegetation, including 3,920 square feet of tamarisk and Russian olive habitat. Clearing and grading will temporarily impact 31,477 acres. Much of the pipeline would be adjacent to existing highways or well-traveled roads. Project construction would be phased over approximately 14 years, with only small portions of the area disturbed at any one time. The pipeline construction would occur almost exclusively in upland habitat, much of which has been previously disturbed.

San Juan River Crossing

The method of construction to be used at the San Juan River crossing (Figure 1) has not been determined. Consequently, the Service has analyzed the impacts for both potential river crossing construction methods: 1) open trench with construction of coffer dams in one-half of the river width at any one time; and 2) directional boring. Impact to aquatic resources will be minimized by the actions outlined in the "Conservation Measures" section below.

Impacts of the Open Trench Method

The open trench would include clearing and grading of 0.9 acres of degraded riparian habitat that consists of tamarisk and Russian olive and 0.10 acres of temporary impacts to an emergent wetland. Of the 0.9 acres of riparian impact, 0.65 acres will result in temporary impacts and will be replanted with native riparian species; 0.25 acres will be placed in the pipeline right-of -way and planted in grasses. The 0.10 acres of wetland area temporarily impacted will be replanted with native emergent wetland species.

Impacts of the Directional Boring Method

All the impacts associated with the directional boring method would be within the project's evaporation pond footprint which will be constructed on 4.5 acres of previously developed upland.

Water Treatment and Pumping Facilities

For either method used to cross the San Juan River, construction of water treatment and pumping facilities adjacent to the San Juan River would permanently impact 1.5 acres, temporarily impact 3.2 acres of degraded riparian habitat that consists of tamarisk and Russian olive and would include the conversion of 4.5 acres of a previously developed area to an evaporation pond.

Water Depletion Impacts

San Juan River Water Depletion

The project is designed to divert a total of 37,764 acre-feet of water per year from the San Juan River with a resulting depletion of 35,893 acre-feet to the San Juan Basin, based on 2040 projected population with a demand rate of 160 gallons per capita per day. The Cutter Diversion would require 4,645 acre-feet per year with no return flow to the San Juan River. The PNM diversion would take the remaining 33,119 acre-feet of diversion, with an average return flow of 1,871 acre-feet. The planned diversion and depletion by location is shown in Table 1.

It is assumed that the only return flow from the project to the San Juan River would enter the river at the Shiprock wastewater treatment plant. There may be some water delivery to users with individual septic systems in the Shiprock area, but the delivery is expected to be a small percentage of the total. The return flow through the treatment plant is assumed to be 50 percent for the Shiprock deliveries. All other deliveries would also have similar losses, but the system losses would be due to evaporation, or recharge local groundwater aquifers. For water balance purposes, no return flow to the San Juan River from these other locations is expected or accounted. Return flow to the Rio Grande or Little Colorado Rivers is highly unlikely, even though there will be discharge to the groundwater in these areas. Local groundwater storage space together with local pumping will limit the potential for surface discharge. Even if surface discharge does occur, the distance to the Rio Grande or Little Colorado Rivers is so great that it is unlikely that return flow would reach these rivers.

Table 1.—Forecast 2040 Demand and Design Capacity by Service Area

Location	SJR Diversion ac-ft/yr	SJR Depletion ac-ft/yr
City of Gallup, NM	7,500	7,500
Jicarilla Apache Nation	1,200	1,200
Navajo Nation, New Mexico		
Central Area	834	834
Crownpoint	2,473	2,473
Gallup Area	4,316	4,316
Huerfano	864	864
Rock Springs	2,118	2,118
Route 491	5,366	5,366
Torreon	2,240	2,240
San Juan River	3,742	1,871
NAPI industrial uses	700	700
Navajo Nation, Arizona (Window Rock area)	6,411	6,411
Total Navajo Nation	**29,064**	**27,193**
Project Total	**37,764**	**35,893**

Deliveries typically vary depending on changes in demand with the largest demand in summer months. The Shiprock water delivery pattern for March 1992 through February 1993, shown in Table 2, was used to determine average monthly deliveries. Return flows were assumed to follow the same distribution.

Table 2.—Monthly Demand Pattern for All Deliveries

Month	% Demand	Month	% Demand
January	7	July	10
February	6	August	10
March	9	September	10
April	7	October	8
May	9	November	7
June	10	December	7

The system design capacity to handle a 7-day peak demand for pumping plants and pipelines is computed as 1.3 times the peak average monthly demand. Daily and diurnal demand peaking are handled by the community storage tanks.

Operational Flexibility

Jicarilla Apache Nation and Gallup Water Supply

Table 1 shows a project annual water depletion for the Jicarilla Apache Nation (JAN) of 1,200 acre feet and for the City of Gallup, 7,500 acre feet. The plans for the Jicarilla Apache Nation Navajo River Water Supply Project (JANNRWSP) include the allowance to deliver all or part of this water to other uses, including the NGWSP, at a time that it should be needed. The NGWSP plans to use 6,570 acre-feet previously committed to JANNRWSP plus 170 acre feet of other unused JAN water supply, requiring 1,960 acre-feet of new depletion (Table 3). The City of Gallup depletion is assumed to be included in JAN depletions in Table 3.

Table 3—Summary of Depletions for full NGWSP Development

Water Right Holder	In Baseline (changed use) ac-ft	New Depletion ac-ft	Met w/ unused baseline depletion[1] ac-ft	Total Depletion ac-ft
Jicarilla Apache Nation	6,740[2]	1,960		8,700
Navajo Nation		6,411	20,782	27,193
NGWSP Total	6,740	8,371	20,782	35,893

[1] See Depletion Guarantee description.
[2] Includes 170 acre-feet from unused historical rights and 6,570 acre-feet from the JANNRWSP.

Navajo Nation Supply

The Navajo Nation portion of the NGWSP depletion is 27,193 acre feet per year (Table 3). The Navajo Nation portion of the NGWSP is comprised of 20,782 acre feet per year of unused depletions currently in the hydrologic baseline and 6,411 acre feet per year of new depletions (Table 3). Another 3,100 acre-feet will be returned to the San Juan River by return flow from the Navajo Indian Irrigation Project (NIIP) by the time the Navajo Nation demands reach the full 27,193 acre feet. This reduces the net new depletion to 5,271 acre feet per year.

If at some point in the future the amount of the unused depletions is less than 20,782 acre feet per year, the Navajo Nation will guarantee the availability of this remaining depletion by reducing their total water use in the basin.

Depletion Guarantee

This section clarifies the conditions of the Depletion Guarantee and describes the commitments necessary to monitor depletions and maintain compliance with the ESA. ***The Depletion Guarantee is a commitment by the Navajo Nation that ensures that depletion for the NGWSP will be offset by unused Navajo Nation NIIP depletions in the basin***. That portion of the NGWSP depletion that consists of unused depletions currently in the hydrologic baseline (20,782 acre feet) is attributed to Navajo Nation uses in New Mexico. Unless the sum of actual depletions from all uses listed in the hydrologic baseline shown in Table 4, plus all NGWSP uses reach the total listed in the baseline (854,371 acre feet) plus 5,271 acre feet, the full NGWSP depletion of 35,893 acre feet will be allowed (Table 3). The depletion for projects that may be added to the hydrologic baseline at a date later than the date of the Biological Opinion for NGWSP will not be counted in this analysis.

If the depletion conditions described in the paragraph above are reached, the Navajo Nation will reduce its total depletion to stay below the allowed total for the basin. This could be accomplished by changes in operation of any of the Navajo projects that deplete water from the San Juan River. The maximum depletion guarantee requirement is 20,782 acre feet. Changes in the flow recommendation or in species status may result in reduction or removal of this guarantee in the future, based upon reconsultation.

Monitoring Requirements

No specific, detailed accounting of depletions will be required unless the sum of NIIP and Animas LaPlata Project (ALP) depletions reaches 290,000 acre-feet (Table 4). Since these projects are easily tracked, it will limit monitoring requirements for the entire basin. If this condition is met, all the depletions listed in the baseline for NGWSP will be monitored and reported on a 5-year cycle to coincide with the USBR Consumptive Use and Loss report. Depletions will be reported by the categories listed in the hydrologic baseline shown in Table 4 and the total computed.

If the sum of these depletions reaches the hydrologic baseline level for NGWSP plus 5,271 acre-feet, the elements of the depletion guarantee will be implemented. At that point, modeling will be completed for the limits the Navajo Nation proposes putting in place to meet flow conditions specified in the BA.

Responsibilities

San Juan River Basin Recovery Implementation Program
The SJRRIP Hydrology Committee will be responsible for reviewing the accounting of depletions. The Committee will also implement the San Juan River Basin Hydrology Model (SJRBHM) to assure compliance with the flow recommendations as specified in the NGWSP BA for limits identified by the Navajo Nation at the time the depletion guarantee is implemented.

Bureau of Reclamation
The Bureau will identify the point at which ALP and NIIP annual depletions reach 290,000 acre-feet. If that target depletion is reached, Reclamation will initiate reporting of depletions for the categories listed in the hydrologic baseline for NGWSP (Table 4) on a 5-year cycle as a part of the consumptive use and loss reporting procedure. As a result of the monitoring, Reclamation will identify the point at which the sum of actual uses for these categories plus the NGWSP reach

Table 4.—Baseline and Current Depletion Summary in the San Juan River Basin[1]

Depletion Category	Riverware Baseline (ac-ft)	Estimated Current (ac-ft)	Presently Unused (ac-ft)
New Mexico Depletions			
Navajo Lands Irrigation Depletion			
Navajo Indian Irrigation Project	280,600[2]	160,330	120,270
Hogback	12,100	9,535	2,565
Fruitland	7,898	6,147	1,751
Cudei	900	715	185
Subtotal	**301,498**	**176,727**	**124,771**
Non-Navajo Lands Irrigation Depletion			
Above Navajo Dam - Private	738	575	163
Above Navajo Dam - Jicarilla	2,190	350	1,840
Animas River	36,711	24,878	11,833
La Plata River	9,808	8,470	1,338
Upper San Juan	9,137	6,680	2,457
Hammond Area	10,268	7,507	2,761
Farmers Mutual Ditch	9,532	7,457	2,075
Jewett Valley	3,088	2,379	709
Westwater	110	110	0
Subtotal	**81,582**	**58,406**	**23,176**
Total NM Irrigation Depletion	**383,080**	**235,133**	**147,949**
Non-Irrigation Depletions			
Navajo Reservoir Evaporation	27,350	29,235	-1,885
Utah International	39,000	31,388	7,612
San Juan Power Plant	16,200	16,200	0
Industrial Diversions near Bloomfield	2,500	2,500	0
Municipal and Industrial Uses	8,453	7,443	1,010
Scattered Rural Domestic Uses	1,400[3]	1,400	0
Scattered Stockponds & Livestock Uses	2,200[3]	2,200	0
Fish and Wildlife	1,400[3]	1,400	0
Total NM Non-Irrigation Depletion	**98,503**	**91,766**	**6,735**
San Juan-Chama Project Exportation	107,514	107,514	0
Unspecified Minor Depletions	4,500[4]	2,500	2,000
JANNRWSP	6,570[5]	0	6,570
Total NM Depletions (Excluding ALP)	**600,168**	**436,914**	**163,254**

Table 4.— Baseline and Current Depletion Summary in the San Juan River Basin – continued

Depletion Category	Riverware Baseline (ac-ft)	Estimated Current (ac-ft)	Presently Unused (ac-ft)
Colorado Depletions – Upstream of Navajo			
Upper San Juan	10,858	9,270	1,588
Navajo-Blanco	7,865	6,972	893
Piedra	8,098	6,892	1,206
Pine River	71,671	69,775	1,886
Subtotal	**98,492**	**92,909**	**5,583**
Colorado Depletions – Downstream of Navajo			
Florida	28,607	27,749	858
Animas	25,119	24,099	1,020
La Plata	13,245	13,049	196
Long Hollow	1,339	0	1,339
Mancos	19,532	15,516	4,016
Subtotal	**87,842**	**80,413**	**7,429**
Total CO Depletions (Excluding ALP)	**186,334**	**173,322**	**13,012**
Total CO & NM Combined Depletions	**786,502**	**610,236**	**176,266**
ALP	57,133[6]	1,620	55,513
Subtotal	**843,635**	**611,856**	**231,779**
McElmo Basin Imports	-11,769	-11,769	0
Utah Depletions	9,140[7]	9,140	0
Arizona Depletions	10,010[5]	10,010	0
NET NM, CO, UT, AZ Depletion	**851,016**	**619,237**	**231,779**
NM Off River Depletions			
Chaco River	2,832[5]	2,832	0
Whiskey Creek	523[5]	523	0
GRAND TOTAL	**854,371**	**622,592**	**231,779**

[1] Baseline depletion values are from the Generation 2 San Juan River Basin Hydrology Model operated by the SJRIP and may change with new versions of the model or new basin hydrology. They are provided here as a reference point and would naturally be adjusted to match changes approved by the SJRIP.

[2] Includes 10,600 af of annual groundwater storage. At equilibrium this drops to 270,000 af, based on irrigation of the full 110,630 acres every year. The proposed schedule of anticipated depletions prepared by the New Mexico Interstate Stream Commission to reflect the Navajo Water Rights Settlement Agreement includes an equilibrium depletion for NIIP of 256,500 AF based on an average fallow acreage of 5%. While including fallow land in the depletion calculation is reasonable, the larger number is used here to be consistent with the NIIP Section 7 consultation and the full capacity of the project.

[3] Indicates offstream depletion accounted for in calculated natural gains.

[4] 1500 af of depletion from minor depletions approved of SJRIP in 1992. 3,000 af from 1999 Intra-service consultation, a portion of which may be in Colorado

[5] Biological Opinion lists this depletion as 6,654 af, but model configuration shows 6,570. Model configuration used.

[6] Actual approved depletion is 57,100 af. Small changes in reservoir evaporation between runs results in small variation from actual project depletion. Exact match would require multiple iterations because of model limitations.

[7] 1,705 San Juan River depletion, 7,435 off stream depletion.

the total stated in the hydrologic baseline for NGWSP plus 5,271 acre-feet. If this level of depletion is reached, Reclamation will limit deliveries to Navajo projects as directed by the Navajo Nation, to levels required by implementation of the depletion guarantee. In the event that the SJRRIP terminates, Reclamation will assume the responsibilities listed above for the SJRRIP.

Navajo Nation
The Navajo Nation will limit uses as specified in the depletion guarantee if the conditions stated above are reached and provide to the SJRIP and Reclamation the projects it wishes limited.

Conditions

None of the actions and conditions listed here shall limit the ability of the Reclamation to reinitiate consultation on the NGWSP to increase its baseline depletion or alter the requirements of the depletion guarantee.

Conservation Measures

The following conservation measures are part of the proposed action.

San Juan River and Other Water Crossings

1. Silt curtains, cofferdams, dikes, straw bales or other suitable erosion control measures will be used to prevent erosion from entering water bodies during construction.
2. Water quality parameters will be monitored before, during, and after construction to ensure compliance with State Water Quality Standards. In-water work will stop if State Water Quality Standards are exceeded at or below the worksite.
3. Construction of the cofferdam will be scheduled during minimal low flows to avoid and minimize direct or indirect effects to fish species. River flows up- and downstream of construction areas will be maintained. Fish passage around dewatered construction areas will be maintained at all times.
4. A fish net barrier will be installed upstream and downstream of the construction site during construction to exclude fish from the work area during periods of in-water work.
5. Reclamation will coordinate with the Service to have a biologist(s) on site to rescue any fish species stranded as a result of construction activities.
6. Concrete pours will occur in forms and/or behind cofferdams to prevent discharge into the river. Any wastewater from concrete-batching, vehicle wash-down and aggregate processing will be contained and treated or removed for off-site disposal.

7. Fuels, lubricants, hydraulic fluids, and other petrochemicals will be stored and dispensed outside the 100-year floodplain in an approved staging area. Equipment will be inspected daily for petrochemical leaks. Construction equipment will be parked, stored and serviced only at approved staging area, outside of the 100-year floodplain.
8. An oil spill response plan will be prepared for areas of work where spilled contaminants could flow into water bodies. The plan will be developed prior to initiation of construction. Oil spill response kit, which includes appropriate sized spill blankets, shall be on-site at all times.
9. On-site supervisors and equipment operators will be knowledgeable in the use of spill containment equipment.
10. Appropriate Federal and State authorities will be notified in the event of any contaminant spill.
11. Disturbed areas within the wetted channel will be covered with clean cobble or quarry stone from an upland source. Disturbed areas adjacent to the wetted channel will be stabilized and planted with native riparian vegetation.

The following conservation measures will be implemented for the cactus:

1. Cactus surveys will be conducted prior to construction to identify individual plants and avoid where possible.
2. Where possible, refine the pipeline alignment to avoid individual cacti and populations as a whole.
3. Select an alternative site for the pumping plant currently planned for the intersection of Highways 491 and 36.
4. Mark cacti with protective cones when construction activity occurs in their vicinity.
5. Prior to disturbing areas where cacti are found, dig up susceptible plants and place them in a safe area, replant these cacti without delay once construction in the area is complete.
6. Consult with a qualified local botanist during marking and/or transplant of cacti.

Additionally, the following conservation measures will be implemented within areas of upland vegetation:

1. The footprints of pipeline and accessory components will be minimized.
2. Noxious weeds will be continually controlled within disturbed areas.

The Service requires, as part of the Terms and Conditions that documentation and reporting on the implementation of the conservation measures will occur within six months after completion of the project. Annually, thereafter for a period of five years, documentation and reporting will occur on the status of transplanted and relocated cacti and on control of noxious weeds within the disturbed sites.

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 1 m (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). 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.

Based on early fish collection records, archaeological finds, and other observations, the pikeminnow was once found throughout warm water 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 (Service 1967, 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 areas of the San Juan River Basin (59 FR 13374): New Mexico, San Juan County; and Utah, San Juan County. The San Juan River from the 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 that is delivered to specific habitats in accordance with a hydrologic regime that is required for the particular life stage for 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 the range of 16°C (60.8°F) to 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 5 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.

Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 500 mm (20 in) in length (Vanicek and Kramer 1969, Seethaler 1978, Hamman 1981). Hatchery-reared males became sexually mature at 4 years of age and females at 5 years. Average fecundity of 24, 9-year old females was 77,400 (range, 57,766–113,341) or 55,533 eggs/kg, and average fecundity of 9 ten-year old females was 66,185 (range, 11,977–91,040) or 45,451 eggs/kg (Hamman 1986).

Most information on pikeminnow reproduction has been 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. 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 site 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 2003a). 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 1 year, young are rarely found in such habitats, although 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 (between Bluff and Mexican Hat) 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 RM142). In contrast to pikeminnow in the Green and Yampa rivers, the majority of pikeminnow in the San Juan River 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 pikeminnow in the San Juan River 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). Habitat characteristics at the lower spawning area, based on radio telemetry and visual observations, include 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 from approximately July 12 to 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 duration of the spawning period appear to vary from year to year. Information on radio-tagged adult pikeminnow during the 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 for adults because they are dewatered or access is restricted (Holden 2000). Pikeminnow utilized the Animas River in the late 1800s. This river could 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 terrestrial 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 exotic, 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 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 the 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, toxic chemicals, and habitat degradation. The ability of a population 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 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 larval 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 SJRRIP 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 River 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 shiners (*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 River 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). The 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 1983, Pimental et al. 1985). Although mechanical removal (electrofishing, seining) of channel catfish began in 1995, intensive efforts (10 trips/year) did not begin until 2001. Mechanical removal has not yet 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 ESA; therefore, a formal listing package identifying threats was not prepared. Construction and operation of mainstem 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 River 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 River 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. Some native fish populations in the upper Basin have managed to persist, while others are nearly extirpated. River reaches where native fish have declined more slowly, more closely resemble pre-dam hydrologic regimes, where adequate habitat for all life phases still exists, and where migration corridors 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 concerns in recent years (Abell 1994). Changes in water quality and contamination of associated biota are known to occur in 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 Catastomidae, 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 may live 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 a commercially marketable quantity was 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 a point where it impairs the essential life history 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 54957). 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" (59 FR 13374). Recruitment of larval razorback suckers to juveniles and adults 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 San Juan River Basin (59 FR 13374): New Mexico, San Juan County; and Utah, San Juan County. The San Juan River from the Hogback Diversion in T. 29 N., R. 16 W., section 9 to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26.

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

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 River 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 likely 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). McAda and Wydoski (1980) reported an average fecundity (N=10) of 46,740 eggs/fish (27,614–76,576). 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 River 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, flooded 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 from stocked fish 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*) (Jonez and Sumner 1954, Marsh and Langshorst 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 four 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 River Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic (lake-like) and riverine environments. 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: 351-696) and the population was characterized as stable or declining slowly with some evidence of recruitment (Modde et al. 1996). They attributed this suspected recruitment to unusually high spring flows during 1983–1986 that inundated portions of the floodplain used as nurseries by young. 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) reported 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 SJRRIP (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 River Basin, recovery efforts include the capture and removal of razorback suckers from all known locations for genetic analyses and development of brood stocks. In the short-term, augmentation (stocking) may be the only means to prevent the extirpation of razorback sucker in the upper Colorado River Basin. However, in the long-term it is expected that natural reproduction and recruitment will occur. A genetics management plan and augmentation plan have been written for the razorback sucker (Crist and Ryden 2003).

Mesa Verde Cactus

The cactus was listed as a threatened species on October 30, 1979 (44 FR 62472). No critical habitat was designated. When listed, existing or potential threats included coal, oil, and gas exploration and production; commercial and residential development; road, powerline, and pipeline construction; commercial and private collecting; off-road vehicle (ORV) impacts; livestock trampling; and natural threats of disease and predation.

The Mesa Verde cactus is a small globose, usually single-stemmed, plant 3.2 - 6.6 centimeters (1.5 - 3 inches) in diameter. The spines are 6 - 13 mm (0.25 - 0.50 in) long in clusters of 8 - 11. The flowers are about 2 cm (0.75 inch) in diameter, cream to yellow-colored, and bloom in late April or early May. Mesa Verde cactus grows in clay soils derived from shales of the Mancos and Fruitland formations. These formations erode easily forming low rolling hills. The soils have high alkalinity, are gypsiferous, and have shrink-swell properties that make them harsh sites for plant growth. The sparse vegetation is dominated by two species of saltbush (*Atriplex corrugata* and *A. nuttallii*) on the uplands and several species of forbs and grasses (*Chrysothamnus greenei*, *Sphaeralcea coccinea*, *Abronia elliptica*, *Sporobolus cryptandrus*, and *Hilaria jamesii*) in the drainages.

The distribution of Mesa Verde cactus encompasses a roughly rectangular area extending north to south from about 15 miles north of the Colorado-New Mexico border to the vicinity of Sheep Springs, New Mexico, and east to west from the vicinity of Waterflow, New Mexico, to about 15 miles west of Shiprock, New Mexico. Plants can occur sporadically anywhere that soils are suitable, but there appear to be five areas of plant concentration. These areas are near the base of the Mesa Verde Escarpment in Montezuma County, Colorado, near the Colorado-New Mexico state line, in the vicinity of Shiprock, in the vicinity of Sheep Springs, and north of Waterflow. The New Mexico plants all occur in San Juan County.

The Mesa Verde Cactus Recovery Plan estimates 5,000 to 10,000 plants occur within the species' range, but this number is probably low (Spellenberg 1978, Service 1984). The number of individuals of cacti per unit area varies tremendously. As many as 20 individual plants have been seen within 50 square meters or as few as a single specimen with no other Mesa Verde cacti within several hundred meters. This cactus does not have an even distribution throughout its range but tends to form major populations within certain favorable habitats (Spellenberg 1978, Knight 1981, Service 1984).

Most Mesa Verde cactus populations occur on tribal lands. Perhaps 70 percent of occurrences are on the Navajo Reservation and another 20 percent on the Ute Mountain Indian Reservation. The other 10 percent of the populations occur east of the Hogback on private lands and on public lands administered by the BLM.

A 2-hectare monitoring plot was established on BLM land in 1986 and data were recorded annually through 1995 by personnel from the New Mexico Forestry Division (1995). During the 10-year study period, 240 new plants were found and 230 were lost. The reason for most mortality could not be determined, but a small number could be attributed to ORVs, cow tracks, rodent predation, cactus poaching, and investigator damage. The study showed that reproduction is episodic with the greatest population increases coming after the wet year of 1990, which followed two years of extreme drought. This monitoring found that the population is generally stable.

Environmental Baseline

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

The Service describes the environmental baseline in terms of the biological requirements for habitat features and processes necessary to support life stages of the subject species within the action area. When the environmental baseline departs from those biological requirements, the adverse effects of a proposed action on the species or proposed critical habitat are more likely to jeopardize the listed species or result in destruction or adverse modification of proposed critical habitat.

Status of the Species within the Action Area

Colorado Pikeminnow

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 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, physical changes associated with the dam, and barriers to movement, wild pikeminnow have been eliminated from the upper San Juan River upstream of Navajo Dam. Below Navajo Dam, summer water temperatures are colder and winter water temperatures are warmer than the pre-dam condition. The first10 km (6.2 mi) below the dam are essentially sediment free, resulting in the clearest water of any reach (Miller and Ptacek 2000). The cool, clear water has allowed development of an intensively managed blue-ribbon trout fishery to the exclusion of most native species (Miller and Ptacek 2000).

Mark and recapture estimates place 19 wild adult pikeminnow in the San Juan River from river-mile (RM) 136.6 to RM 119.2 (95 percent C.I. 10-42; Ryden 2000a). Radio tagged adults appear to have relatively small home ranges and primarily use habitats from RM 109 to RM 142. The exception to this trend was one fish that consistently used habitats immediately downstream of Bluff, UT (RM 80; Ryden 2000a). Spawning has been documented in a region of high channel complexity characterized by shifting gravel bars from RM 133.4 to RM 129.8 (Ryden 2000a). Additional suitable spawning habitat has been identified at RM 178.7 and 168.4 (Bliesner 2003). Drift data from 1995 suggested a spawning site considerably downstream of RM 129 (Platania, et al. 2000) but its location was not identified. Prior to spawning, adults stage at the mouth of the Mancos River. Spawning dates (back calculated from larval drift) range from July 8 to August 12 (Platania et al. 2000). Larval and juvenile pikeminnow have been collected from low velocity shoreline and pocketwater habitats downstream of RM 130 (Ryden 2000a).

Between 1987 and 1996, no wild pikeminnow adults were caught above Shiprock (approximately RM 150). Radio telemetry 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). The removal of the diversion at Cudei (RM 142), construction of non-selective fish passage at the Hogback Diversion (158.6) and the completion of the PNM (RM 166.1) selective fish passage ladder in 2003 has restored fish access to about 36 miles of critical habitat on the San Juan River for pikeminnow. In 2004, 5 pikeminnow (226-250 total length [8.9-9.8 in]) were caught in the lower few miles of the Animas River (Ryden and McAda 2005). These fish were all age-2 that had been stocked in June 2004 about 0.3 RMs downstream of the Animas River confluence (Ryden and McAda 2005). During the seven-year research period (1991 to 1997) it was estimated that there were fewer than 50 adults in the San Juan River in any given year (Ryden 2000a).

Experimental stocking of pikeminnow in the San Juan River began in 1996. Between 1996 and 2000, approximately 832,000 larval pikeminnow were stocked in the San Juan River. About 727,000 were stocked between RM 141 and 158. The balance was stocked at RM 52 (Ryden, 2003). Initial retention was encouraging and over winter survival was high (spring captures = 62.5-62.7 percent of fall captures) and survival between age-one and age-two based on recapture rates neared 100 percent (Archer et al. 2000). As a result of this initial success an augmentation plan began in 2002 and calls for stocking and monitoring 300,000 age-0 pikeminnow at RM 180.2 and RM 158.6 for seven years (Ryden and McAda 2003). In addition to augmentation, ongoing recovery efforts include mimicry of a natural hydrograph, adult and larval fish monitoring, habitat and water quality monitoring and control of non-native species and removal of migration barriers.

In 2003, the fish passage at the PNM weir was finished and put into operation. During the summer of 2003, 9 pikeminnow used the fish passage (Lapahie 2004). One of the goals of the SJRRIP is the expansion of range of Colorado Pikeminnow and removal of barriers to migration (SJRRIP 1995). The removal of the Cudei diversion dam and construction of fish passage at the Hogback diversion dam in 2001 and the documented use of the PNM weir has provided opportunity for and documented use of this upper portion of the river by pikeminnow; an important step toward recovery.

Razorback Sucker

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 (six were recaptured once) 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 a spawning site. Of the 12 razorback suckers handled in 1987, 8 were ripe males and 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 (Ryden, Service, pers. comm., 2005). A Schnabel multiple-census population model estimated that there were 1200 razorback suckers in the San Juan River from RM 158.6 to 2.9 in October 2004 (Ryden, Service, pers. comm., 2006). This population estimate refers to stocked razorback sucker.

Mesa Verde Cactus

Numerous activities in Mesa Verde cactus habitat have required section 7 consultations, but only four have resulted in formal consultations. A formal consultation was conducted with the Federal Water and Power Resources Service in March 1980. The action was the Gallup-Navajo Indian Water Supply Project, which proposed to deliver domestic water in a buried pipeline from the San Juan River to several communities in northwestern New Mexico. The project had the potential to impact about 200 cacti. A non-jeopardy opinion with conservation recommendations was given. A formal consultation was conducted with Bureau of Indian Affairs (BIA) in May 1985 (Cons. #2-22-83-F-039). The action included improvements to Navajo Route 36 from Shiprock to Fruitland. It was estimated the project would impact 40 plants. A non-jeopardy opinion was given with recommendations that the plants are transplanted to a safe locality and that transplanting success after one year be reported to the Service. A formal consultation was conducted with BLM in February 1997 (Cons. #2-22-96-F-010). The proposed action was continued implementation of the BLM, Farmington District, Resource Management Plan (RMP). A non-jeopardy opinion was given with the conclusion that management provisions and protective measures in the RMP are sufficient to prevent adverse effects to the cactus. No conservation recommendations were given. The final formal consultation was conducted with the BIA in 2000 on the proposed Shiprock Northern Navajo Fairgrounds located on the Navajo Nation, San Juan County, New Mexico (Cons. #2-22-99-F-467). A non-jeopardy opinion with conservation recommendations was given.

During field surveys along the western pipeline route adjacent to US Highway 491, fewer than 100 individual Mesa Verde cacti were documented. The population is located south-southeast of the junction of US Highway 666 and Navajo Route 36 and is within the boundary of both proposed pipeline alignments. Three additional areas of potential habitat were documented: 1) south of the junction of Hwy 666 and 36 for approximately 15 miles to the vicinity of Little Water, New Mexico; 2) north of Navajo Route 36 and west of the Hogback; and 3) immediately east of the Hogback, from the Amarillo Canal to Highway 666. During the spring and early summer of 2002 additional surveys were conducted in these areas (Ecosystems Research Institute 2002). Approximately 150 acres were surveyed. No Mesa Verde cactus were observed, however the area has experienced a prolonged drought. During drought conditions cacti recede into the ground and become very difficult to distinguish. Mesa Verde cactus were also historically known from about 1 mile south of Sheep Springs adjacent to Highway 666 and in the vicinity of Shiprock and Waterflow, New Mexico (Spellenberg 1978, Knight 1981).

Factors Affecting Species Environment within the Action Area

Colorado Pikeminnow and Razorback Sucker

The San Juan River is a tributary to the Colorado River and drains a basin of approximately 25,000 mi^2 (65,000 km^2) located in Colorado, New Mexico, Utah, and Arizona (Reclamation 2003). From its origins in the San Juan Mountains of southwestern Colorado (at an elevation exceeding 13,943 ft) (4,250 m), the river flows westward through New Mexico, Colorado, and into Lake Powell, Utah. The majority of water that feeds the 345 mi (570 km) of river is from the mountains of Colorado. From a water resources perspective, the area of influence for the proposed project begins at the inflow areas of Navajo Reservoir, and extends west from Navajo Dam approximately 224 mi (359 km) along the San Juan River to Lake Powell. The dam is operated and maintained by Reclamation (Reclamation 2003). The major perennial tributaries in the project area are the Los Pinos, Piedra, Navajo, Animas, La Plata, and Mancos Rivers, and McElmo Creek. There are also numerous ephemeral arroyos and washes that contribute little flow to the San Juan River, but large sediment loads.

As recognized in the Draft Environmental Impact Statement for Navajo Reservoir Operations (Reclamation 2002) (DEIS), changes in biodiversity associated with the historical San Juan River occurred when Navajo Dam was placed into operation. The reservoir physically altered the San Juan River and surrounding terrain and modified the pattern of flows downstream. Similar to rivers downstream of other dam operations in the southwestern United States, the San Juan River downstream of the dam became clearer due to sediment retained in the reservoir, and the water became colder, because it is released from a deep pool of water. The DEIS states that all species of plants and animals that existed along the river channel were affected to varying degrees. The disruption of natural patterns of flow caused changes to the vegetation along the river banks by altering the previously established conditions under which the plants reproduced and survived.

Navajo Dam regulates river flows, provides flood control and contributes to recreational and fishery activities (Reclamation 2002). In addition to the changes caused to the river by dam operations, the DEIS (Reclamation 2002) recognized that there were changes to how the lands in the area were used. Irrigation water provided by Navajo Dam contributed to agriculture being practiced on a large scale. The reservoir stores water for the NIIP (Consultations #2-22-91-F-241, #2-22-92-F-080, and #2-22-99-F-381), the Hammond Irrigation Project, and various municipal and industrial uses making it possible to nearly double the amount of irrigation in the basin. At present, the NIIP diverts an annual average of approximately 160,000 af from the reservoir for irrigation south of Farmington (Reclamation 2002). In the future, this use is expected to approximately double (Reclamation 2002). This will further affect the river and the native species dependent on the river both directly, through flow diversions, and indirectly, through changes in water quality, as a result of the water acquiring salts, pesticides, and fertilizers from the irrigated lands' return flows to the river (Reclamation 2002).

In addition to the effects of operating Navajo Dam, over the last century, the San Juan River has experienced diversions for municipal use, resulting in a variety of return flows to the river, including industrial waste, stormwater runoff, and discharges from sewage treatment plants. Compounding these changes has been the appearance of non-native species of fish and plants, creating competition with native species (Reclamation 2002).

Although there are impacts to the river ecosystem from dam construction itself, dams have many impacts that continue after the structure is complete. Dams affect the physical, chemical, and biological components of a stream ecosystem (Williams and Wolman 1984, Collier et al. 2000, Service 1998, Mueller and Marsh 2002). Some of these effects include a change in water temperature, 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 (e.g., Sherrard and Erskine 1991, Power et al. 1996, Kondolf 1997, Polzin and Rood 2000, Collier et al. 2000, Shields et al. 2000). Of these, change in water temperature, blockage of fish passage, transformation of riverine habitat into lake habitat, changes in the timing and magnitude of high and low flows, and changes in channel morphology are discussed in greater detail.

Water Temperature

The cold water below Navajo Dam limits the potential spawning habitat of the endangered fishes in the San Juan River. Prior to dam construction water temperatures at Archuleta (approximately 10 km [6.1 mi] below the dam) were above the threshold spawning temperature of 20° C (68° F) for approximately 2 months (Holden 1999). Since dam construction, water temperature is rarely over 15° C (59° F) and is too cold for successful pikeminnow spawning (Holden 1999, Miller, SJRRIP 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). Consequently, spawning is unlikely to occur from Navajo Dam to the confluence of the Animas River (approximately 72 km [45 mi] below the dam) and would be delayed for two weeks or more from the confluence with the Animas River down to Shiprock.

Water temperatures at Shiprock before the construction of Navajo Dam were above 20° C (68° F) from approximately mid-June until mid-September (three months) (Holden 1999). Projected temperatures at Shiprock from 1993-1996, during a portion of the 7-year research period, were above 20° C (68° F) for more than one month (August) (Holden 1999). Because fish are cold-blooded, their metabolism and growth depend on water temperature. The amount of food eaten, assimilation efficiency, and time to sexual maturity are affected by temperature (Lagler et al. 1977). Cold water typically decreases food consumption, decreases assimilation efficiency, decreases growth rate, and increases the time to sexual maturity (Lagler et al. 1977). Development time of pikeminnow and razorback sucker embryos is inversely related to temperature and survival is reduced at temperatures that depart from 20° C (68° F) (Bulkley et al. 1981, Hamman 1982). Marsh (1985) found that for razorback suckers, time to peak hatch was 216 hours (9 days) at 15° C (59° F) and 84 hours (3.5 days) at 25° C (77° F) and that the percent of eggs hatched was highest at 20° C (68° F). All the pikeminnow eggs tested died at incubation temperatures of 15° C (59° F) or lower (Marsh 1985). Marsh (1985) concluded that his results indicated that survival and hatching success were maximized near 20° C (68° F). Reducing the number of days water temperature is near 20°C (68°F) is expected to have a negative impact on the hatching success and growth of razorback sucker and pikeminnow.

Because the combination of a suitable spawning bar (an area of sediment-free cobbles) and suitable temperatures occur downstream on the San Juan (at the Mixer [RM 133.4 to RM 129.8]), there is a greater chance that larval fish will drift into Lake Powell and be lost from the population. Dudley and Platania (2000) found, based on a neutral buoyancy bead study, that drifting larval pikeminnow would be transported from the Mixer to Lake Powell in as little as 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. 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). The same pattern may also occur on the San Juan River.

In conclusion, cold water released from Navajo Dam has the following effects on razorback sucker and pikeminnow; water temperatures that were once suitable for spawning for pikeminnow near Archuleta are no longer suitable; and, if spawning were to occur near Shiprock, it would be delayed by approximately 2 weeks compared to pre-dam. A delay in spawning reduces the amount of time that larval fish have to grow before winter.

Blockage of Fish Passage

Like other major dams on the Colorado River and its tributaries, Navajo Dam blocked all fish passage. While native fish once could move unimpeded from the San Juan River into the Colorado River and its tributaries, they are now confined to a relatively short reach of 362 km (225 mi) between Lake Powell and Navajo Dam. If adverse conditions occur (extreme low flow, extreme high flow, unfavorable temperatures or water quality) the fish can not escape or seek refuge in the Colorado River as they once could. 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). In addition to the major dams, diversion structures constructed in the San Juan River have also created barriers to fish passage.

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 (PNM weir), 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 and Ptacek 2000). 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 non-selective fish passage. Channel catfish that were tagged downstream of the Hogback Diversion in spring and summer 2002 were recaptured upstream of the structure in summer and fall 2002. It is likely that pikeminnow, razorback sucker, and other native fishes can negotiate the ladder. The 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. Thanks to funding and technical assistance from the SJRRIP and operation and maintenance by the Navajo Nation, the PNM selective fish ladder was completed and has been operational since 2003. This has allowed passage past that structure by pikeminnow and razorback suckers. Between June and December 2003, 17,394 native fish used the passage including 9 pikeminnow and 4 razorback suckers (LaPahie 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, at the Fruitland Irrigation Canal Diversion (RM 178.5), model results reported in Evaluation of the Need for Fish Passage (Stamp and Golden, 2005) suggest that the rock dam structure does not significantly hinder fish passage, expect perhaps at very high discharges (8,000 cfs and greater).

Dams have fragmented razorback sucker and pikeminnow habitat throughout the Colorado River system. Within the San Juan River, fish passage was once impeded by five in-stream structures. One of these structures has been removed, two have been equipped with fish passage structures, and two remain as impediments to fish passage for part of the year depending on flow. However, no remaining structures are complete barriers within critical habitat. Pikeminnow and razorback sucker can potentially navigate from Lake Powell, past the Animas River, up to the Hammond Diversion Dam, a total of approximately 338 km (210 mi).

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, while others use nursery areas only a few miles below the spawning areas (Trammell 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 1996). 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 River that effectively killed the majority of the 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 that are predators on native fish. As mentioned earlier, larval native fish that drift into Lake Powell are almost certainly lost to predation by largemouth bass, smallmouth bass, striped bass, walleye, or crappie (*Pomoxis* sp.). Striped bass migrates up the San Juan River as far upstream as the PNM weir (RM 166) in some years (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 both YOY and juvenile native fish.

In conclusion, the transformation of riverine habitat into lake habitat had the following impacts on razorback sucker and pikeminnow:

1) Approximately 128 km (80 mi) of river was inundated and no longer provide suitable habitat for both fish with the exception of adult razorback sucker, which can use portions of Lake Powell (Platania et al. 1991).

2) Nursery habitat for both species was inundated when Lake Powell was created (and filled).

3) The emphasis of fisheries management shifted to game fish production. Consequently riverine habitat that supported native fish, including razorback sucker and pikeminnow, was treated with rotenone (after Navajo Dam was constructed) so that game fish production in the reservoirs could be promoted (Olson 1962, Holden 1991, Quartarone and Young 1995).

4) Non-native game fish were stocked in Lake Powell and Navajo Reservoir. Non-native fish are believed to limit the success of pikeminnow and razorback sucker recruitment and are considered biological threats to the species (McAda and Wydoski 1980, Minckley 1983, Osmundson 1987, Tyus 1987, Ruppert et al. 1993, Bestgen 1997, Bestgen et al. 1997, Service 1998, McAda and Ryel 1999, Muth et al. 2000).

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). Historically, 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 (mean monthly values) at the U.S. Geological Survey (USGS) Station gauge near Shiprock, New Mexico. The flows for this period of time do not necessarily represent a "natural" condition because water development began in the basin near the turn of the century and many irrigation projects that diverted and depleted water from the San Juan River were already in place. 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 1962, 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 more than 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 was flatter during this time period).

During the 1991 to 1997 research period, flows were manipulated by Reclamation in coordination with the SJRRIP to determine fish population and habitat responses when Navajo Dam was operated to mimic a natural hydrograph (Holden 1999). Thanks to Reclamation's flexibility in managing flows and the technical input from the SJRRIP this period of experimental flow manipulations allowed researchers an opportunity to develop flow recommendations. A more natural hydrograph was maintained during this period (1991 to 1997) of experimental flows. The research flow period was more similar to the years that followed (1998 to present) than they were prior to 1991. For this reason, the years from 1991 to present were used to analyze the effects of the Flow Recommendations on physical habitat and endangered fish populations.

Since the Flow Recommendations were published (Holden 1999), Navajo Dam has been operated to meet them. A natural hydrograph has been mimicked, although the pre-Navajo Dam peak magnitudes are no longer possible because of outlet restrictions at the dam. Although higher peak flows could be beneficial in maintenance of desirable channel morphology, it is also possible that because the river is truncated by Lake Powell, higher peak spring flows would carry more larval fish into Lake Powell. The more natural hydrograph created by the Flow Recommendations is an improvement over the pre-1991 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. Although the magnitude of flows that once existed on the San Juan cannot be duplicated because of the existence of Navajo Dam, the timing of natural peak flows can be closely approximated. The implementation of the Flow Recommendations is an important improvement over the dam operations that were in effect from 1962-1991.

Changes in Channel Morphology

The quantity and timing of flows influence how the channel and various habitats are formed and maintained. 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). Channel narrowing is a problem because as the channel width decreases, water velocity increases, and the amount of low velocity habitats, important to the early life stages of the fish, decreases (Service 1998). Between the 1930s and 1950s the channel narrowed by an average of 29 percent between the present day site of Navajo Dam (RM 224) and River Mile 67 (Holden 1999). From 1930 to 1942, suspended sediment load was approximately 47,200,000 tons/year (Holden 1999). Between 1943 and 1973, suspended load dropped by half to 20,100,000 tons/year (Holden 1999). The 1930s aerial photography shows a sand-loaded system, and where the channel was not confined, the river was broad during high flows and braided during low flows (Holden 1999). Channel narrowing before

1962 was most likely due primarily to the reduction in sediment load. Channel narrowing in later years (after 1962) corresponds to the modification of flows by Navajo Dam and the introduction and encroachment of Russian olive (Holden 1999). Indications are that the trend towards a narrower channel flattened or stopped by 1988 (Bliesner 2004).

Reduced peak flows after Navajo Dam was completed (1962 to 1991) exacerbated the growth of exotic riparian vegetation (primarily salt cedar and Russian olive). 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 (prior to 1991). During this period of time, the amount of backwater habitat has decreased in 4 of 6 reaches (Bliesner 2004). However, the base year used to track backwater habitat (1962-1991) 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 (i.e., pools, eddies), slackwater, and shoal areas have not changed significantly since 1992 (Bliesner 2004). Because backwaters are an important habitat for young native fishes (e.g., 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 drought and lack of high flows may also be contributing to the short-term loss of backwater habitat that is currently being observed.

Channel complexity is another important component of razorback sucker and pikeminnow habitat. One measure of channel complexity is the number and area of islands present. Between 1950 and 1960 there was a large decrease in island area (Bliesner 2004). Vegetation encroached on the channel and long secondary channels were cut off as the floodplain stabilized. The increase in vegetation during this period coincided with a long-term drought, which contributed to channel simplification (Bliesner 2004). Between 1960 and 1988, island area increased to the historic levels that were present in 1934 (Bliesner 2004). The 10 years prior to 1988 were the wettest on record, so although vegetation continued to increase in the floodplain, the large flows opened secondary channels, creating large islands. During this period, Russian olive invaded the system and spread rapidly (Bliesner 2004). Since 1992, the trend in island area and island number have shown slight (but statistically insignificant) increases in all reaches except for one (Bliesner 2004). At this point, the data indicate that there has been no loss of bank full channel complexity since 1992. The period of monitoring has been short; confirmation of these trends is tentative until there is another hydrologic wet period (Bliesner 2004).

Large flows (bank full and above) are most effective at moving sediment through the system and long duration of high flows appears to maintain backwater and low velocity habitats and assist in maintaining channel complexity. Flows above 8,000 cfs are effective in maintaining backwater habitat, while flows in the range of 5,000 cfs are not (Bliesner 2004). While manipulation of the hydrograph through dam releases can maximize the utilization of available water for habitat maintenance, some periodic swings in the availability of particular habitats are likely to occur in response to natural hydrologic cycles. At current population levels, habitat does not appear to be a limiting factor for either the razorback sucker or pikeminnow adults (Holden 2000). However, the habitat needs of larval fish have not been thoroughly explored and further research may find specific habitat needs that are not being met or that are limiting (Holden 2000).

In conclusion, the trend towards a narrower channel appears to have stopped and although the amount of backwater habitat has decreased, other important low velocity habitats and channel complexity have not changed significantly (Bliesner 2004). Channel morphology has been monitored for a relatively short time and the recent drought and lack of high flows may have an over-riding influence on channel-forming processes. Monitoring over a longer period with the inclusion of wet years and high flows will give a better picture of how the Flow Recommendations are maintaining favorable channel characteristics for the pikeminnow and razorback sucker. However, it appears that suitable channel morphology is being maintained and improved.

Water Quality

In addition to the physical changes from dams and water diversions, and biological changes from introduction of non-native fish, chemical changes have occurred as a result of widespread irrigation and drainwater disposal in the Colorado River Basin (Finger et al. 1995, Thomas et al. 1997, Engberg et al. 1998). Quartarone and Young (1995) 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 River 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 Reclamation projects in the San Juan drainage (specifically associated with 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, Simpson and Lusk 1999).

Information on existing water quality in the San Juan River has been derived from data gathered by the U.S. 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 Reclamation's water quality data for the Animas-La Plata Project; and ongoing contaminant monitoring and research conducted as part of the SJRRIP. 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 1989). 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 (a potential spawning site for pikeminnow). PAH levels in the bile of common carp and channel catfish sampled were high in one fish and moderate in several other fish 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. 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 (less than 0.5 micrograms per gram on a dry weight basis (μg/g), is toxic at higher levels (> 3 μg/g), and may be adversely affecting endangered fish in the upper Colorado River Basin (Hamilton 1999). Excess dietary selenium causes elevated concentrations of selenium to be deposited into developing eggs, particularly the yolk (Buhl and Hamilton 2000). If concentrations in the egg are sufficiently high, developing proteins and enzymes become dysfunctional and lead to deformed embryos that may be at higher risk for mortality.

Selenium concentrations in the San Juan River Basin are of concern because of its 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 which are derived from or which 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 River. 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 River, 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 maximum recorded values 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). However, dietary selenium is the primary source for selenium in fish (Lemly 1993, Buhl and Hamilton 1995). Thus, sediment and biotic analyses are necessary to understand the risk of selenium to fish and wildlife.

The SJRRIP arranged for toxicity tests to be conducted to determine the effects of environmental contaminants in water (Hamilton and Buhl 1995), and in diet and tissues 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 tests showed that dietary selenium (as opposed to water borne selenium) was the primary source of selenium accumulation in pikeminnow, accumulated selenium left the tissues slowly after exposure ended, and the selenium concentrations in eggs were significantly greater than concentrations in the parent (Buhl and Hamilton 2000). However, the concentrations in the eggs (9.8-11.6 μg/gram) were lower than those in eggs linked with reproductive impairment in fish (Buhl and Hamilton 2000). Unfortunately, due to small sample size, the reproductive metrics (number of eggs expressed, egg weight, hatchability, time to hatch, and survival, growth, and deformities of the larvae) could not be statistically evaluated in this study (Buhl and Hamilton 2000).

Quartarone and Young (1995) 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. However, 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, as recovery of the pikeminnow and razorback sucker proceeds, research should continue on this issue. These fish can live over 40 years (Behnke and Benson 1983), increasing their susceptibility to bioaccumulation of selenium. In addition, they often stage at tributary mouths such as the Mancos River before spawning, increasing their exposure to elevated levels of dietary selenium (Wilson et al. 1995). Therefore, the impact of selenium on reproductive success may become more important in coming years as adults survive and age in the river.

From 1998 to 2005 the SJRRIP annually monitored water quality constituents. Trends of the constituents with time were examined by linear correlation. There were no statistically significant trends for this data set. During the drought years in the latter part of the record there was a slight elevation in TDS and the associated constituents due to reduced flows and increased percentage of return flow during the late summer. However, the water quality remains good even during these drought times.

Selenium concentrations remain low in the mainstem, with most readings below detection. Looking at the trend with time from 1994 to 2003, there appear to be fewer detectable readings, and those readings tend to be smaller. There is an increasing trend of detectable readings down river as more tributary flow enters the system, but this has not increased with time. With the exception of the measurement of 9 ppb total recoverable selenium at Mexican Hat, the maximum concentration measured in the San Juan River during the 1994 to 2003 period is 2 ppb, with most of the detectable readings at 1 ppb, the detection limit. The water quality standard exceedences do not appear to be a result of implementation of the flow recommendations and there is no trend with time.

As a result of the lack of statistically significant trend data, the SJRRIP discontinued annually monitoring of water quality constituents in 2005 and has recommended conducting toxicity tests every five years to determine the effects of environmental contaminants in water, and in diet and tissues of the razorback sucker and pikeminnow in the San Juan River.

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. 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 (Jackson 2001). 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 RM 188 and RM 148 (Ryden 2005). In 2004, 280,000 age-0 pikeminnow were stocked in numerous low-velocity habitats from RM 188 to RM 148 (Ryden 2005a). In 2005, 302,270 age-0 pikeminnow were stocked in numerous low-velocity habitats from RM 188 to RM 148 (Ryden, Service, in litt. 2006).

Forty-nine pikeminnow adults were stocked at the Highway 371 bridge (RM 180.2) in 1997; however, these fish did not remain in the reach 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 2005). In 2002, there were 39 total recapture events with pikeminnow during all field studies; 36 of these 39 recapture events were with fish stocked as adults in April 2001 (Ryden 2003b). In 2003, 1,005 age-1 pikeminnow were stocked at RM 180.2 (Ryden 2005). In 2003, 32 juvenile pikeminnow were collected during adult monitoring; these fish had been stocked as juveniles in October 2002 (Ryden 2005). In 2004, 1,219 age-2 pikeminnow were stocked at RM 180.2 (Ryden 2005). In 2004, 159 juvenile pikeminnow were collected during adult monitoring; the majority of these fish had been stocked as age-0 juveniles in either fall 2002 or fall 2003, although some of the fish that were originally stocked as older age-classes were recaptured as well (Ryden 2005). In 2005, 500 age-1 and 4,041 age-2 pikeminnow were stocked at RM 180.2 (Ryden, Service, in litt. 2006). In 2006, a total of 127 juvenile pikeminnow were collected during adult monitoring (Ryden, Service, in litt. 2006). As in previous years, the majority of these fish had been stocked as age-0 juveniles in either fall 2003 or fall 2004, although some of the fish that were originally stocked as older age-classes were recaptured as well. Very few fish that had been stocked as age-0 juveniles in the fall of 2002 were recaptured during the 2005 adult monitoring trip. Survival of the fall 2002 stocking of age-0 fish does not appear to have been very good through age-3 (i.e., 2005) (Ryden, Service, in litt. 2006). Between 1996 and 2005, over 1,800,000 pikeminnow of varying age-classes have been stocked into the San Juan River (Ryden, Service, in litt. 2006).

Because of human impacts to the Colorado and San Juan Rivers, pikeminnow was thought to be extirpated from the San Juan River (Tyus et al. 1982). Surveys conducted from 1987-1989 revealed that pikeminnow was still present in the San Juan River, but in very low numbers (Platania et al. 1991). When the SJRRIP was established in 1992, one of the program elements was the protection of genetic integrity, management, and augmentation of populations of the endangered fish. Pikeminnow have been stocked every year since 1996 (Ryden 2003a) and in 2005 a total of 306,811 fish were stocked, meeting the augmentation plan target for the first time. Pikeminnow from a wide range of size-classes were captured in the San Juan in 2004 and 2005, indicating that there has been survival from numerous years' stockings (Ryden 2005, Ryden, Service, in litt. 2006). In addition, the catch per unit effort for pikeminnow in 2004 was the highest recorded since river-wide sampling began in 1996 (Ryden 2005). The SJRRIPs augmentation program has been successful in increasing the number of pikeminnow in the San Juan River in a relatively short time, increasing the number of fish much faster than if augmentation had not taken place.

Razorback Sucker.—Although evidence suggests that razorback suckers were once abundant in the San Juan River at least up to the confluence with the Animas River (Platania and Young 1989), wild razorback suckers, if they still exist, are extremely rare in the river. Even with intensive sampling only one adult was captured in the river from 1987- 1989, and 292 collections of larval fish during that same time recovered no razorback sucker (Platania et al. 1991). Because of the limited number of razorback sucker and the lack of recruitment, a stocking program was begun to supplement the population. Between 1994 and 2005, a total of 12,843 hatchery and pond raised razorback suckers were stocked into the San Juan River (Ryden, Service, in litt. 2006).

Fish that were stocked in 1994 and 1995 are still being collected during annual sampling (Ryden 2001, Ryden, Service, in litt. 2006). Larval razorback suckers have been collected each year since 1998, indicating that the stocked fish are successfully spawning in the San Juan River (Brandenburg et al. 2003, Brandenburg and Farrington 2005, Brandenburg et al., in litt. 2006). Despite the small number of stocked fish, many stocked razorback sucker recruited to adulthood and successful spawning by these fish has been recorded every year since 1998 (Ryden 2003b, Brandenburg and Farrington 2005). In addition, the catch per unit effort for razorback sucker in 2004 was higher than in any previous year (Ryden 2005). The augmentation program has been successful in increasing the number of razorback sucker in the San Juan River in a relatively short time, increasing the number of fish much faster than if augmentation had not taken place.

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 (RM 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. 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 SJRRIP 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. 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, 62 razorback suckers were collected, all were stocked fish (Ryden 2003b).

Five razorback sucker spawning aggregations have been identified at various river locations. These aggregations occurred at RM 100.2 in 1997, 1999, and 2001 (Ryden 2004), at RM 17.6 in 2002 (Jackson 2003, Ryden 2004) and at RM 154.27 in 2004 (Ryden 2005). Collection of larval razorback sucker for eight consecutive years (1998 – 2005) indicates that even though groups of spawning adults were not observed every year, spawning did occur.

Water Depletions

Significant depletions and redistribution of flows of the San Juan River have occurred as a result of other major water development projects, including the NIIP and the San Juan-Chama Project. At the current level of development, average annual flows at Bluff, Utah, already have been depleted by 30 percent (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 likely contributed to the decline in pikeminnow and razorback sucker populations (Service 1998). Depletions are expected to increase as full development of water rights and water projects occurs. To the extent that water is exported out of the basin (San Juan-Chama Project) or consumptively used (e.g., evaporation from fields, irrigation canals, reservoir surface) it is not available to maintain flows within the river. Maintenance of streamflow is essential to the ecological integrity of large western rivers (Service 1998).

Water depletion projects that were in existence prior to November 1, 1992, are considered to be historic depletions because they occurred before the initiation of the SJRRIP. Projects that began after this date are considered new projects. On May 21, 1999 the Service issued a BO (R2/ES-TE CL 04-054) determining that new depletions of 100 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 would still require consultation.

Consultations contributing to the baseline conditions used reoperation of Navajo Reservoir in accordance with the Flow Recommendations as part of their section 7 compliance. Some of these projects have been completed (e.g., PNM Water Contract with Jicarilla Apache Nation), some are partially complete (e.g., NIIP), and some have not been fully implemented (e.g., Animas-La Plata Project). As these projects are fully implemented, the amount of water available for operational flexibility will decrease.

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 impediments (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^3 of water sampled.

In December 2004, 140 pikeminnow in 3 size classes were caught in the Hogback Diversion (Platania and Renfro 2005). Most of the individuals (92 percent) were between 33-65 mm standard length (SL) (1.3-2.5 in) that had been stocked in October 2004. Seven were between 130-187 mm SL (5.1-7.4 in) and 4 were 210-264 mm SL (8.3-10.4 in) (Platania and Renfro 2005). Pikeminnow were caught from 0.5 to 17.8 canal miles from the diversion structure (Platania and Renfro 2005). In 2005, recently-stocked pikeminnow were captured in the Hogback and Fruitland Diversion canals.

Pikeminnow that enter diversion structures face an uncertain fate, although fish may find their way back to the river. Because the number of fish entrained at diversion structures is unknown the SJRRIP is analyzing entrainment at all of the diversion structures. Diversions that entrain fish will be addressed by the SJRRIP. Razorback suckers are not currently found high enough in the system to enter the diversion structures.

Non-Native Fish

Nearly 70 non-native fish species have been introduced into the Colorado River system over the last 100 years (Service 1998). 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, long-ear sunfish (*Lepomis megalotis*), bluegill, white crappie, fathead minnow, red shiner, Western mosquitofish, common carp, white sucker, white sucker x flannelmouth sucker hybrids, white sucker x bluehead sucker hybrids, threadfin shad, grass carp, and plains killifish (Ryden 2000 Buntjer 2003). Channel catfish was first introduced in the upper Colorado River 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 and black bullhead have died from choking on the pectoral spines (McAda 1983, Pimental et al. 1985, Quartarone and Young 1995, SJRRIP 2003b, Laphie 2003). Mechanical removal of non-native fish (seining and electrofishing) from the San Juan River 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 large-bodied non-native fishes and are known predators on native fish and eggs (Davis 2003).

For more than 50 years, researchers have been concerned that non-native fishes have contributed to the decline of native fishes in the Colorado River Basin (Service 1989). Non-native species are potential predators, competitors and vectors for parasites and disease (Tyus et al. 1982, Lentsch et al. 1996, Pacey and Marsh 1999, Marsh et al. 2001). Because non-native fish are considered to be an important biological threat to pikeminnow and razorback sucker, control of non-native fishes through removal has become part of the SJRRIP. Recent adult monitoring reports show evidence that the nonnative fish removal efforts are having a marked and measurable effect on the channel catfish and common carp populations in the San Juan River (Ryden 2005, Ryden, Service, in litt. 2006). There is also an upward trend in both abundance and longitudinal distribution among both flannelmouth sucker and bluehead sucker that corresponds with the intensive nonnative fish removal efforts which began in 2001 (RM 166.6 – 147.9) and (RM 52.9 – 2.9).

From 1998-2005, 32,367 channel catfish and 16,335 common carp were removed from the river (Davis 2005). Catch rates did not decrease for either species. For channel catfish, both adult and juvenile size classes saw general, although not significant, declines in 2005 (Davis 2005). The advantages of reducing the mean length of channel catfish 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 2005). 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 2005).

The primary method used to capture large-bodied 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 to 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 could be adverse effects to pikeminnow and razorback sucker from repeated shocking and handling.

Mesa Verde Cactus

Numerous commercial activities are occurring within Mesa Verde cactus habitat. Oil, gas, and coal resources are all being developed in the area. Associated development includes roads, pipelines, powerlines, and expanding commercial and residential development. Road realignments and upgrades to serve rural communities in the vicinity of Shiprock have impacted

Mesa Verde cactus. The installation of new water pipelines to serve rural customers has also impacted some plants and habitat. The growth of Shiprock, New Mexico, oil and gas development, and off-road vehicle (ORV) use threaten populations of the Mesa Verde cactus (NMRPTC 1999).

The sparsely vegetated rolling hills occupied by Mesa Verde cactus are attractive to ORV enthusiasts. The potential for ORV impacts is greatest near towns. Mesa Verde cactus populations that occur in the suburban fringes of Farmington and Shiprock have been impacted by ORVs in the past, and this threat continues.

Mesa Verde cactus is a rare species attractive to some cactus enthusiasts. Because of its specialized soil requirements, it is difficult to grow in cultivation and, therefore, not readily available from legitimate commercial sources as are many other endangered cacti. Illegal collecting was observed during the 1995 monitoring study and several instances of suspected illegal collecting have been reported (New Mexico Forestry Division 1995). The overall impact of illegal collecting is probably minor, but it can be significant in populations that are known to collectors and visited repeatedly.

Livestock impacts to Mesa Verde cactus are from the result of trampling. There is little available forage in Mesa Verde cactus habitat so livestock numbers are usually low. There have been some reports of livestock trampling in monitoring plots, but this is considered a minor threat.

Impacts to Mesa Verde cactus populations from predation or disease can be significant. A species of moth lays its eggs on Mesa Verde cactus plants and the larvae burrow into the interior. Plants then rot and die (Service 1984). Between 2001 and 2002, Mesa Verde cactus populations exhibited population declines in response to predation from the longhorn cactus beetle (*Moneilema semipunctatum*), a native predator of cacti (New Mexico State Forestry Division 2003). Mesa Verde cactus population plots on BLM lands near Waterflow, New Mexico had mortality rates of 68.5 and 97.1 percent (New Mexico State Forestry Division 2003). Similar declines were noted in 2003 on the Navajo Nation in New Mexico and the Ute Mountain Ute Reservation in Colorado (Daniela Roth, Navajo Natural Heritage Program, pers. comm.). Increased beetle predation may have been a natural response to high cactus density in the population plots, and might not have been correlated with drought conditions (New Mexico State Forestry Division 2003). These predators may explain the scattered distribution of Mesa Verde cactus because dense populations of plants would be more susceptible to attack than scattered individuals. These threats as well as past and present projects contribute to the environmental baseline of the cactus.

Effects of the Action

'Effects of the action' means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). If the proposed action includes offsite measures to reduce net adverse impacts by improving habitat conditions and survival, the Service will evaluate the net combined effects of the proposed action and the offsite measures as interrelated actions.

'Interrelated actions' are those that are part of a larger action and depend on the larger action for their justification; 'interdependent actions' are those that have no independent utility apart from the action under consideration (50 CFR 402.02). Future Federal actions that are not a direct effect of the action under consideration, and not included in the environmental baseline or treated as indirect effects, are not considered in this BO.

Effects to Endangered Species

Colorado Pikeminnow and Razorback Sucker

Entrainment of Larval Fish

Colorado Pikeminnow.—The project will adversely affect future recruitment of pikeminnow spawning above the proposed intake (RM 167). While no spawning sites have been documented above the proposed diversion, the quality of gravel bars suggests spawning potential between the diversion and RM 180 (Bliesner 2003). Spawning has been documented between RM 129.8 and RM 133.4 (Ryden 2000a), while drift data suggest spawning likely occurred at a location somewhat downstream of RM 128 (Platania et al. 2000). Given the known range of spawning, the availability of spawning habitat above the diversion and a relatively uniform distribution of available spawning habitat between RM 128 and RM 180, about 25 percent of pikeminnow spawning activity could occur above the proposed intake at some point in the future (13 of 52 miles above the diversion). If spawning habitat below RM 128 exists as the drift data suggests, then something less than 25 percent of the spawn would be above the diversion.

Based on spawning dates in the San Juan River, larvae typically enter the drift from mid-July to mid-August (Platania et al. 2000) and are passive in the drift for 3 to 6 days after emergence (Dudley and Platania 2000). Therefore, larval pikeminnow spawned above the diversion would be subject to entrainment in the fish screen for about 35 to 40 days. Flows during peak pikeminnow larvae drift average about 1,500 cfs at the Farmington gage (1993-2003; USGS 2003). The proposed intake will divert about 4 percent (59 cfs) of the total river flow during this time frame. Larval pikeminnow will not be excluded by a 3/32 inch screen (Platania et al. 2000). Thus, we estimate that about 4 percent of larvae spawned above the intake will be subject to entrainment. Since only 25 percent or less of the spawn is expected above the diversion, the net loss is expected to be approximately 1 percent of all pikeminnow larvae produced in the San Juan River.

There are no additional measures that could be used to minimize take from this diversion. While no spawning sites have been documented above the proposed diversion, the net loss of pikeminnow larvae is expected to be approximately 1 percent of all pikeminnow larvae produced in the San Juan River once a viable pikeminnow population is reestablished. Because the SJJRIP will continue to augment the establishment of a viable pikeminnow population, the take of 1 percent of all pikeminnow larvae produced in the San Juan River is expected to be diminished during reestablishment. After a viable pikeminnow population is reestablished, the take of 1 percent of all pikeminnow larvae produced in the San Juan River is expected to be diminimiss and the level of anticipated take is not likely to result in jeopardy to pikeminnow.

Razorback Sucker.—The razorback sucker will be adversely affected by the NGWSP due to the possibility of entrainment of larval fish during spawning. Spawning typically occurs on the ascending limb of the hydrograph during May (Brandenburg et al. 2004). With an assumed potential spawning range between RM 100 to RM 180 and a uniform distribution of spawning adults in the future, about 16 percent of the larval drift would occur above the diversion. During May the flow averages about 4,100 cfs of which 59 cfs or 1.4 percent enters the NGWSP diversion. Therefore, not more than 0.2 percent of the non-retained drifting larvae would be subject to entrainment in the diversion.

There are no additional measures that could be used to minimize take from this diversion. While no spawning sites have been documented above the proposed diversion, the net loss of razorback sucker larvae is expected to be approximately 0.2 percent of all razorback sucker larvae produced in the San Juan River once a viable razorback sucker population is reestablished. Because the SJJRIP will continue to augment the establishment of a viable razorback sucker population, the take of 0.2 percent of all razorback sucker larvae produced in the San Juan River is expected to be diminimiss during reestablishment. After a viable razorback sucker population is reestablished, the take of 0.2 percent of all razorback sucker larvae produced in the San Juan River is expected to be diminimiss and the level of anticipated take is not likely to result in jeopardy to razorback sucker.

Water Quality

Water quality changes will be undetectable because project withdrawals will only reduce minimum flow by less than 0.5 percent on average with the greatest impact being less than 3 percent (Reclamation 2002). Return flow from all sources accounts for about 10 percent of the flow of the river during base flow periods. Most constituents are concentrated about 4 fold in return flow through evaporative losses so the increase in water quality constituent concentrations below the diversion due to withdrawal will be about 0.9 percent, with a similar reduction in concentrations above that location due to increased flow. Return flow at Shiprock will be through the Shiprock treatment plant, meeting the requirements of the NPDES permit, with an average annual flow of 5.0 cfs (1 percent of the minimum flow). During runoff months, flows are slightly increased, so water contaminant concentrations in the water will decrease. The net increase in any water quality parameter will be less than 2 percent. The Biological Assessment for the NIIP (Keller-Bliesner Engineering, 1999) concluded that the water quality risk to the endangered species was low for all parameters. Because the increase in water quality constituents will be undetectable, the effect to pikeminnow and razorback sucker will be insignificant and discountable.

Depletions
The project would reduce the amount of water in the river system by 5,271 af /year. The effects to pikeminnow and razorback sucker would result from the effects of the action upon their habitats. In general, the SJRRIP determined that mimicry of a natural hydrograph would create, maintain, and maximize key habitats, and that it could be accomplished through reoperating Navajo Dam. The Flow Recommendations (Holden 1999) were developed by the SJRRIP to address this directly and the Flow Report (Holden 1999) is the primary source of information concerning the research and management actions taken to meet accomplish this.

The SJRRIP determined that to maximize key habitats for native fishes, flows in the San Juan River needed to more closely match a natural hydrograph in magnitude, duration, and timing than they had since Navajo Dam's completion. High spring flows were a natural San Juan River characteristic and a characteristic that is needed to create and maintain key habitats for the endangered and native species. The life histories of the endangered species are closely tied to the magnitude, duration, and timing of the natural hydrograph. Habitat for spawning and rearing young, although very different for the two endangered species is expected to improve and be maximized with a relatively natural annual hydrograph. To meet this need, the Flow Recommendations provided increased spring peak magnitude and duration, while maintaining timing more similar to pre-dam conditions than to post-dam flows. Base flows were also altered to resemble the magnitude and timing of pre-dam conditions.

To the extent that the proposed diversion would reduce flows and contribute to further habitat alteration, the depletion was modeled using the San Juan River Basin Riverware model to determine its effect on the Flow Recommendations developed by the SJRRIP Biology Committee for the recovery of the listed fish species. The modeled results show that the depletion will prevent the flow recommendations from being met less than 0.01 percent of the time for 2,500 cfs criteria of recommended discharges. Which means the 2,500 cfs criteria will be missed by about 12 percent for three days in one year out of the 65 year analysis period. All other flow recommendations are fully met, including base flow requirements and runoff flow statistics. While base flows are slightly reduced from baseline conditions (less than 3 percent in any month and less than 0.5 percent average), minimum flow requirements and runoff flow statistics of the flow recommendations are met. Baseline flows upstream of the PNM weir will be increased with return flows from the project (Table 5).

Because the Integration Report found that the flows at 5,000 cfs and 2,500 cfs are not causing the expected response (Miller 2005), minor effects to these flows are not expected to have a measurable adverse effect for the endangered fish or their designated critical habitat and will not preclude recovery of the species.

Table 5.—Summary Flow Statistics for the NGWSP plus Baseline with NIIP Equilibrium Depletion Limited to 249,218 Acre-Feet

	Discharge (cfs)			
Duration	>10,000	>8,000	>5,000	>2,500
	Average Frequency			
1 days	33.8%	55.4%	73.8%	95.4%
5 days	27.7%	46.2%	70.8%	86.2%
10 days	15.4%	38.5%	66.2%	78.5%
15 days	7.7%	30.8%	60.0%	73.8%
20 days		24.6%		69.2%
21 days			55.4%	
30 days		13.8%	41.5%	66.2%
40 days			32.3%	55.4%
50 days			26.2%	47.7%
60 days			18.5%	41.5%
80 days			10.8%	27.7%

Maximum Years Without Meeting Criteria

Flow Criteria - Max Duration	Allowed	Modeled
9700 cfs for 5-days – 10-years	10	10
7760 cfs for 10-days – 6-years	6	6
4850 cfs for 21-days – 4-years	4	4
2450 cfs for 10-days – 2 years	2	3

Effects to Pikeminnow and Razorback Sucker Critical Habitat

Water Quantity

The proposed action will result in an increase in depletions in the San Juan River of not more than 5,271 af /year over the environmental baseline but does not impact the ability for the San Juan River Flow Recommendations to be met.

The SJRRIP determined that mimicry of a natural hydrograph would create, maintain, and maximize key habitats, and that it could be accomplished through reoperating Navajo Dam. The

Flow Recommendations (Holden 1999) were developed by the SJRRIP to address this directly and the Flow Report (Holden 1999) is the primary source of information concerning the research and management actions taken to meet accomplish this.

The SJRRIP determined that to maximize key habitats for native fishes, flows in the San Juan River needed to more-closely match a natural hydrograph in magnitude, duration, and timing than they had since Navajo Dam's completion. High spring flows were a natural San Juan River characteristic and a characteristic that is needed to create and maintain key habitats for the endangered and native species. The life histories of the endangered species are closely tied to the magnitude, duration, and timing of the natural hydrograph. Habitat for spawning and rearing young, although very different for the two endangered species is expected to improve and be maximized with a relatively natural annual hydrograph. To meet this need, the Flow Recommendations provided increased spring peak magnitude and duration, while maintaining timing more similar to pre-dam conditions than to post-dam flows. Base flows were also altered to resemble the magnitude and timing of pre-dam conditions.

Because the proposed diversion does not impact the ability for the San Juan River Flow Recommendations to be met with the 5,271 af /year depletion, it is expected that key habitats for the endangered fish will continue to be created, maintained and maximized and the proposed diversion will not have a adverse effect on pikeminnow or razorback sucker critical habitat.

Water Quality

Water quality changes will be undetectable because project withdrawals will only reduce base flow by less than 0.5 percent on average with the greatest impact being less than 3 percent. Return flow from all sources accounts for about 10 percent of the flow of the river during base flow periods. Most constituents are concentrated about 4 fold in return flow through evaporative losses so the increase in water quality constituent concentrations below the diversion due to withdrawal will be about 0.9 percent, with a similar reduction in concentrations above that location due to increased flow. Return flow at Shiprock will be through the Shiprock treatment plant, meeting the requirements of the NPDES permit, with an average annual flow of 5.0 cfs (1 percent of the minimum flow). During runoff months, flows are slightly increased, so water contaminant concentrations in the water will decrease. The net increase in any water quality parameter will be less than 2 percent. The Biological Assessment for the NIIP (Keller-Bliesner Engineering, 1999) concluded that the water quality risk to the endangered species was low for all parameters. Because the increase in water quality constituents will be undetectable, the effect to pikeminnow and razorback sucker will be insignificant and discountable.

Physical Habitat

The modification of flow regimes, water temperatures, sediment levels, and other habitat conditions caused by water depletions has contributed to alteration of many habitat elements important to pikeminnow and razorback sucker. Water depletions during spring runoff affect physical habitat in several ways. High spring flows are important for creating and maintaining complex channel geomorphology and suitable spawning substrates, and in creating and providing larvae, YOY and juvenile access to off-channel habitats. The Flow Recommendations were developed because native fish species evolved under certain flow patterns. A basic premise of the SJRRIP was that reoperation of Navajo Dam to mimic a natural hydrograph would improve both habitat quantity and quality by re-establishing a spring peak and low late-summer, autumn, and winter base flows. It was the consensus of biologists working with the endangered fishes in the Colorado River Basin that natural flow patterns and magnitudes were needed by these fishes (Holden 1979, Minckley et al. 1991, Tyus 1991). The life histories of most native species are integrally tied to the timing, duration, and magnitude of the natural hydrograph. Razorback sucker spawn during high spring flows, and their larvae are adapted to utilize habitats that are most available during that time of year. Pikeminnow spawn later in the summer as flows recede, and their larvae utilize habitats that are most available during the low flow periods of late summer and autumn. Because the depletion does not affect the implementation of the Flow Recommendations, the depletion is not expected to impact the recovery of the pikeminnow or razorback sucker in the San Juan River. The depletions caused by the proposed project will not adversely modify critical habitat for pikeminnow and razorback sucker.

Biological Environment

The Flow Recommendations were developed because native fish species evolved under certain flow patterns. A basic premise of the SJRRIP was that reoperation of Navajo Dam to mimic a natural hydrograph would improve both habitat quantity and quality by re-establishing a spring peak and low late-summer, autumn, and winter base flows (Holden 1979, Minckley et al. 1991, Tyus 1991). The life histories of most native species are integrally tied to the timing, duration, and magnitude of the natural hydrograph. Razorback sucker spawn during high spring flows, and their larvae are adapted to utilize habitats that are most available during that time of year. Pikeminnow spawn later in the summer as flows recede, and their larvae utilize habitats that are most available during the low flow periods of late summer and autumn. Because the depletion does not affect the implementation of the Flow Recommendations, the depletion is not expected to impact the recovery of the pikeminnow or razorback sucker in the San Juan River. The modification of flow regimes, water temperatures, sediment levels, and other habitat conditions caused by water depletions has also contributed to the establishment of nonnative fishes.

Future projects and depletions that occur in the San Juan River Basin will reduce the amount of water available to the river; however, the Flow Recommendations were developed to provide suitable flows for the endangered fish. The hydrologic model on which the Flow Recommendations is based is currently being updated and revised and will include hydrologic data through 2000. It will not be until 2006, at the earliest, that the drought years of 2002 and 2003 will be incorporated into the model because of the lag time it takes to calculate and update depletions that occur in the Basin. However, even when the drought years are incorporated into the model, it is not anticipated that the Flow Recommendations would change. Flow Recommendations would only change if the SJRRIP Biology and Hydrology Committees recommended a change.

Because of current depletions and structural limitations of Navajo Dam, there are limitations on the amount of water that can be delivered to the San Juan River. 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). Because of the short period of time that the Flow Recommendations have been in place, it is unknown if a peak flow of 10,000 cfs will be sufficient to maintain the channel and habitat complexity over the long-term. However, monitoring of key habitat characteristics is ongoing. The Service expects that adjustments to the San Juan River Flow Recommendations will be made if long-term monitoring indicates that changes are warranted.

Summary

The proposed action will result in an increase in depletions in the San Juan River of not more than 5,271 af /year over the environmental baseline but does not impact the ability for the San Juan River Flow Recommendations to be met. By following the Flow Recommendations, the operation of Navajo Dam will mimic the natural hydrograph and result in flow patterns similar to those that occurred prior to 1962. Because the flows now mimic the natural hydrograph, the Service anticipates that the response of designated critical habitat will be that key habitats for the endangered fish continue to be created, maintained and maximized. The anticipated response of pikeminnow and razorback sucker to the Flow Recommendations would be increased population size.

Mesa Verde Cactus

Cactus surveys were conducted in 2000 and 2002, prior to and coinciding with the population decline in 2001 and 2002. Fewer than 100 cacti were found south-southeast of the junction of US Highway 491 and Navajo Route 36. This population is within the proposed route for the San Juan Lateral pipeline and an associated booster pumping station. The pumping station would remove about one acre of cactus habitat. Two additional areas of cactus habitat may also be affected by the pipeline and associated structures: 1) south of the junction of Hwy 491 (formerly Hwy 666) and 36 for approximately 15 miles to the vicinity of Little Water, New Mexico; and 2) north of Navajo Route 36 and west of the Hogback Diversion.

Although the pipeline would be buried, the proposed action could potentially destroy up to 100 Mesa Verde cactus plants. Construction activities will include fencing, utilities installation, heavy equipment grading, and vegetation clearing. This will destroy Mesa Verde cactus habitat and any plants in the direct path of these activities. Parts of the project footprint not graded and cleared could be impacted by foot traffic, vehicle use, and parking with the resulting destruction of additional habitat and plants. Project construction would be staged over a 14-year period and result in temporary impacts to upland vegetation, the majority of which has been previously disturbed. The proposed conservation measures may limit some of these impacts to the cactus. However, there are conflicting reports whether transplanting this cactus minimizes impacts. For example, Spellenberg (1978) notes that Mesa Verde cacti does not transplant well, but Brack (1986) found that 34 of 35 cacti survived short-term following a transplant attempt. As noted, these cacti are difficult to locate, especially during drought conditions. Not all cacti will be found during surveys and some will be destroyed by construction-related activities. For these reasons, we anticipate that adverse effects resulting in mortality of individual cacti will occur.

Indirect Effects

Indirect effects are those that are caused by, or result from, the proposed action, and are later in time, but are reasonably certain to occur.

Colorado Pikeminnow and Razorback Sucker

Occasional maintenance activities for the diversion structure and fish screen are indirect effects resulting from the implementation of the proposed action. It is our expectation that injury or mortality of individuals could occur through the implementation of maintenance activities.

Mesa Verde Cactus

Occasional vehicle use for maintenance activities will affect cacti by alteration of habitat, erosion, alteration of drainage, and crushing of individuals through vehicle road use. Over the 34-year period of this consultation it is not possible to quantify the number of plants affected.

Additional indirect impacts to the cactus may occur from soil deposition related to construction activities, which could reduce reproduction and/or recruitment. Moreover, individual plant mortality could be caused from root exposure due to soil loss. Still, removal and trampling of vegetation around individual cacti are expected to be short-term in duration and vegetation is expected to recover following construction activities.

The pipeline and associated structures would not facilitate OHV travel because the majority of the pipeline route parallels existing roads. Moreover, the pipeline corridor would be reseeded with native vegetation and in most cases, fenced to exclude livestock grazing and promote re-establishment of native vegetation. Fencing would also deter OHV travel and access from potential plant collectors. Because best management practices will be used during construction activities, we do not anticipate an increase in fugitive dust, sedimentation/erosion, or increased risk of fire or fuel spill.

Interrelated and Interdependent Effects

Colorado Pikeminnow and Razorback Sucker

As proposed, the NGWSP could not operate without the presence of Navajo Dam, therefore it is also interrelated with this proposed action. Because the effects of Navajo Dam and NIIP projects were already considered in previous consultations, they are part of the environmental baseline of this consultation.

Mesa Verde Cactus

The use of access roads and vehicles in the action area is considered interrelated and interdependent with the construction of current proposed project. Although the majority of vehicles will likely stay on roads, effects of the project from interdependent and interrelated actions will likely result in cacti being crushed by vehicles or personnel while constructing the proposed pipeline.

The Federal Register notice of intent to prepare an environmental impact statement and announcement of public scoping meetings identified that a long-term high quality municipal and industrial water supply is needed to improve the standard of living for current and future populations and to support economic growth of the Navajo Nation, the City of Gallup, New Mexico, and the City of Window Rock, Arizona (59 FR 16219). NEPA had not yet been completed for the project. However, the BA further explains that the proposed project will deliver treated municipal water to selected Navajo communities and a portion of the Jicarilla Apache Nation. Although the proposed project would provide water for future residential or commercial development activities within the action area, the majority of the water supply would service the southeastern area of the Navajo Nation, which is not considered cactus habitat. Reclamation indicated that additional development and changes in land use to meet expected future population demands will likely occur on Tribal lands as directed by the Tribes. The proposed project connects to existing systems and additional residential development is expected to be limited to those areas. It is unknown whether any of these developments would occur within occupied cactus habitat. If information becomes available through the NEPA analysis that indicates future development would occur within cactus habitat and adversely affect the species, this consultation must be reinitiated.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions on endangered or threatened species or critical habitat that are reasonably certain to occur in the foreseeable future in the action area considered in this BO. 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 analysis as stated here applies to section 7 of the Act and should not be confused with the broader use of this term in the NEPA or other environmental laws.

Colorado Pikeminnow and Razorback Sucker

(1) 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 was allowed in this area; however, the Colorado Oil and Gas Commission approved an increase of the well spacing to one well per 160 acres. Potentially more than 700 additional wells may be drilled and approximately 250 of these could occur on private or State land. Coalbed methane development requires the extraction of groundwater to induce gas flow. It was estimated that the wells would be drilled in about 10 years (by 2013) but, because of slow groundwater movement, water depletion effects would not be incurred until at least 2025.

A study was initiated in 1998 to determine the effects of groundwater extraction from the Fruitland Formation. The study is called the 3M Project (mapping, modeling, and monitoring) and is being conducted by the Colorado Oil and Gas Conservation Commission (COGCC) in cooperation with the Southern Ute Indian Tribe, the BLM, the Forest Service and the industry. The mapping and modeling studies were completed in 2000. Mapping results are presented in the Colorado Geological Survey's Open File Report 00-18. Modeling results are available at the COGCC's website and through the BLM's San Juan Public Lands Center. A follow-up project was funded by the Ground Water Protection Research Foundation (GWPRF), and the report is available through the BLM.

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 predevelopment conditions, discharge to the Animas, Pine, Florida and Piedra rivers. These rivers provide flow to the San Juan River. Coalbed methane wells occur on Federal, State, Tribal and private lands. The BLM prepared an Environmental Impact Statement to address coalbed methane development on the Southern Ute Indian Reservation. The BLM also prepared a separate EIS 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 BLM. 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 GWPRF 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 6.

Table 6.—Surface Water Depletions: 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[1]	60	0	60	[2]
Total	204.5	74	199.5	

[1] Piedra River depletions are estimated based on discharges simulated from the 3M Project and the depletions modeled in the GWPRF at other rivers.

[2] Maximum depletions at the Piedra River will depend on the rate of coalbed methane development in the northeastern portion of the San Juan Basin.

The model results show that prior to coalbed methane development, the Fruitland Formation discharged approximately 205 ac-ft /year to the San Juan River. Modeling shows approximately 74 ac-ft /year is currently being depleted with existing wells and predicts the maximum depletions to be approximately 200 ac-ft /year.

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 biological opinion that addressed the impacts of future Federal projects that individually involve small water depletions up to a total of 3,000 ac-ft /year. It was determined in that biological opinion 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. The coalbed methane development on State and private lands was not addressed in the small depletion biological opinion. This development does not involve future Federal actions but does involve small individual depletions similar to the projects addressed by the small depletion biological opinion. Therefore, the Service concludes that an additional future depletion of approximately 200 ac-ft /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 San Juan River 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.

(2) Future 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 the environmental baseline depletions 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 will increase demands for water. 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.

(3) 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.

(4) 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.

(5) Gradual change in floodplain vegetation from native riparian species to non-native species e.g., 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 nursery habitat available for both species.

(6) The presence of striped bass and walleye in Lake Powell constitutes a future threat to pikeminnow and razorback sucker in the San Juan River

(7) Increased boating, fishing, off-highway vehicle use, and camping in the San Juan River basin 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.

Mesa Verde Cactus

The growth of Shiprock, New Mexico, has affected plants in the vicinity of the town. The open clay badlands where this plant occurs are attractive for ORV use. Oil and gas development and pipeline and powerline construction occur throughout the range of this species. This plant is very difficult to keep alive under cultivation because of its specialized soil requirements, so there are few commercial sources of plants. As a result, signs of limited collecting are periodically seen at the best known localities. Depending on the intensity of these actions, individual cacti can be killed or habitat may be fragmented. These types of activities contribute to the cumulative effects of the proposed action.

Conclusion

Pikeminnow and Razorback Sucker

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. The rationale for our opinion is provided below.

According 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," (2001) the Service must determine if progress toward recovery of the two fish species has been sufficient for the SJRRIP to serve as a Reasonable and Prudent Measure for water development projects. To make this determination we have reviewed: 1) the Program Evaluation Report (Holden 2000), 2) The Long Range Plan (1995), 3) the Draft Final Program Integration Report (Miller 2005), 4) scopes of work proposed for 2005-2007, 5) SJRRIP Biology Committee meeting notes, hydrological and biological data, and 6) have spoken with SJRRIP committee members to evaluate the effectiveness of the Flow Recommendations and other elements of the SJRRIP in conserving populations of pikeminnow and razorback sucker in the San Juan River.

Under the principles, the Service is to determine progress toward recovery based on (SJRRIP 2001):

- Actions that will result in a measurable positive population response, a measurable improvement in habitat for the fishes, legal protection of flows needed for recovery, or a reduction in the threat of immediate extinction.

- Status of fish populations.

- Adequacy of flow.

- Magnitude of the impact of the activity (including but not limited to, contaminant and fish migration impacts).

It is the intent of the SJRRIP 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 primary goals of the initial SJRRIP studies were to determine the factors that are limiting the pikeminnow, razorback sucker, and other native fishes, and to determine ways to reduce or eliminate the limiting factors. Because the numbers of pikeminnow and razorback sucker were so few at the time research began, population monitoring was an immediate need.

While initial emphasis was on identification of limiting factors, the seven-year research period also addressed recovery potential through mimicry of the natural hydrograph and study of hatchery-reared endangered fishes released into the San Juan River. The seven objectives identified in the 1995 Long Range Plan pertained to: 1) development of interim management objectives for the endangered fishes and native fish community, 2) habitat identification and restoration, 3) endangered fish species restoration and native fish community management, 4) nonnative fish species management, 5) water quality impacts, 6) public awareness, and 7) adaptive management. 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 (SJRRIP Biology Committee 2002), indicating that progress is being made.

The SJRRIP actions implemented to date have addressed all of the management actions identified in the 2002 recovery plans and the short-term (2002-2006) population response criteria developed for razorback sucker and pikeminnow in 2001 have been met. The population response criteria for pikeminnow and razorback sucker are listed below. Population responses for each criterion are summarized from emails received from Dale Ryden (Service, in. litt. 2005).

Pikeminnow

1A) *Collection of 10 or more pikeminnow (greater than 350 mm [13.8 in] total length) during a standardized monitoring trip.* On the fall 2003 standardized monitoring trip, 32 pikeminnow with total lengths ranging from 150-259 mm (5.9 to 10.2 in) were captured. On the fall 2004 standardized monitoring trip, 159 pikeminnow ranging from 130-360 mm TL were captured, two of which were > 350 mm TL (Ryden 2005). On the fall 2005 standardized monitoring trip, 127 pikeminnow ranging from 125-419 mm TL were captured, four of which were > 350 mm TL.

1B) *A population estimate of pikeminnow (greater than 350 mm [13.8 in] total length) which is significantly greater (alpha = 0.05) than the Ryden (2000a) estimate of 50 fish. This estimate (N=19; 95 percent CI 10-42) was for adult fish collected between RM 136.6 and 119.2 and is the only such metric available for this species in the San Juan River.* If criterion 1A is met in large enough numbers, it may be possible to meet this goal's target in the near future.

2A) *Presence of wild larval or YOY pikeminnow in standardized monitoring collections in 2 of 5 years.* The capture of wild larval pikeminnow has been infrequent. Larval pikeminnow were caught in 2001 and two individuals were caught in 2004 (Brandenburg and Farrington 2005). Not until stocked pikeminnow become adults and begin reproducing in fairly large numbers will wild larval fish begin to be detected more regularly. The very low survival rates observed from previous (1996-2000) stocking/augmentation of early life stage pikeminnow and the subsequent lack of recruitment of those fish into adulthood is partially responsible for this criterion not being met. However, the lack of wild adult fish and associated progeny is also a factor.

2B) Range expansion above Hogback Diversion following removal and/or modification of this and other fish barriers identified by the SJRRIP. This criterion has been met, via augmentation efforts. Cudei Diversion has been removed from the river and both Hogback Diversion and the PNM Weir have fish passage structures that are in operation. Studies are now in progress to assess the need for fish passage at both the Arizona Public Service Weir and the Fruitland Diversion. Pikeminnow are being stocked on an annual basis upstream of all of these diversions, as well as immediately downstream of Hogback.

Razorback Sucker

1A) *Collection of more than 20 razorback sucker greater than 300 mm (11.8 in) total length during the annual fall standardized monitoring.* This criterion was met in 2002 (23 fish caught), but fell 2 fish short in 2003. In 2004 and 2005, this criterion was again met, when 113 and 51 razorback sucker (> 300 mm TL) were collected, respectively.

1B) *Collection of greater than 0.15 razorback sucker greater than 300 mm (11.8 in) total length per hour of electrofishing.* This criterion was met in 2002, 2003, 2004, and 2005 with the collection of 0.25, 0.19, 1.21, and 0.59 razorback sucker (> 300 mm TL) per hour of electrofishing, respectively.

2) *Evidence of reproduction (i.e., presence of wild larvae and/or YOY) during standardized monitoring in at least 2 of 5 years.* This criterion has been met. Larval razor back suckers have been caught in every year from 2000 to 2004 (Brandenburg et al. 2003, Brandenburg and Farrington 2005).

From these data, we conclude that the razorback sucker and pikeminnow populations in the San Juan River are more secure today than they were in the 1980s and 1990s and that the threat of extinction has been reduced. Of the two species, the razorback sucker population currently appears to be benefiting more from management efforts. The number of razorback sucker larval fish caught appears to be increasing (Brandenburg et al. 2003) and in 2003, two juvenile razorback sucker (249 and 274 mm TL) were collected in the lower San Juan River (at RM 35.7 and 4.8, respectively). Their size at time of capture and lack of a PIT tag strongly implies that these are likely wild-produced progeny of stocked razorback sucker, providing the first evidence of recruitment in the San Juan River. Between 1991 and 1995, 19 (17 adult and 2 juvenile) wild pikeminnow were collected in the San Juan River by electrofishing (Ryden 2000a). In 2004 and 2005 159 and 127 sub-adult pikeminnow were caught during the fall standardized monitoring trips. While it is still too early to determine if these fish will survive to the adult stage and reproduce, the trend is encouraging. Because the effective riverine habitat in the San Juan River has been shortened by 87 km (54 mi) by inundation of Lake Powell (at full pool) and 150 km (93 mi) by cold water releases from Navajo Dam, it is unclear if truly self-sustaining populations of pikeminnow can be established without the presence of warmer water so that spawning can occur farther upstream. However, with continued management (e.g., adherence to the Flow Recommendations, removal of fish passage barriers) and stocking/augmentation, it is expected that population numbers will increase and be maintained.

The action that has probably led to the largest population response is stocking/augmentation because it has had the direct effect of increasing fish numbers. Because both species are long-lived it will take many years to determine whether the SJRRIP is successful. However, the Service will continue to annually review the progress of the SJRRIP according 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" (2001). As part of the annual review, the Service will determine if progress toward recovery of the two fish species has been sufficient for the SJRRIP to continue to serve as the Reasonable and Prudent Measure for water development projects.

Other actions that have been taken by the SJRRIP that are intended or expected to have a positive population response are:

(1) Providing and Restoring Habitat

Flow Recommendations were developed in 1999 and have been implemented. The Biological Opinion on Navajo Reservoir Operations, Colorado River Storage Project, Colorado-New Mexico-Utah was completed on January 6, 2006; the NEPA EIS Record of Decision was signed July 31, 2006.

With the Flow Recommendations in place, the annual hydrograph mimics the natural hydrograph more closely than in the pre-Flow Recommendations period. The Flow Recommendations provide a peak spring flow improving spawning conditions and the summer base flows are lower, more closely resembling the pre-dam conditions. We expect that a more natural hydrograph provided by the implementation of the Flow Recommendations will have a beneficial effect on native species compared to the pre-Flow Recommendation conditions. However, because population numbers of the endangered fish are so low and because so many actions are occurring simultaneously, documenting a positive population response that is a direct result of any one particular action alone may not be possible.

Temperature suppression associated with hypolimnic releases from Navajo Dam is being studied, and if found to be limiting, the SJRRIP will identify any resulting appropriate options that should be implemented and funded through the SJRRIP.

(2) Providing passage over, around or through fish migration and movement barriers within occupied habitat

The SJRRIP has restored access to approximately 36 miles of critical habitat. In 2002, the Hogback Diversion was reconstructed to provide for improved fish passage as well as improved irrigation diversion control. The SJRRIP funded that portion of the Hogback Diversion reconstruction assignable to fish passage.

In 2002, the Program funded removal of the Cudei Diversion and installation of a siphon to connect the Cudei project to the Hogback canal to improve upstream passage for endangered fish species in the river.

The SJRRIP also funded the construction in 2003 and operation of a selective fish passage facility at the San Juan Generating Station diversion weir, located just downstream of Fruitland. The SJRRIP provides annual funding to the Navajo Nation to operate the selective fish passage facility.

In 2005, the APS and Fruitland Diversion structures were technically evaluated as to their effect on access to spawning and rearing habitat upstream in 2005; the final report was issued in October 2005 and the Biology Committee is currently evaluating the need for any future remedial work at these two diversion structures. The Fruitland Diversion is located at RM 178.5 on the San Juan River, between the confluence of the Animas and the confluence of the La Plata River with the San Juan River near Farmington, New Mexico. The APS diversion - also known as the Four Corners Power Plant Diversion – is located at RM 163.3. Both of these diversions are located within the designated critical habitat for pikeminnow and razorback sucker.

(3) Minimize entrainment of sub-adults and adults at diversion structures, including canal headings and pumping stations

In 2004, the SJRRIP funded an assessment of fish entrainment in the Hogback Diversion canal, San Juan River, New Mexico. The results of this assessment lead to a 2005 project for a design study of a fish screen at the Hogback Diversion.

Concerns regarding potential entrainment of endangered fish into the diversion structures located below the confluence of the San Juan and Animas rivers are currently being evaluated.

(4) Control problematic non-native fishes

While a positive endangered fish population response cannot yet be linked to this effort, it is expected that the amount of predation and competition between native and non-native fish is reduced, promoting the survival of native fish. Nonnative mechanical removal began in 1997 and continues as a stand-alone program. Additionally, nonnative fish removal during research and monitoring activities augment this program. Intensive removal efforts began in 1999 in the upper river near Farmington, New Mexico, and in 2002 in the canyon section between Mexican Hat and Clay Hills, Utah. Other control measures such as the selective fish passage structure at PNM Weir have been implemented and will continue. Flow manipulation with Navajo Dam releases and Lake Powell elevation regulation will be evaluated as to their effect on nonnative populations. Measurable objectives and methods for assessing and maintaining effectiveness of removal efforts will be developed and implemented. Non-native fish stocking and baitfish policies of affected states will be implemented.

Other conditions we must consider in evaluating habitat conditions are: 1) The Flow Recommendations have been implemented for a short period of time; 2) the channel may still be adjusting to the new hydrologic regime and changes in watershed conditions. It appears that implementation of the Flow Recommendations has maintained nearly all important physical habitat characteristics over the last several years (Bliesner 2004). As studies continue and the Flow Recommendations are implemented over a longer period of time, the improvement, maintenance, or deterioration of habitat can be assessed more accurately. The SJRRIP has appropriate long-term monitoring in place to make this assessment.

The proposed action is significant since it affects the full length of San Juan River occupied by the two endangered fish and extends in perpetuity. It is essential that the SJRRIP continue with the same level of agency commitment and funding to be able to monitor and address the effects of this proposed action. As full implementation of projects increases in the Basin, leading to greater depletions, the SJRRIP will need to determine if, and when, conditions which currently are not detrimental to the endangered fishes become more severe with additional depletions. Continued long-term monitoring is essential. The SJRRIP has implemented new studies over time to help understand the biological and physical characteristics of the San Juan River and the Service believes that the SJRRIP has been prudent in its selection of research topics and monitoring.

Mesa Verde Cactus

After reviewing the current status of the cactus, 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 implementation of the action, as proposed, is not likely to jeopardize the continued existence of the cactus. No critical habitat has been designated for this species; therefore, none will be affected.

We find that the implementation of the proposed action is not expected to result in high levels of cactus mortality, especially with the implementation of Reclamation's conservation measures, which are part of the proposed action, to limit adverse effects. The range of Mesa Verde cactus includes remote areas that have not been thoroughly surveyed. The plant is sporadically distributed within its suitable habitat with the total number of plants probably exceeding 10,000 (Service 1984). For the most part, Federal agencies have been able to effectively conserve Mesa Verde cactus by making only minor modifications in project plans or by carefully executing project activities to avoid plants that might otherwise have been damaged or destroyed. Because Mesa Verde cactus is almost completely on either Indian lands or Federal lands managed by the BLM, a very high proportion of the activities that might affect the cactus are subject to section 7 consultation, and this process has contributed measurably to conservation of the species. The Mesa Verde cactus population on BLM-lands north of Waterflow, New Mexico, was monitored for 14 years, and recently found a dramatic decline in the number of cacti in 2001 and 2002. This was attributed to a native predatory beetle (New Mexico Forestry Division 1985, 2003). This population appears to be slowly recovering (B. Sivinski, pers. comm., 2006). Given that conservation efforts for the species have been effective, that population numbers for the species are large enough to sustain some losses without detriment to the species as a whole, and that monitoring indicates populations are stable, the Service concludes that the potential loss of up to 100 Mesa Verde cactus plants from the proposed Navajo-Gallup Water Supply Project would not be likely to jeopardize the continued existence of the species. In addition, even these losses can be greatly reduced with implementation of the conservation recommendations given below. As noted above, when the NEPA analysis is completed for this project, if the analysis indicates that project related future development would occur within cactus habitat and adversely affect the species, this consultation must be reinitiated.

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), take 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 take is in compliance with the terms and conditions of an incidental take statement. Our incidental take statement is specific to a particular life stage and that stage only. For example, the following incidental take statement is specific to larval fish. We make no assumptions about how many adult fish these larval fish may produce and do not predict the number of juvenile or adult fish lost based on the larval number taken.

The measures described below are non-discretionary, and must be undertaken by Reclamation so that they become binding conditions of any grant or permit issued to any applicants, as appropriate, for the exemption in section 7(o)(2) to apply. Reclamation has a continuing duty to regulate the activity covered by this incidental take statement. If Reclamation (1) fails to assume and implement the terms and conditions, or (2) fails to require applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, Reclamation must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. [50 CFR §402.14(i)(3)]

Amount or Extent of Take

The Service anticipates that take in the form of direct take of larvae during the spawning season and harm will occur in association with the water depletion and entrainment.

Depletion

Because the proposed 5,271 af/year depletion does not impact the ability for the San Juan River Flow Recommendations to be met, it is expected that key habitats for the endangered fish will continue to be created, maintained and maximized and the proposed diversion will not have a adverse affect on pikeminnow or razorback sucker critical habitat. Any amount of net depletion above 5,271 af/year may result in incidental take and would require reinitiation of consultation.

Entrainment

Colorado Pikeminnow

Based on the best available information concerning the habitat needs of this species, the project description, and information furnished by Reclamation, the Service anticipates that pikeminnow larvae will be taken as a result of this proposed action. This incidental take is expected to be in the form of harm, harass, and kill as the result of entrainment of larvae during the spawning season.

Based on spawning dates in the San Juan River, larvae typically enter the drift from mid-July to Mid-August (Platania et al. 2000) and are passive in the drift for 3 to 6 days after emergence (Dudley and Platania 2000). Therefore, larval pikeminnow spawned above the diversion would be subject to entrainment for about 35 to 40 days. Flows during this period average about 1,500 cfs at the Farmington gage (1993-2003; USGS 2003). The proposed intake will divert about 4 percent (59 cfs) of the total river flow during peak pikeminnow drift. Pikeminnow exit the drift at 0.55 inches and will not be excluded by a 3/32 inch screen (Platania et al. 2000). We estimate that about 4 percent of larvae spawned above the intake will be subject to entrainment. Since only 25 percent or less of the spawn is expected above the diversion, the net loss is expected to be less than 1 percent of all pikeminnow larvae produced in the San Juan River.

The implementation of the SJRRIP is intended to minimize impacts of water depletions and therefore, implementation of the SJRRIP will serve as reasonable and prudent measures for minimizing the take that result from the withdrawal of 59 cfs of river flow. Any amount of water withdrawal above this level during larval drift would exceed the anticipated level of incidental take.

Razorback Sucker

Based on the best available information concerning the habitat needs of this species, the project description, and information furnished by Reclamation, the Service anticipates that razorback sucker larvae will be taken as a result of this proposed action. This incidental take is expected to be in the form of harm, harass, and kill as the result of entrainment of larvae during the spawning season.

Spawning typically occurs on the ascending limb of the hydrograph during May (Brandenburg, et al. 2004). With an assumed potential spawning range from RM 100 to RM 180 and a uniform distribution of spawning adults in the future, about 16 percent of the larval drift would occur above the diversion. During May the flow averages about 4,100 cfs of which 59 cfs or 1.4 percent enters the NGWSP diversion. Therefore, not more than 0.2 percent of drifting larvae would be subject to entrainment in the diversion in the San Juan River on any given year.

Because of the nature of the larvae life history stage and the variation in population sizes from year to year, it is difficult to estimate the number of individuals that will be taken with implementation of this project. Based upon the proposed project, it is estimated that a maximum 59 cfs of the occupied habitat (total river flow) will be taken during peak razorback sucker drift.

The implementation of the SJRRIP is intended to minimize impacts of water depletions and therefore, implementation of the SJRRIP will also serve as the reasonable and prudent measure for minimizing the take that result from the withdrawal of 59 cfs of river flow. Any amount of water withdrawal above this level during larval drift would exceed the anticipated level of incidental take.

Mesa Verde Cactus

Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plant species. However, limited protection of plants from take is provided to the extent that the ESA prohibits the removal and reduction to possession of federally endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

Effect of the Take

In the accompanying BO, the Service determined that the level of anticipated take is not likely to result in jeopardy to the razorback sucker and pikeminnow or result in the destruction or adverse modification of their critical habitat.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize impacts of incidental take of the razorback sucker and pikeminnow:

1) Reclamation will continue to support and participate in the implementation of the SJRRIP as a reasonable and prudent measure to minimize take.

Terms and Conditions

Compliance with the following terms and conditions must be achieved in order to be exempt from the prohibitions of section 9 of the ESA. The terms and conditions implement the reasonable and prudent measure described above and outlines required reporting/monitoring requirements. These terms and conditions are non-discretionary:

1. Reclamation will continue to seek funding for the implementation of the SJRRIP as a reasonable and prudent measure to minimize take.

2. Reclamation will spend funding, as appropriated, for the implementation of the SJRRIP as a reasonable and prudent measure to minimize take.

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. The recommendations provided here relate only to the proposed action and do not necessarily represent complete fulfillment of the agency's section 7(a)(1) responsibility for these species. In order for the Service to be kept informed of actions that either minimize or avoid adverse effects or that benefit listed species and their habitats, we request notification of the implementation of the conservation recommendations. We suggest the following conservation recommendations be implemented:

1. Reclamation should increase survey efforts during wet years and concentrate within the project footprint during the cactus flowering season (typically April and May) in order to increase the probability of sighting and avoiding individual cacti;

2. Any suspicious collection of cacti related activity within the action area should be reported to the Service.

3. Resurvey the area to determine the present distribution and abundance of Mesa Verde cactus plants. Provide a buffer of 100 feet and fence the entire area including the buffer to exclude livestock.

4. If possible, transplant cacti during the period March 1 - April 15 because this has been shown to be a time of year when high transplant success can be achieved (Roth 1997). Provide supplemental watering for the first growing season, if needed. Monitor the transplanted plants for three years and report the results to the Service.

Reporting Requirements

Documentation and reporting on the implementation of the conservation measures and terms and conditions will occur within six months after completion of the project and annually thereafter for a period of five years. The nearest Service Law Enforcement Office must be notified within 24 hours in writing should any listed species be found dead, injured, or sick. Notification must include the date, time, and location of the carcass, cause of injury or death (if known), and any pertinent information. Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death. In conjunction with the care of sick or injured endangered species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. If necessary, the Service will provide a protocol for the handling of dead or injured listed animals. In the event Reclamation suspects that a species has been taken in violation of Federal, State, or local law, all relevant information should be reported in writing within 24 hours to the Service's New Mexico Law Enforcement Office (505/883-7814) or the New Mexico Ecological Services Field Office (505/346-2525).

Reinitiation Notice

This concludes formal consultation on the proposed Navajo-Gallup Water Supply Project. As required by 50 FR 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. See section on Amount or Extent of Take; 2) new information reveals effects of the agency action that may impact 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 may cause an effect to the listed species or critical habitat that was not considered in this opinion; 4) a new species is listed or critical habitat designated that may be affected by the action; or 5) if the SJRRIP ceases to exist or if funding levels are reduced so that critical deadlines for specified recovery actions are not met.

The SJRRIP 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 Reclamation dated July 6, 2001, 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. Therefore, reinitiation of section 7 consultation would be required for all projects dependent on the Recovery Program, including the subject action. If reinitiation is required, 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".

In future communications regarding this project please refer to consultation number 2-22-01-F-532. If you have any questions or would like to discuss any part of this biological opinion, please contact David Campbell of my staff at (505) 761-4745.

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