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UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Arizona Public Service Company — Project No. 2069-007
Arizona

NOTICE OF AVAILABILITY OF FINAL ENVIRONMENTAL ASSESSMENT

March 26, 2004

In accordance with the National Environmental Policy Act of 1969 and the Federal Energy Regulatory Commission's (Commission) regulations, 18 CFR Part 380 (Order No. 486, 52 F.R. 47897), the Office of Energy Projects has reviewed the application for surrender of license for the major, constructed Childs Irving Hydroelectric Project. The project is located on Fossil Creek, in Yavapai and Gila counties, Arizona. The project is located entirely on lands of the National Forest System: it occupies 326.8 acres within the Coconino National Forest and 17.2 acres within the Tonto National Forest. The Commission staff has prepared a Final Environmental Assessment (FEA) on the license surrender.

The FEA contains the staff's analysis of the potential environmental impacts of the retirement of the project and the removal of most of the project facilities, and has concluded that surrendering the license, with appropriate environmental protection measures, would not constitute a major federal action that would significantly affect the quality of the human environment.

A copy of the FEA is available for review at the Commission in the Public Reference Room or may be viewed on the Commission's website at http://www.ferc.gov using the "eLibrary" link. Enter the docket number excluding the last three digits in the docket number field to access the document. For assistance, contact FERC Online Support at FERCOnlineSupport@ferc.gov or toll-free at 1-866-208-3676, or for TTY, (202) 502-8659.

You may also register online at http://www.ferc.gov/docs-filing/esubscription.asp to be notified via email of new filings and issuances related to this or other pending projects. For assistance, contact FERC Online Support.

For further information, contact Dianne Rodman at (202) 502-6077.

Magalie R. Salas
Secretary

FINAL
ENVIRONMENTAL ASSESSMENT
FOR SURRENDER OF LICENSE

Childs Irving Project

FERC Project No. 2069-007

Arizona

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower-Environment and Engineering
888 First Street, NE
Washington, DC 20426

March 2004

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SUMMARY

The Childs Irving Project is an existing, operating 7-megawatt (MW) hydroelectric facility located on Fossil Creek in central Arizona. It consists of two developments: Childs and Irving. The project is entirely on lands of the United States, managed by the Forest Service as parts of the Coconino and Tonto National Forests. The project diverts water from 14 miles of stream. Arizona Public Service Company (Public Service), the current licensee, proposes to surrender the license, remove most of the project facilities, and restore the project site, to include maintaining and/or enhancing native fish and amphibian populations.

On September 15, 2000, Public Service filed an Offer of Settlement that was signed by American Rivers, Arizona Riparian Council, Center for Biological Diversity, Northern Arizona Audubon Society, Arizona Chapter of The Nature Conservancy, and Yavapai-Apache Nation. The Offer of Settlement supports the surrender of the license. The U.S. Fish and Wildlife Service supports the Settlement Agreement (letter from David L. Harlow, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, October 20, 2000). Benefits expected to result from implementing the settlement include enhancement of aquatic resources and riparian habitat in and along Fossil Creek, and protection of travertine, recreation, and aesthetic resources.

This final environmental assessment analyzes the effects of various alternatives, including no action, for license surrender and facility removal, specifically the disposition of the Irving Development's Fossil Springs dam.

Should the Commission decide to accept the license surrender for the Childs Irving Project and allow Public Service to cease project operation, our analysis shows that the best alternative would be to require Public Service to remove the top 14 feet from the 25-foot-high Fossil Springs dam and most of the other project facilities, and restore the site. If the Commission approves the surrender-application, the development and implementation of the following mitigative measures would ensure the protection of the project area's resources: (1) controlling erosion and sedimentation; (2) allowing the sediment remaining behind the Fossil Springs dam site to wash out naturally; (3) revegetating disturbed areas; (4) controlling noxious weeds; (5) monitoring suspended sediment and halting work under wet conditions when excessive sediment delivery is possible, or when the state standard for suspended sediment is exceeded; (6) preventing hazardous substance spills; (7) protecting *Agave* plants; (8) monitoring the success of the development of riparian habitat and the presence, distribution, and abundance of special-status species downstream from Fossil Springs dam, and, if necessary, implementing adaptive management measures to ensure that special-status species are able to maintain their populations until stabilization after the dam's removal; (9) restoring the Stehr Lake site to its natural, pre-project condition after flows to the lake cease; (10) installing bat grates at the mouths of the project tunnels to allow bats to use the tunnels for roosts while rendering the tunnels inaccessible to the public; (11) conducting bird nesting

surveys for sensitive, candidate, and Forest Service Management Indicator Species in the project area, and if nests are identified, establishing deconstruction activity buffers around those locations for the duration of the species-specific breeding seasons; (12) salvaging and transferring any razorback sucker before Stehr Lake is drained; (13) taking care during the draining of Stehr Lake to prevent the transfer of nonnative fish from the lake into Fossil Creek; and (14) leaving selected project facilities in place as part of a historical record of the area. The estimated cost for project surrender with the measures that staff would recommend is $11,806,000.

We conclude that surrendering the license for the project, with measures identified by staff, would not constitute a major Federal action significantly affecting the quality of the human environment.

FINAL ENVIRONMENTAL ASSESSMENT

FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF ENERGY PROJECTS
DIVISION OF HYDROPOWER-ENVIRONMENT AND ENGINEERING

Childs Irving Project
FERC Project No. 2069-007--Arizona

I. APPLICATION

On December 18, 1992, Arizona Public Service Company (Public Service) filed an application for a new license for the existing 7-megawatt (MW) Childs Irving Project, located on Fossil Creek, a tributary of the Verde River, 7 miles west of Strawberry, in Yavapai and Gila counties, Arizona (see figure 1). The project is located entirely on lands of the National Forest System, including 326.8 acres within the Coconino National Forest and 17.2 acres within the Tonto National Forest. In August 1997, the Commission issued a Draft Environmental Assessment (DEA) on the proposal to relicense the project. The relicensing DEA considered the alternative of retiring the project, but recommended that a new license be issued.

After issuance of the relicensing DEA, Public Service entered into discussions with the U.S. Forest Service (Forest Service), U.S. Fish and Wildlife Service (FWS), the intervenors in the relicensing proceeding (American Rivers, the Center for Biological Diversity, and the Yavapai-Apache Nation), and other interested entities. Consequently Public Service and the other parties filed an Offer of Settlement (Settlement Agreement) on September 15, 2000, signed by Public Service, American Rivers, Center for Biological Diversity, the Yavapai-Apache Nation, the Arizona Chapter of the Nature Conservancy, the Northern Arizona Audubon Society, and the Arizona Riparian Council. The FWS supports the Settlement Agreement (letter from David L. Harlow, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, October 20, 2000). The filing requested that the Commission approve (1) surrender of the license, and (2) the Removal and Restoration Plan included in the Offer of Settlement. The Offer of Settlement specifies two deadlines: (1) cease power generation and restoring full flow back to Fossil Creek no later than December 31, 2004; and (2) complete site restoration to the satisfaction of the Commission and the Forest Service by no later than December 31, 2009.

Public Service filed an application to surrender the license and a Removal and Restoration Plan on April 30, 2002. This final environmental assessment (FEA) analyzes the environmental and developmental impacts of the surrender proposal. We also consider the Settlement Agreement in our analysis.

II. PURPOSE AND NEED FOR ACTION

A. PURPOSE

The purpose of the proposed action is to approve or deny Public Service's application to surrender the Childs Irving Hydroelectric Project license, remove most of the project facilities, restore the site, and return full streamflow conditions to Fossil Creek.

B. NEED FOR ACTION

The existing Childs Irving Project is located in the Arizona-New Mexico power area of the Western System Coordinating Council (WSCC) region. In its September 2002 report, WSCC reports an available summer peak capacity of 26,821 MW in 2002 and shows 16,953 MW of generation additions planned for the period 2002 through 2011 in the Arizona-New Mexico power area. The Childs Irving Hydroelectric Project capacity is a small part of the regional capacity needs. The capacity lost by removing the project would be replaced by other generating resources available in the region. The most likely resource to replace the project capacity and generation would be natural gas fueled combustion turbine generators, which make up nearly 100 percent of the new capacity additions proposed in the region.

Under the no-action alternative, the power from the project would continue to be useful in meeting a small part of both Public Service's and the region's need for power, and would continue to avoid the air pollution effects associated with an equivalent amount of fossil-fueled generation.

III. PROPOSED ACTION AND ALTERNATIVES

A. PROPOSED ACTION

1. Project Description and Operation

The project consists of two separate but interrelated components:

(A) The Irving Development consists of: (1) a 25-foot-high concrete diversion structure, about 0.2 miles downstream from Fossil Springs, that diverts up to 43 cubic feet per second (cfs) from Fossil Creek; (2) a 16,578-foot-long flume; (3) a 3,278-foot-long penstock; (4) a powerhouse containing one generating unit with a total installed capacity of 1,600 kilowatts (kW); (5) a tailrace returning water to the flume of the Childs Development; (6) a 6.31-mile-long, 69-kilovolt (kV) transmission line leading to the powerhouse of the Childs Development; and (7) appurtenant facilities. Although the current license does not require a minimum instream flow release, under existing conditions 0.2 cfs seeps continuously around

the Fossil Springs dam and flows in the 4-mile-long Irving bypassed reach.

(B) The Childs Development consists of: (1) a 5-foot-high diversion structure on Fossil Creek 350 feet upstream of the Irving powerhouse, that diverts flows from the creek when the Irving powerhouse isn't operating; (2) a 23,190-foot-long conduit discharging into a regulating reservoir, Stehr Lake; (3) the 23-acre Stehr Lake, created by a 12-foot-high dam and a 20-foot-high dam; (4) a 6,281-foot-long pressure tunnel connecting the lake with a penstock; (5) the 4,800-foot-long penstock; (6) a powerhouse containing three generating units with a total installed capacity of 5,400 kW; (7) a tailrace discharging water into the Verde River; (8) a 200-foot-long, 60-kV transmission line interconnecting with the Public Service transmission grid; and (9) appurtenant facilities. Public Service operates the project run-of-river and, although the current license does not require a minimum instream flow release, releases a flow of 2 cfs into the 10-mile-long Childs bypassed reach.

2. License Surrender and Project Removal

Public Service proposes to surrender the license application upon completion of project deconstruction in accordance with a Settlement Agreement that stipulates that Public Service would discontinue operation of the project by December 31, 2004, and complete facility removal and site restoration no later than December 31, 2009 (Arizona Public Service Company, 2002).

Figure 2 shows the existing project facilities and the proposed disposition of those facilities agreed to by the signatories to the Settlement Agreement. Public Service's proposed Removal and Restoration Plan provides for the following actions: (1) removal of existing above-ground structures and equipment at the Fossil Springs diversion area; (2) removal of the Irving Development's steel flume and supporting wooden trestle, and elimination and restoration of the flume road between the Fossil Springs dam and the Irving powerhouse; (3) sealing of the Irving flume tunnel no. 1; (4) removal of the above-grade Hot Water Canyon siphon pipe, including the concrete inlet structure; (5) removal of the above-grade portion of the Irving penstock and concrete inlet structure; (6) removal of the Irving powerhouse and related equipment, fencing, power poles, wires, and transformers; (7) removal of all buildings at the Irving powerhouse site, including seven houses, a commissary building, maintenance shop, and sheds; (8) disconnection and burial of the Irving plant potable water system[1] and septic system; (9) removal of the concrete forebay wing walls and 5-foot-high Fossil Creek

[1] In its comments on the surrender DEA, the Forest Service indicated that it wanted a spring box connected to the potable water system secured for possible future use, rather than being completely dismantled.

diversion dam at the Irving plant; and (10) removal of the above-grade portions of the gravity conveyance system (consisting of concrete box flume sections, steel pipe sections, tunnel sections and steel flume sections supported on wooden trestles) between the Irving plant site and Stehr Lake. Steel support sections for metal pipe valley crossings (bridges) would be removed down to the top of their concrete foundations. Wooden trestles would be removed to grade.

Stehr Lake, a 23-acre off-stream impoundment that serves as a forebay for the pressure tunnel and steel pipe delivery system to the Childs plant, would be dewatered, the earthen embankments breached, and the lake area returned to natural vegetation. The Stehr Lake outlet works would be removed and the pressure tunnel sealed off at both ends. A 1,394-foot-long reinforced concrete pressure pipe from the tunnel to the 30-foot-diameter by 30-foot-high concrete surge tank would be sealed at both ends and left in place; the surge tank would be removed; and the 4,635-foot-long steel penstock, with diameters ranging from 48 inches to 32 inches, would be sealed at both ends and left in place. The Childs powerhouse would be left in place as an historic feature, after removal of all electrical, mechanical, and maintenance equipment. The Childs substation, located next to the powerhouse, would remain in service, with all poles, equipment, and wires not required for customer service removed.

Fossil Springs Diversion Dam

Although the Settlement Agreement states that Public Service would lower the Fossil Springs diversion dam by 6 feet, the surrender application leaves open the final disposition of the Fossil Springs diversion dam for subsequent phases of the proposed project retirement process. In its December 31, 2002, additional information filing, Public Service provided information with which to assess the following four alternatives for decommissioning the 25-foot-high by 100-foot-long, concrete diversion dam: (1) retain the existing structure, (2) lower by 6 feet and retain the remaining structure, (3) lower by 14 feet or more, the final decision on how much dam structure to be removed to be made jointly in the field by Public Service and the Forest Service, and retain the remaining structure, and (4) remove the entire structure. Alternatives (1) and (2) above would require the installation of rock anchors to ensure the continuing, long-term stability of the structure.

The small (about 680-foot-long) reservoir created by the Fossil Springs diversion dam is almost completely filled with sediment. In its December 31, 2002, additional information filing, Public Service proposed constructing a cofferdam to divert the streamflow away from the dam during deconstruction for the partial and full dam removal alternatives. But in an August 25, 2003, additional information filing, Public Service requested that the cofferdam proposal be removed from further consideration as a means for dewatering the dam during deconstruction. Instead, Public Service now proposes to construct a diversion channel to convey the 40-cfs base flow around the work area during deconstruction and until natural high-flow events transport the reservoir sediments downstream. The sediment immediately

behind the dam would be mechanically excavated to a stable working slope of 3 horizontal to 1 vertical to allow the removal, or partial removal, of the concrete dam. Sediment mechanically removed from the stream bed would be dewatered and used as fill in the restoration of the Irving site. Concrete removed from the dam would be disposed in the Irving flume tunnel before sealing the tunnel entrance with concrete, or placed in designated staging areas for later disposal at Forest Service approved locations.

3. Proposed Environmental Measures

Public Service proposes the following environmental protection and mitigation measures:

- return full flow to Fossil Creek below Fossil Springs dam no later than December 31, 2004;
- construct a diversion channel to route the creek's base flow around Fossil Springs dam during deconstruction;
- remove between the top 14 feet of the Fossil Springs dam and all of the dam (the final decision of how much dam structure to be removed would be made jointly in the field by Public Service and the Forest Service) in 3-foot stages, beginning in September 2007, with work ongoing for 12 to 16 weeks;
- following dam deconstruction, allow the reservoir sediment to be transported downstream during naturally occurring storm events;
- fully remove the Fossil Creek dam, beginning in September 2004, with work ongoing for 6 to 8 weeks;
- dispose of excess concrete residuals in locations approved by the Forest Service;
- control erosion and sedimentation during the removal of project facilities;
- revegetate land disturbed during the removal of project facilities;
- prevent the spread of noxious weeds;
- implement measures for the safe storage, handling, and disposal of petroleum and hazardous products as part of its proposed plan for removing the Fossil Springs dam;
- fund stocking of largemouth bass and bluegill, not to exceed $5,000, to assist the

Arizona Game and Fish Department (Game and Fish) in developing a fishery at Tremaine Lake, as mitigation for the loss of the sport fishery at Stehr Lake;

- install grates to allow bats continued access to project tunnels while preventing public access; and

- retain some project facilities to preserve the historic record of the area.

We discuss each of these proposals in the individual resource sections of this FEA.

B. ALTERNATIVES TO THE PROPOSED ACTION

1. No-Action Alternative

Under the no-action alternative, the project would continue to operate under the terms and conditions of the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented.[2] Furthermore, provisions of the Settlement Agreement would not be implemented. We use this alternative as the baseline environmental condition for comparison with the action alternatives.

C. ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

We considered and eliminated from detailed study retiring the project and leaving all the Childs Development facilities or all of both developments' facilities in place.

We believe that leaving either all the Childs Development facilities or all of both developments' facilities in place under any project retirement alternative isn't reasonable for the following reasons: (1) the facilities would require continued maintenance, for which Public Service would no longer be responsible; (2) the project occupies federal lands managed by the Forest Service, which desires that Public Service remove most of the project facilities (letter from Harv Forsgren, Regional Forester, U.S. Forest Service, Regional Office, Albuquerque, New Mexico, February 20, 2003); and (3) Section 6.2 of the Commission's regulations states that the Commission shall require the licensee in a surrender application to

[2]If, at the time an original license expires, the federal government has not exercised its option to take over the project and the Commission has not issued a new license to the existing licensee or a new licensee, Section 15(a)(1) of the Federal Power Act provides that the Commission shall issue an annual license to the existing licensee.

restore federal lands to a condition satisfactory to the Department having supervision over such lands.[3]

IV. CONSULTATION AND COMPLIANCE

A. COMMENTS AND INTERVENTIONS

After the Commission issued a public notice of the surrender application on May 10, 2002, the following entities commented. The notice established a 30-day time frame for filing comments.

Commenting Entity	Date of Letter
Steven Overby and John Malusa	May 24, 2002
Forest Service	June 7, 2002
U.S. Fish and Wildlife Service	June 7, 2002
Steve Overby	June 7, 2002
Arizona State Parks	June 24, 2002
Friends of Arizona Rivers	July 7, 2002
Ellen S. Soles	January 7, 2003
Southwest Alternative Generation Enterprises	January 15, 2003

The following entities filed motions to intervene in the surrender proceeding.

Intervening Entity	Date of Motion
Gila County	June 4, 2002
Forest Service	June 6, 2002
American Rivers	June 7, 2002
Southwest Alternative Generation	June 7, 2002
Living Rivers	June 26, 2002*
Center for Biological Diversity	July 24, 2002*
Yavapai Apache Nation	September 16, 2002*

* Late intervention was granted in a notice issued October 9, 2002.

The Forest Service filed a motion to intervene in opposition of the surrender application, stating that although it "strongly supports the goal of surrender and decommissioning to restore full stream flow to Fossil Creek, the Forest Service opposes

[3] 18 CFR § 6.2.

certain terms of the settlement agreement." We discuss the Forest Service concerns in the individual resource sections of this document. We note that the Forest Service is not a signatory to the Settlement Agreement.

The following entities commented on our surrender DEA pursuant to the public notice requesting comments, issued by the Commission on June 4, 2003. The notice established a 30-day time frame for filing comments. These comments and our responses are included in Appendix B of this FEA.

Commenting Entity	Date of Letter
Bureau of Reclamation	June 20, 2003
Forest Service	July 1, 2003
Arizona Game and Fish Department	July 1, 2003
Stephen Monroe	July 2, 2003
Sally E. Stefferud	July 2, 2003
U.S. Fish and Wildlife Service	July 2, 2003
Grand Canyon Trust	July 3, 2003
Sierra Club	July 3, 2003
Center for Biological Diversity	July 3, 2003
Jurich Consulting, Inc.	July 3, 2003
Charles A. Wood Trust	July 7, 2003
Jerome A. Stefferud	July 8, 2003
Arizona Public Service Company	July 8, 2003
American Rivers	July 9, 2003

B. WATER QUALITY CERTIFICATION

On November 21, 2002, Public Service applied to the Arizona Department of Environmental Quality (Environmental Quality) for water quality certification (WQC), as required by Section 401(a) of the Clean Water Act.[4] Environmental Quality received Public Service's request on November 25, 2002 (personal communication with Andrew Cajero-Travers, Water Quality Division, Arizona, Department of Environmental Quality, Phoenix, Arizona, November 27, 2002). On November 20, 2003, Environmental Quality granted certification to Public Service for the project, subject to (1) standard administrative conditions; (2) a requirement for Public Service to obtain any other necessary permits; and (3) a requirement that the proposed deconstruction activities not cause or contribute to long-term adverse impacts to beneficial uses of Fossil Creek.

[4] 33 U.S.C. § 1341 (a) (1).

V. ENVIRONMENTAL ANALYSIS

In this section, we analyze and compare the environmental effects of Public Service's proposal, other alternatives to the proposed action, and the no-action alternative. In addition to project-specific impacts, we analyze the potential for significant cumulative impacts to resources affected by the project and by other past, present, and reasonably foreseeable activities in the watershed. Unless otherwise cited, the information presented below in the Affected Environment sections has been taken from Public Service's relicense application (1992) and any additional information that Public Service filed.

A. GENERAL DESCRIPTION OF THE VERDE RIVER BASIN

The Verde River flows 190 miles from the Chino Valley in north-central Arizona to its confluence with the Salt River in south-central Arizona (Sullivan and Richardson, 1993). Its basin is bounded by the Mogollon Rim to the north and northeast, the Mazatzal Mountains to the east, and the New River Mountains and Black Hills to the south and west, respectively. The Verde River drains an area of about 6,188 square miles. The primary source of runoff for the river and its major tributaries comes from the Mogollon Rim, where precipitation infiltrates permeable sandstone, limestone, and fractured volcanic outcroppings to intersect the water table.

Fossil Creek is one of the six perennial tributaries of the Verde River: Sycamore Creek, Oak Creek, Beaver Creek, West Clear Creek, Fossil Creek, and the East Verde River. These tributaries drain the north and east portions of the river basin and flow in a southwesterly direction.

B. SCOPE OF CUMULATIVE EFFECT ANALYSIS

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (15 CFR §1508.7), a cumulative effect is the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. We find that cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

We evaluated the cumulative effects of the proposed action and alternatives with regard to other existing and foreseeable developments in the Verde River Basin. We identified cumulative effects on mineral travertine, fish, riparian resources (including riparian vegetation and riparian-obligate wildlife such as the yellow-billed cuckoo and lowland leopard frog), aesthetics, and recreation that may be affected by the proposed surrender of the Childs Irving

Project in combination with other activities within the river basin.

Other water resource developments in the Verde River Basin consist of one existing hydroelectric project--the Blue Ridge Project (FERC Project No. 2304)[5] on the East Verde River--and two Bureau of Reclamation storage reservoirs--Horseshoe reservoir and Bartlett reservoir--on the Verde River, downstream from the Childs Irving Project. There are no pending applications for license or exemption from license in the Verde River Basin.

The FWS states that the Verde River ecosystem is threatened by the following actions: groundwater depletion; previous and ongoing mining operations; sand and gravel extraction; agricultural water diversion; livestock grazing; urban development and associated contamination; and overuse for recreation (U.S. Fish and Wildlife Service, 1993). Two of these actions--livestock grazing and overuse for recreation--are relevant to the proposed surrender of the project license. In addition, natural high-flow events in the Fossil Creek watershed could cumulatively affect the watershed's resources.

1. Geographic Scope

The geographic scope of our cumulative effects analysis defines the physical limits or boundaries of the proposed action's effects on the identified cumulatively affected resources. Because the proposed action may affect some of the resources differently, the geographic scope for each of the resources may vary. We chose the geographic scope based on the potential direct and indirect effects of the proposed surrender of the project and other activities potentially affecting the resources within the Verde River Basin.

For travertine, aesthetics, and recreation resources, we considered the cumulative effects of high-flow events in Fossil Creek. The geographic scope we considered for these three resources is the 4.5-mile-long reach of upper Fossil Creek where travertine deposition would occur if full flows are returned. Streams, such as Fossil Creek, that support travertine formations are rare. Historical accounts of Fossil Creek indicate travertine formations were adversely affected by diversion of stream flows, periodic flooding, and past livestock grazing. We chose this area because travertine deposits form on rocks and other objects in the stream channel and eventually create a series of pools. As we discuss in our FEA, the federally listed razorback sucker, which may occur upstream from Fossil Springs dam, could migrate downstream after partial or full removal of the dam and benefit from the travertine habitat created by restoring full flows into Fossil Creek or move on to the Verde River. In addition, a

[5] The Commission issued a license to the Phelps Dodge Corporation for Project No. 2304 on March 20, 1963, effective January 1, 1963, for a period of 50 years. The Commission approved a transfer of the license to Phelps Dodge Morenci, Inc., a wholly owned subsidiary of Phelps Dodge Corporation, on June 17, 1986.

cumulative beneficial effect on recreation could occur as a result of the visual interest in the travertine formations.

The geographic scope we considered for fish and riparian resources is Fossil Creek and its canyon from the Fossil Springs impoundment downstream to the confluence of Fossil Creek and the Verde River. We chose this area because habitat modification from the late 1800's and the introduction of non-native fish species have affected the native fish community. By restoring the flow to currently dewatered riffles and increasing the wetted perimeter, riparian resources and the associated fishery would be enhanced. Furthermore, the proposed remaining portion of the Fossil Springs dam would be an effective barrier to non-native fish (such as green sunfish and smallmouth bass) downstream from the dam.

Cattle grazing have a cumulative adverse effect on fish and riparian resources in the Fossil Creek watershed. Grazing eliminated ground cover and resulted in soil erosion throughout Arizona (Hunt et al., 1992). The Fossil Creek watershed was intensively grazed during the late 1880's, but the grazing pressure has declined since the turn of the last century. In 1988 and 1991, the Forest Service substantially reduced the grazing use of the Fossil Creek grazing allotment, which includes the watershed above Fossil Springs.

2. Temporal Scope

The temporal scope includes a discussion of the past, present, and future actions and their effects on travertine, fish, riparian resources, aesthetics, and recreation. Based on the proposed surrender of the project license and expected timeframe for the establishment of woody riparian vegetation, our temporal scope is 10 years into the future. The historic discussion is limited, by necessity, to the amount of available information for each resource. The quality and quantity of information, however, diminishes as we analyze resources further away in time from the present.

C. PROPOSED ACTION AND ACTION ALTERNATIVES

In this section, we discuss the impacts of the proposed project license surrender and alternatives on environmental resources. For each resource, we first describe the affected environment--the existing condition and baseline against which we measure impacts--and then discuss the environmental impacts.

1. Geology and Soils

Affected Environment: The majority of the Fossil Creek watershed is underlain by sedimentary rocks of the Colorado Plateau, primarily sandstone and limestone. The sedimentary rocks are covered by a thin layer of volcanic rock. The soil derived from sandstone and limestone is well-drained sandy loams and medium-to-fine textured. The soils

derived from volcanic rock are fine-textured, well-drained loams and clay loams. All soil types have varying amounts of exposed bedrock.

A prominent geologic feature, Fossil Springs, is located a short distance upstream from the Irving development diversion dam and provides the primary water source for the hydroelectric project. The springs provide a relatively constant base flow of about 43 cfs, nearly all of which is diverted by the Fossil Springs diversion dam for power generation. The diversion dam itself was constructed in 1916 and the small reservoir impounded by the dam has since become nearly filled with sediments eroded from the watershed and trapped behind the dam. Public Service estimates the total sediment volume in the project reservoir is about 25,000 cubic yards (cy).

When a reservoir becomes filled with sediments, it reaches a state of equilibrium with respect to its capacity to trap and retain additional upper watershed sediments. When this occurs, the bulk of the sediment yield of the upper watershed is conveyed through the reservoir reach to the stream below the dam by high flows. Because the sediment carrying capacity of the 43-cfs base flow diverted for power is small compared to flows many times higher that occur during storm events or from seasonal snow melt, sediment transport in Fossil Creek under current conditions is relatively unaffected by project operation.

The limestone aquifer that is the source of the water at Fossil Springs is supersaturated with calcium carbonate, which has resulted in the formation of travertine deposits at various locations along the stream bed in the project vicinity. In the following sections we discuss the project-affected environment relative to two key geologic resource issues: travertine and reservoir sediments.

a. Travertine

Travertine is a mineral that can provide biological, recreational, and aesthetic benefits. The groundwater emerging from the limestone formations at Fossil Springs is supersaturated with calcium carbonate and dissolved carbon dioxide. This provides an environment conducive to the precipitation of calcium carbonate in the form of travertine. Travertine consists of calcium carbonate deposited from solution in surface waters. Its structure is concretionary, banded, and often porous.

Travertine deposits form on rocks, logs, leaves, and other objects in the channel, and will typically create dams, terraces, and other structures within the active stream channel. Its growth is accelerated when algae are present, possibly because algae take up carbon dioxide through photosynthesis (Pentecost, 1990).[6] Water backs up behind the travertine dams, and a

[6]Elevated carbon dioxide concentrations in groundwater result in the production of carbonic acid and a greater potential for water to dissolve carbonate rocks. Upon emerging to atmospheric conditions, the carbon dioxide begins to outgas, causing an increase in the

series of pools or terraces often forms in a stairstep pattern in the stream channel. Travertine formations can have a major effect on the geomorphology of a stream. Travertine formations can also enhance pool habitat for fish, as we discuss in the section on aquatic resources.

Historical accounts of Fossil Creek report large travertine dams in the channel of what is now the Irving reach. In 1891, Charles F. Lummis described waters in Fossil Creek as "so impregnated with mineral that they are constantly building great round basins for themselves, and for a long distance flow down over bowl and bowl" (Lummis, 1891). In 1904, F.M. Chamberlain reported dams "from several inches to a few feet in height, the highest is said to be 10 feet" and pools, the largest of which were "50 to 60 yards long, 20 to 30 feet wide, and approximately 20 feet or more deep" (Chamberlain, 1904).

The travertine that Lummis and Chamberlain saw was destroyed in subsequent floods. Today there is evidence of historical travertine deposition in Fossil Creek and relic travertine deposits appear above the current stream channel. Also, travertine is currently being deposited on the project flume and other project facilities, primarily below the Irving plant. Public Service's research indicates that the diminished amount of travertine in the stream today is due to the diversion of streamflows from the natural channel, periodic flooding, and past livestock grazing. Malusa (1997) found that calcite (travertine) deposition in Fossil Creek is directly proportional to the amount of the spring-fed base flow that is allowed to remain in the stream.

b. Reservoir Sediment Deposits

The small reservoir formed by the 25-foot-high Fossil Springs diversion dam has almost completely filled with sediments since the dam was constructed in the early 1900's. Figure 3 is a topographic map of the dam site and reservoir pool area. Figure 4 is a profile along the centerline of Fossil Creek from about 350 feet below the dam to about 850 feet upstream of the dam. The profile shows the creek bottom as it is today and as it was in 1914, before the reservoir filled with about 20 feet of sediment. Public Service estimates the total volume of sediments in the reservoir is about 25,000 cy. The grain size of sediment samples collected from the impoundment area indicates that this material is predominantly coarse-grained sands and gravels, with an increasing amount of large diameter (greater than 100 millimeters) material moving upstream from the dam.

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calcium carbonate saturation index, resulting in supersaturation and precipitation as travertine. Diurnal flux in dissolved carbon dioxide concentrations caused by algal photosynthesis may contribute to travertine deposition. In addition, filamentous green algae attached to the Fossil Springs diversion dam are thought to provide a favorable nucleation surface for calcium carbonate deposition (Malusa, 1997).

Under current conditions, the reservoir is nearly filled with sediments (figure 4), to the point that sediment transport through the dam site is probably at or near equilibrium conditions and where the sediment into the project reservoir equals the sediment passed downstream on an average annual basis. Monroe (2002) concluded that the volume of sediment stored at the Fossil Springs dam site is small compared to the potential sediment yield of the Fossil Springs watershed and the sediment transport capacity of Fossil Creek. Using sediment yield data from other similar watersheds, Monroe estimates the total annual yield of sediment for the Fossil Creek watershed above the Fossil Springs diversion dam could range from less than 1,000 tons/year to over 200,000 tons/year. We estimate this would be equivalent to from about 675 cy to 135,000 cy per year at a sediment density of 110 pounds per cubic foot (about 3,000 pounds per cy).

Environmental Impacts: License surrender followed by removal of project facilities and return of full flow conditions to Fossil Creek would result in long-term effects on travertine formation in the stream bed of Fossil Creek. Removal of the Fossil Springs diversion dam would cause short-term effects related to stream sediment and long-term effects on stream channel morphology in the immediate area of the dam and reservoir. Although not a natural geologic feature, project removal would eliminate the source of water for the manmade Stehr Lake, located in the project flow line. The lake would be removed, and the site would be graded to provide drainage and revegetated with native vegetation. Land-disturbing project removal activities could result in both short-term and long-term erosion effects, if adequate temporary protections and permanent land restoration practices are not properly designed and implemented.

a. Travertine Deposition

Under current conditions, with the Childs Irving Project operating, the mineral-rich Fossil Springs water is diverted from Fossil Creek through project water conveyance facilities and ultimately discharged into the Verde River, bypassing the lower 4.5 miles of Fossil Creek. The calcium carbonate contained in the waters diverted for power purposes either precipitates in the form of scale attached to project water conveyance facilities or is carried in solution or suspension into the Verde River. Retiring the Childs Irving Project and returning full flow to the bypassed reaches of Fossil Creek would increase the amount of travertine deposition in Fossil Creek, as described below.

The calcium carbonate precipitation that forms travertine is a combination of inorganic processes that are accelerated by the presence of algae. The process of travertine formation begins when water saturated with calcium carbonate and a relatively high concentration of carbon dioxide (compared to atmospheric concentrations) emerges from the limestone bedrock at Fossil Springs. As this water begins to flow downstream, carbon dioxide gas is released, and the pH increases, causing calcium carbonate to precipitate.

Precipitation of travertine typically occurs at, or immediately below, areas of turbulence, where the greatest amount of carbon dioxide is released (Herman and Hubbard, 1990). In Fossil Creek, calcium carbonate would be preferentially precipitated in open sunlight areas where there are abrupt changes in either water velocity or slope that cause water turbulence. These are the optimal environments for both inorganic and organic precipitation processes. Travertine precipitation could also occur in heavily shaded areas where the water is strongly agitated and loses carbon dioxide. Precipitation in that case is mostly by inorganic processes. Organic precipitation processes occur when algae are present, possibly because algae take up carbon dioxide through photosynthesis (Pentecost, 1990). Both processes can be significant and neither is necessarily more significant than the other.

Water turbulence is another variable in forming travertine. With lower flows, turbulence becomes more uniformly distributed in the stream, and consequently travertine deposition becomes more uniform. In contrast, by increasing flow, turbulence would concentrate in areas with slope changes and thus would create travertine structures. The effect of increased flows on the size and shape of travertine structures can't be predicted exactly, however, particularly because the travertine structures themselves would change streambed morphology.

Factors that provide for travertine deposition are: (1) a high ratio of water laden with calcium carbonate to water without calcium carbonate (runoff water, etc.); (2) turbulence, which causes the water to be exposed to the air to release carbon dioxide; and (3) the amount of algae in the water.

Factors that erode travertine deposits are: (1) water without calcium carbonate; (2) storm events; and (3) spring runoff. Storms and spring runoff carry bedload, sediments, and debris, all of which can contribute to the erosion of travertine deposits. Deposition of these materials in the stream bed can also create new sites with conditions favorable for travertine development.

To predict potential travertine deposition, Public Service used data from a water quality study at Fossil Springs, Stehr Lake, and the Childs and Irving power plants. The results predict that more than 1,375 tons of travertine deposition per year could occur if all 43 cfs were released to Fossil Creek. Public Service equates this to an average rate of travertine deposition of about 0.29 inches per year, if spread out uniformly over the entire reach. At 2 cfs, travertine could accumulate at about 0.02 inches per year, if spread out uniformly over the same reach. Public Service points out, however, that its calculations were limited to one set of pH determinations and that the distribution of travertine deposition would more likely be uneven. In another study, Malusa (1997) concludes the amounts of travertine deposition would be 3.5 times these amounts. These studies make it clear that the higher flows following project retirement would result in increased travertine deposition.

In March 1996, Public Service shut down the Irving power plant to perform maintenance, and all of the springs' discharge (43 cfs) flowed through the Irving reach for 1 month. During that month, travertine in the Irving reach accumulated to depths of 1 foot by incorporating woody channel debris (Overby and Neary, 1996).

With the re-establishment of spring-fed flows and associated travertine deposition, Fossil Creek has the potential to be an area of geological interest that could increase recreational activity. Havasu Creek, a tributary of the Colorado River in northern Arizona, is a stream with extensive travertine deposition, and draws many visitors to see the spring-fed stream and the travertine pools.

Using the available information, we conclude that travertine deposition in Fossil Creek would increase under all project retirement alternatives compared to the existing conditions, in which nearly all of the base flow is diverted out of the bypassed reach.

b. Reservoir Sediment Deposits

In our surrender DEA we considered four alternatives for decommissioning the Fossil Springs diversion dam: (1) leaving the dam in place, which would maintain the existing conditions with respect to reservoir sediments; (2) removing 6 feet from the top of the dam, the alternative proposed by Public Service at the time of the DEA; (3) lowering the dam by 14 feet or more, and (4) complete removal, which Public Service defined as removing the top 20 feet of the dam and which the Forest Service recommended at the time of the DEA. Information and comments filed in response to the surrender DEA by Public Service and the Forest Service modified the positions of both of these parties on the disposition of the Fossil Springs diversion dam.

Public Service changed its recommendation from removing just the top 6 feet of the dam, which would result in most of the reservoir sediments remaining in the reservoir, to lowering the dam by 14 feet or more, which would expose most of the reservoir sediments to erosion and transport downstream by high-flow events. The Forest Service modified its recommendation for complete removal of the dam to a recommendation for removal of between 14 feet and full removal, leaving the final decision to the Forest Service and Public Service at a later phase of deconstruction.

Reservoir sediment transport studies conducted by Public Service to support a decision on the disposition of the Fossil Springs diversion dam only considered the 6-foot removal and full removal options. From our review of the results of these studies, we believe that the effects of the 14-foot removal alternative on reservoir sediments can be approximated by interpolating between the predicted sediment removal quantities and bottom profiles for 6-foot removal and full removal.

Under all surrender alternatives, the 43-cfs diversion for power generation would be eliminated and all of the natural flow would remain in Fossil Creek. The 43-cfs diversion flow is a base flow condition (supplied by Fossil Springs) that has little or no bedload carrying capacity and represents a small percent of the much larger flows that are required to resuspend and transport reservoir sediments downstream (Arizona Public Service Company, 2002). Because dam removal operations would disturb reservoir sediments in the immediate work area, Public Service is proposing to construct a stable diversion channel through the reservoir sediments to convey the 43-cfs base flow around the dam during deconstruction. This measure would help to minimize the potential for violating the Arizona State water quality standard for suspended sediment during deconstruction.

Leaving the Fossil Springs dam in place would basically maintain existing stream bed conditions with respect to sediment transport and deposition both upstream and downstream of the dam.

Removing 6 feet from the top of the Fossil Springs dam would expose some of the reservoir sediments to increased scour during high-flow events but would still retain most of the sediment wedge above the dam. Lowering the dam by 14 feet or complete dam removal, however, would allow most of the sediments to be transported as suspended sediment and bedload on downstream during high flows (see figure 4). Table 1 summarizes how much of the 25,000-cubic-yard sediment wedge behind the Fossil Springs diversion dam would be transported downstream by a range of various size storm flow events for the 6-foot removal, 14-foot removal, and total dam removal alternatives.

Table 1. Estimated quantity of sediment transported by storm flows from the Fossil Springs diversion dam reservoir to below the dam site.[1]

Storm flow magnitude	6-foot dam removal	14-foot dam removal	Total dam removal
2-year, 3-hour (summer) 291 cfs	several hundred cy (assume 300 cy)	700 cy	1,000 cy
2-year, 12-hour (winter/spring) 900 cfs	several hundred cy (assume 400 cy)	1,314 cy	2,000 cy
10-year, 12-hour 3,235 cfs	500 cy	2,214 cy	3,500 cy
100-year, 12-hour 6,743 cfs	1,000 cy	3,285 to 5,000 cy	5,000 to 8,000 cy

[1] Source: Arizona Public Service Company, 2003.

The sediment transport model Public Service used to make the estimates given in figure 4 predicted that most of these eroded sediments would be deposited in the pools immediately below the diversion dam site. Ultimately, multiple storm events would redistribute the sediments further downstream, along with the normal sediment yield of the watershed. As shown by the bottom profiles in figure 4, with total dam removal a single storm event could lower the stream channel by about 20 feet at the dam site, by about 10 feet at a location 100 feet upstream from the dam, and tapering down to less than 5 feet at a location 400 feet upstream from the dam. The effects of stream channel changes on other resources are discussed in the other resource sections.

c. Erosion and Sedimentation Caused by Land-Disturbing Activities

Under any surrender alternative, there would be short-term impacts from removal of the project facilities. These impacts would include soil compaction and displacement from heavy equipment, and soil erosion from land-disturbing activities associated with the removal of project structures.

If the roads are left in place but not maintained, they would turn into channels for overland water flow. The roads could cause erosion and sedimentation before they stabilize. After the Flume Road between the Fossil Springs diversion dam and the Irving powerhouse is no longer needed for access during deconstruction, Public Service proposes to eliminate that road. To reduce the potential for adverse erosion effects caused by abandonment of this and other roads that may no longer be needed after project retirement, Public Service proposes to restore the road bed by means of grading and revegetation with native vegetative materials in accordance with a sediment and erosion control plan.

All surrender alternatives would result in increased recreational use of the Fossil Creek area due to increased streamflow and interest in the rare travertine deposits. Arizona State Parks (1989) states that the most common recreational impacts to soils include: (1) surface soil compaction; (2) reduction in vegetative ground cover; (3) reduction in infiltration and hydraulic conductivity; (4) reduction in soil organic detritus; and (5) increase in soil density. The cumulative effects of these soil impacts are a denudation of the vegetation through a loss of water (due to decreased infiltration) and nutrients (due to a loss of organic matter), and a subsequent increase in the potential for erosion (Arizona State Parks, 1989). While increased recreational use would cause moderate, long-term erosion and sedimentation, we find that Public Service's proposed soil erosion control measures should minimize those effects if the Commission decides to approve the license surrender.

Public Service prepared an erosion and sediment control guidance document on December 2002, and the Forest Service filed a list of its desired site restoration actions for project retirement on February 20, 2003. The guidance document closely follows the Forest Service's desired restoration actions. Implementation of a well-designed erosion and sediment

control plan developed by Public Service in consultation with the Forest Service would protect the land and water resources from adverse deconstruction effects and restore the project site to natural conditions.

Unavoidable Adverse Impacts: There would be short-term adverse sediment and erosion impacts related to lands disturbed during demolition and removal of project facilities. These impacts would be reduced by the implementation of well-designed sediment and erosion control and revegetation plan. Alternatives requiring the lowering, or removal, of the Fossil Springs diversion dam would expose reservoir sediments to erosion and downstream transport during high-flow events. These effects would result in elevated suspended sediment concentrations and turbidity levels in Fossil Creek until a sufficient number and magnitude of events occur to transport the fine-grained materials exposed by lowering the dam out of the creek. Impacts from this effect would occur at high flows during the first year following partial or full removal of the dam. Public Service's proposal to construct a stable diversion channel to route base flow through the exposed sediments would minimize elevated suspended sediment concentrations under base flow conditions.

2. Aquatic Resources

Affected Environment:

a. Streamflow

Fossil Creek originates on the Mogollon Rim at the confluence of Calf Pen and Sandrock Canyons (headwater drainages that originate at the Mogollon Rim) and flows southwesterly for about 17 miles to its confluence with the Verde River 3 miles downstream of the Childs powerhouse on the Verde River. Elevations in the Fossil Creek watershed range from 7,260 feet above mean sea level (MSL) near the headwaters to 2,550 feet above MSL at the Verde River confluence. From its headwaters to Fossil Springs the stream is intermittent, flowing most often in response to snowmelt or widespread frontal storms. Perennial flows in Fossil Creek begin at Fossil Springs, where a series of springs and groundwater upwellings emerge over about a 1,000-foot-long reach of stream. The springs provide a constant baseflow of about 43 cfs (Arizona Public Service Company, 1992).[7] Fossil Springs is the largest group of springs in central Arizona (Monroe, 2002).

Public Service estimated the basin water yield upstream of Fossil Springs using

[7] Monroe (2002) estimates base flow as 46 cfs based upon a reconnaissance of headwater springs in the Gila River Basin published by the U.S. Geological Survey (USGS) in 1963. Because of the absence of gaged streamflows for Fossil Creek, Commission staff accept all flow data as being approximate.

estimates of basin water yield derived from information available from similar nearby watersheds [8] that have been gaged for a minimum of 15 years (letter from Charles W. Cartwright, Jr., Regional Forester, Albuquerque, New Mexico, September 25, 1997). The flow duration curve in figure 5 indicates that flow discharged from Fossil Springs provides the baseflow of Fossil Creek in the reach from the springs to the diversion dam, and this baseflow dominates streamflows about 80 percent of the time. Figure 5 also indicates that baseflow quickly becomes a small component of streamflow whenever watershed runoff occurs.

Loomis (1994) estimated peak flows (table 2) at the Fossil Creek diversion dam using area-regression equations of the U.S. Geological Survey (USGS). These flow events play an important role in forming the channel characteristics of the stream, including its travertine features. The USGS equations are based on streamflow data from numerous gauging stations located in the central mountain region of Arizona. A discharge of 43 cfs from Fossil Springs represents only about 8 percent of relatively frequent floods such as the 2-year event.

Water is diverted from Fossil Creek to the project about 1,200 feet downstream from the springs. The project has no minimum flow requirements; however, at the Fossil Springs dam, the first of two project diversions, about 0.2 cfs of flow currently leaks into Fossil Creek. At the Irving powerhouse, an additional 2 cfs is discharged into Fossil Creek as a result of travertine deposits that constrict the diversion structure leading to the Childs powerhouse.[9]

Table 2. Fossil Creek peak flows and recurrence intervals.[1]

Recurrence interval (years)	Peak flows (cfs)
2	1,026
5	2,257
10	3,737
25	6,034
50	8,998
100	13,531

[1]Source: Loomis, 1994.

[8] Wet Beaver Creek, West Clear Creek, Wet Bottom Creek, Red Tank Draw, and Dry Beaver Creek.

[9] Monroe (2002) identifies the discharge to the Childs bypassed reach as 5 cfs. Public Service proposed a minimum flow of 5 cfs for this reach during its relicensing process (Arizona Public Service Company, 1992).

b. Water Quality

Dissolved oxygen (DO), water temperatures, fecal coliform, and pH samples were collected by Dames and Moore (1990, cited in Arizona Public Service Company, 1992) at four locations in November 1989 and May 1990 for Public Service at: (l) Fossil Springs, (2) the flume inlet at Stehr Lake, (3) the flume outlet at Stehr Lake, and (4) the Childs tailrace. Water temperatures ranged from 20 degrees Centigrade (°C) at the Childs tailrace to 21°C at Fossil Springs. DO levels ranged from 7.9 milligrams per liter (mg/l) at Fossil Springs to 9.5 mg/l at the Childs tailrace. Fecal coliform levels ranged from 8 colonies per milliliter (colonies/ml) at Stehr Lake inlet to 140 colonies/ml at the Childs tailrace, while pH ranged from 7.53 at Fossil Springs to 8.19 at the Childs tailrace. These results comply with the applicable state standards at sampling.[10]

c. Fishery Resources

FOSSIL CREEK

The native fish fauna in most streams in Arizona has dwindled in abundance and diversity during the past century because of human activities, including damming and diversions of streams, erosion, channelization, and groundwater pumping (Miller, 1960; Minckley and Deacon, 1968). In addition, the introduction of nonnative fishes caused changes in the native fish fauna. Today, of the 36 freshwater fish species that are native to Arizona, 19 species are federally listed as threatened or endangered (enclosure 1 of letter from Harv Forsgren, Regional Forester, U.S. Forest Service, Regional Office, Albuquerque, New Mexico, July 1, 2003).

The history of the Fossil Creek ecosystem parallels the problems statewide. Habitat modification from the late 1800's and the introduction of nonnative fishes have affected the native fish community. Early historical accounts of the fishes at Fossil Springs reported the occurrence of the Sonora and desert sucker, speckled dace, and roundtail chub (Chamberlain, 1904). There are no records of the numbers and sizes of fishes that existed historically in Fossil Creek. Therefore, knowledge of the fish fauna found below Fossil Springs is limited and somewhat speculative. Historically, spikedace, loach minnow, longfin dace, and razorback sucker, in addition to the four previously mentioned native species, occurred in the Verde River near the mouth of Fossil Creek. Based on the habitat characteristics of Fossil

[10] In its comments on the surrender DEA, however, the Forest Service states that the latest Environmental Quality report finds that the water quality results for Fossil Creek (headwaters to Verde River) are inconclusive for all designated uses, and that Environmental Quality plans additional monitoring in 2004.

Creek, it's likely that the native fish species reported for the Verde River also occurred in Fossil Creek.

The Forest Service's current management goal is to maintain viable populations of native species through habitat improvement (enclosure 1 of letter from Harv Forsgren, Regional Forester, U.S. Forest Service, Regional Office, Albuquerque, New Mexico, July 1, 2003). Currently, six native species can still be found in varying numbers and distribution in Fossil Creek. Speckled dace are abundant only at Fossil Springs, and uncommon in the reach between the Fossil Springs dam and the Irving powerhouse. Headwater chub occur only upstream of the Fossil Springs dam. Roundtail chub occur only downstream of the dam, primarily in the 5-mile reach below the Irving powerhouse, and are uncommon between Fossil Springs dam and the Irving powerhouse. The abundance and size distribution of Sonora and desert suckers are variable, although both species are present throughout the stream. Longfin dace are rare and limited in extent (Schuhardt, 1989). Spikedace and loach minnow no longer occur in Fossil Creek. Razorback sucker was not recorded there until it was stocked above the Fossil Springs dam in 1988 and survived there for at least several years (Barrett, 1992; Hendrickson, 1992 and 1993).

The five nonnative fishes found in Fossil Creek are green sunfish, smallmouth bass, common carp, flathead catfish, and yellow bullhead. A 25-foot-high waterfall about l mile upstream from the Irving powerhouse generally limits further upstream migration, although green sunfish have been collected in the reach above the falls. Green sunfish are found throughout the stream below Fossil Springs dam.

In addition to nonnative species, the native fish community has been influenced by changes in habitat conditions. Early observers of Fossil Creek were impressed by the volume of the springs and the influence of travertine in the channel (Lummis, 1898; Chamberlain, 1904). From the descriptions given, the stairstep pooling pattern created by travertine deposition helped dissipate stream energy and impounded water providing a diversity of flow depths, velocities, and range of habitat types and complexity. Chamberlain (1904), a fisheries biologist, noted that lime salts formed dams, but they did not appear to hinder the ascent of fish because of the presence of side currents, which formed natural fishways. The quieter pools and backwaters were filled with "a sort of pond weed," and the travertine dams themselves provided hiding cover during periods of low flow and flood flows. The dams provided rooting sites and created channel conditions suitable for aquatic vegetation, which in turn provided additional food sources and hiding cover for fish. The impoundments, or "basins," also helped retain sediment and detritus in the system longer so it was available to the biotic community (Chamberlain, 1904).

Travertine growth is greatly accelerated when organic material such as leaves, branches, woody debris, and algae are present (Pentecost, 1990; Overby and Neary, 1996). Travertine formations are highly dynamic and regularly break down and reform. To maintain

this process, a constant source of calcium carbonate is required. The flow from Fossil Springs historically rebuilt and maintained travertine features that were abraded during flood events.

Currently in Fossil Creek, pools are shallow and limited in extent, with low current velocities. Fish diversity is limited as a result of the lack of habitat diversity and the presence of nonnative, predatory species. Riffle habitat is typically dewatered, leaving little habitat for aquatic macroinvertebrates. Overbank shading is limited except in areas dominated by riparian forested mixed broadleaf vegetation next to the active channel. Emergent vegetation is limited except at Fossil Springs and the area of travertine deposition below Irving powerhouse.

STEHR LAKE

Public Service has historically used Stehr Lake as a regulating reservoir to maintain a 3-day supply of water for the Childs Development in the event that the Irving powerhouse or flume has to be closed for repairs. Through time, sediment accumulation and the growth of emergent vegetation has reduced the storage capacity of Stehr Lake to a little over a day's supply of water and its surface area from 25 surface acres of open water to 5 acres.

Stehr Lake has been stocked with a variety of nonnative fish species over the years. Presently Stehr Lake provides a limited warmwater fishery for largemouth bass, channel catfish, common carp, yellow bullhead, and bluegill. These species maintain self-sustaining populations and are no longer stocked by Game and Fish. Angling pressure at the lake is light and primarily from local residents.

Environmental Impacts: The return of full flows to a 14-mile reach of Fossil Creek and partial or full removal of the Fossil Springs dam would affect sediment transport and suspended sediment downstream of the dam; the risk of spills or leaks of hazardous substances; fisheries habitat upstream and downstream of the Fossil Springs dam; sensitive aquatic species; and Stehr Lake. In addition, the timing of deconstruction could affect downstream resources.

a. Sediment Transport

Deposited sediment can affect invertebrates by filling the interstitial spaces, adversely affecting the invertebrates that are the most readily available to foraging fish (Waters, 1995). Deposited sediment can also adversely affect rearing and adult habitat for warmwater fish by filling pools.

Public Service initially proposed that, before any dam removal activity at the Fossil Springs dam, it would install a cofferdam to stabilize the accumulated sediment behind the dam and divert streamflow around the dam during deconstruction. In response to

Environmental Quality's concerns that this method might not be able to withstand storm flows that could occur during deconstruction, Public Service filed a revised proposal on August 26, 2003.[11] Under the revised proposal, Public Service would eliminate the cofferdam from its design and construct a 10-foot-wide channel, with side spillways, from a pool about 350 feet upstream of the dam and continuing downstream to the side of the stream channel to about 50 feet upstream of the dam, with a 36-inch-diameter polyethylene pipe running the remaining 50 feet to the dam and around the dam. Public Service expects this design to meet Environmental Quality's requirement to withstand storms while diverting the 43-cfs streamflow and its associated sediment around the deconstruction site.

Before deconstruction, Public Service would remove sediment from immediately behind the Fossil Springs dam as needed for deconstruction, and deposit it on land at the staging site. The estimated volume of sediment to be removed is 800 cy, 1,740 cy, or 3,000 cy, for the top 6 feet, top 14 feet or full dam removal, respectively. As part of the excavation, Public Service would grade the sediment remaining behind the dam to create a slope to stabilize the unexcavated sediment. Once the area behind the dam has been excavated and stabilized, Public Service proposes to complete partial or full dam removal in 2 to 3-foot sections, or stages, using jackhammers or similar tools to loosen the concrete dam. Public Service would then leave the remaining sediment “as is” to be washed downstream by naturally occurring storm events.

The Bureau of Reclamation and FWS recommend that the sediment behind the dam not be graded or stabilized, but left in place to prevent any downstream effects from sediment releases (letters from Bruce E. Ellis, Chief, Environmental Resource Management Division, Bureau of Reclamation, Phoenix, Arizona, December 19, 2002, and Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, December 23, 2002, in Arizona Public Service Company, 2002h). The FWS further states that the ideal situation would be if sediments were released in one event timed with spring run-off or other high-flow event, rather than in stages.

In its comments on the surrender DEA, the FWS clarified that it recommends that the sediment not be graded due to the potential impacts from heavy machinery in the stream, but that the sediment wedge left following dam removal be allowed to move downstream naturally during storm events.

As described above, the sediment initially excavated would be removed from the stream and any sediment remaining behind the dam would be left in a stabilized slope. This initial excavation of sediment is necessary to permit access for workers and equipment behind

[11] The August 26, 2003, filing also revised Public Service's initial proposal to remove the top 6 feet of the Fossil Springs dam to removing the top 14 feet.

the dam. Further, the initial excavation would be small compared to the total estimated volume of sediment behind the Fossil Springs dam (25,000 cy). Most of the sediment that is currently behind the dam would be carried out by natural forces as recommended by the Bureau of Reclamation and FWS. If the sediment behind the dam has not been carried from the site by the time the site is transferred to the Forest Service, Public Service proposes to leave the constructed channel in place to allow the natural streamflow and its sediments to bypass the accumulated sediments without further disturbing them.

We find that the initial excavation and removal of sediment would be necessary to provide access to work on the Fossil Springs dam, and that the staged dam removal proposed by Public Service would not result in a staged release of sediments to downstream reaches.

Public Service proposes to fully remove the 5-foot-high Fossil Creek dam, but would do so about 3 years earlier than removal of any of the Fossil Springs dam. The Fossil Creek dam does not support a significant amount of sediment. Further, according to Public Service's proposed schedule, its removal would not overlap with the proposed deconstruction of the Fossil Springs dam. Therefore, we find that the removal of the Fossil Creek dam, with our recommended measures, would not significantly affect downstream native aquatic species. Public Service's schedule is discussed below.

b. Suspended Sediment

The direct effect of suspended sediment is increased turbidity, causing reduced light penetration through the water and resulting in reduced photosynthesis. This can adversely affect the food available for all aquatic species. Suspended sediment results in a pronounced increase in downstream drift by macroinvertebrates that, over a prolonged period, can deplete benthic invertebrate populations, further limiting the amount of food available for fish (Waters, 1995). Other effects of suspended sediments on fish include interference with respiration and visual impairment that can change feeding behavior.

The Forest Service recommends that turbidity monitoring be conducted for all days that any activity may deliver sediment to the stream, including all instream work and all land-disturbing work, particularly when wet and excessive sediment delivery is possible, and that a provision be made for halting work under wet conditions (letters from Ken Anderson, District Ranger, U.S. Forest Service, Sedona, Arizona, December 19, 2002, in Arizona Public Service Company, 2002h; and Harv Forsgren, Regional Forester, U.S. Forest Service, Regional Office, Albuquerque, New Mexico, February 20, 2003). The FWS recommends that water quality be monitored during deconstruction work (letter from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, December 23, 2002, in Arizona Public Service Company, 2002h).

We find that for all alternatives that result in deconstruction activities, aquatic

resources would benefit from the implementation of a plan to (1) monitor suspended sediment immediately downstream of any instream deconstruction activity and any land-based deconstruction activity that may deliver sediment to Fossil Creek or the Verde River, (2) halt work under wet conditions when excessive sediment delivery is possible and the state suspended sediment standard is exceeded, and (3), should the state's suspended sediment standard be exceeded, to identify the cause of the increased suspended sediment and conduct future work so as to avoid exceeding the standard.

c. Hazardous Substances

Chemical substances and residues from lubrication oils and hydraulic fluids may enter streamflow during deconstruction through spills or leaks during use and maintenance of equipment. Studies of oil spills in streams have shown that water turbulence combined with shallow water can promote the mixing of oil into the entire water column, so that a small amount of oil can have significant effects on aquatic life (Albers, 1992). Petroleum concentrations as low as 10 to 100 micrograms per liter (parts per million) can disrupt feeding and reproductive processes in aquatic organisms (U.S. Environmental Protection Agency, 1987). Aquatic species can be adversely affected by chemical substances and hazardous wastes, depending on the substance and exposure, and chemical substances are more readily taken up by aquatic species than terrestrial species because most substances are often soluble in water (Malins and Ostrander, 1993).

Public Service has submitted a draft plan proposing several specific measures for the prevention of spills during deconstruction activities, including the proper labeling of all materials and chemical substances before being brought to the site and written notification by the supplier to Public Service's designee of specific information about all toxic or hazardous materials and chemical substances at least 15 days in advance of their use at the site.

The Forest Service recommends that Public Service implement the following specific measures: (1) complete a hazardous material survey; (2) provide a site management plan to all contractors; (3) store fuels and chemicals at least 100 feet from streams and riparian areas; (4) refuel all machinery and vehicles at least 100 feet from streams and riparian areas; and (5) provide readily available spill containment equipment (letter from Harv Forsgren, Forest Service, Regional Office, Albuquerque, New Mexico, February 20, 2003).

We agree that, for any alternative that would require deconstruction activities, the preparation and implementation of a plan with specific measures to prevent, or minimize the effects of, spills and leaks into the stream would protect aquatic and terrestrial resources. Consultation with the Forest Service, Bureau of Reclamation, FWS, Game and Fish, and Environmental Quality and inclusion of all of the Forest Service's aforementioned recommendations regarding hazardous substances would provide adequate protection of biota, should the Commission approve the surrender application.

d. Fisheries Upstream of Fossil Springs Dam

From Fossil Springs downstream to the upstream end of the small impoundment formed by the Fossil Springs dam, a reach of about 600 feet, the stream consists of runs, riffles, and deep pools with cobble and boulder substrate. The next downstream reach of 650 feet represents the project impoundment that is nearly filled with sediment and contains two pools: a long, wide pool, about 7 feet deep, that extends about 200 feet upstream of the dam; and a small pool, about 14.5 feet deep, that is about 450 feet upstream of the dam. Only native fish are found upstream of Fossil Springs dam, including desert sucker, headwater chub, and speckled dace. The dam serves as a barrier to help protect this native fish community from being invaded by nonnative fish below the dam.

The Forest Service currently recommends from 14 feet to full removal of Fossil Springs dam, in part, to restore the watershed above the dam. The Bureau of Reclamation, Game and Fish, and Arizona State University (ASU) recommend that the Fossil Springs dam be left intact to prevent nonnative fish from accessing the native fish community above the Fossil Springs dam.[12]

Based on modeling provided by Public Service (Arizona Public Service Company, 2002b), we find that removing the top 14 feet of the dam or full dam removal would, over time, erode the sediment in the impounded reach and both pools would be drained. The pool closest to the springs area would be likely to remain for a longer period of time following any dam removal alternative, because of the large amount of sediments deposited as a delta in the upper portion of the impoundment; ultimately this pool might also be lost or reduced in size and depth.

Removing the top 6 feet of the Fossil Springs dam, as Public Service originally proposed, or leaving the dam intact would allow the dam to continue to serve as a barrier between the fish communities upstream and downstream of the dam. In response to the surrender DEA, Public Service modified its proposal to remove the top 6 feet of the Fossil Springs dam to a proposal to remove the top 14 feet of the dam. Public Service states that removing the top 14 feet would allow the remaining portion of the dam to continue to isolate and protect the native fish community upstream of the dam. As proposed by Public Service, about 11 feet of the dam would remain in place and no side channels would be opened for fish

[12] Letters from, respectively: (1) Bruce E. Ellis, Chief, Environmental Resource Management Division, Bureau of Reclamation, Phoenix, Arizona, December 19, 2002; (2) John Kennedy, Habitat Branch Chief, Arizona Game and Fish Department, December 23, 2002; and (3) Paul C. Marsh, Ph. D., Department of Biology, Arizona State University, Tempe, Arizona, December 18, 2002, all attached to Arizona Public Service Company, 2002i.

to move past the dam. The dam sits on a bedrock ledge that forms a steep slope (14-foot vertical drop) below the dam. We agree with Public Service that the proposed remaining portion of the dam would be an effective barrier to the nonnative fish downstream of the dam, including green sunfish.

Full dam removal may not provide the same protection to native fish upstream of the dam. Although the vertical drop below the dam would remain the place, we would expect heavy travertine deposition in this area, resulting in the formation of the extensive bowls and terraces described above. Over time, there would be a potential for the development of side channels, which may allow upstream movement of nonnative fish from below the dam.

e. Fisheries Downstream of Fossil Springs Dam

Below the Fossil Springs dam, the gradient is steep and the stream flows through a narrow canyon before reaching the Irving powerhouse site. The substrate is mostly cobble and boulder. The floodplain widens and the gradient becomes flatter about 1 mile before Fossil Creek enters the Verde River.

All streamflow would be returned to Fossil Creek under any alternative that would require the project to cease operations. Restoration of full flows would result in a baseflow of 43 cfs in the 14-mile reach from the Fossil Springs dam to the confluence of Fossil Creek and the Verde River. Public Service estimates that returning full flows would result in a 60-percent increase in wetted perimeter (wetted part of the streambed), an active travertine zone from Fossil Springs to about 4.5 miles downstream of the springs, and deeper and more extensive pools (Arizona Public Service Company, 2002f). Public Service also estimates that two pools immediately downstream of the dam would become filled with sediment (figure 4).

Overby and Neary (1996) studied relict travertine formations in Fossil Creek and found 81 distinct sets of travertine dams in the reach between the Fossil Springs dam and the Irving powerhouse, mainly at or near channel nick points where water turbulence increases. In some instances multiple terraces had developed in the riparian zone along Fossil Creek, and excavations indicated that these terrace systems were controlled by travertine dam and pool formation (Overby and Neary, 1996). Travertine pools were filled with alluvium during episodic peak flows, allowing the channels to aggrade and terraces to build at increasingly higher flows (Overby and Neary, 1996). Although periodic flooding degrades travertine deposits, the rate of redeposition when flows from Fossil Springs remain in the channel appears adequate to repair and maintain the travertine dam and pool formations that support the terrace, as indicated by the remnants of historical formations still in evidence at Fossil Creek and the present day formations found downstream of the Fossil Creek dam that persist even with periodic flooding events (Overby and Neary, 1996; Monroe, 2002). Over a 1-month period when full flows were returned to Fossil Creek during a project maintenance outage, Overby and Neary (1996) found travertine accumulation up to 30 centimeters (12

inches).

We conclude that returning full flows to Fossil Creek would benefit aquatic species by increasing the diversity of riverine habitat in Fossil Creek through restoring flow to currently dewatered riffles, increasing the depth and width of pools, adding to existing cover and food resources, and creating new pools, backwaters, and side channels from travertine-created instream structures. These improvements would enhance habitat for native and nonnative fishes below Fossil Springs dam. We also conclude that the increase in large pools in the 4.5-mile travertine zone would provide ample and more complex pool habitat to replace the pool habitat lost by draining habitat above the dam, although the benefits of this habitat to native fishes may be limited without the Bureau of Reclamation's efforts to eradicate nonnative fishes. In addition, if the project ceased generation and the flows that had been diverted to the project were rediverted for another use instead of being returned to the stream, the benefits to aquatic resources would not be realized.

The Forest Service recommends that Public Service monitor the development of stream habitat for native aquatic species after the restoration of full flows and fully remove the Fossil Springs dam after monitoring shows that habitat for native species has successfully developed (letter from Harv Forsgren, Forest Service, Regional Office, Albuquerque, New Mexico, February 20, 2003).

We find that it would not be the responsibility of Public Service to monitor native fish habitat after full flows have been returned to the stream. Current project impacts result from the diversion of flows from Fossil Creek. After all diverted flows have been returned to Fossil Creek, Public Service would have no means to affect flow. We would not expect any significant impacts from Public Service's deconstruction activities (including partial or full dam removal, if required), because they would be accompanied by such measures as the Commission may require for the protection of native fish and their habitat during deconstruction. Measures for suspended sediment monitoring and hazardous substance handling and storage have been discussed above. Sediment and erosion control are discussed in the Geology and Soils Resources section.

The FWS also recommends that the Commission, Public Service, Forest Service, Bureau of Reclamation, and the FWS determine how partial flows may be returned incrementally to Fossil Creek (letter from Ester M. Pringle, Acting Regional Director, U.S. Fish and Wildlife Service, Albuquerque, New Mexico, June 7, 2002). The FWS does not provide a basis for restoring flows incrementally to Fossil Creek. We expect returning flows of about 43 cfs to be within the tolerance of the native fish community, as these flows are what that community has experienced in the past during plant outages and what occurred naturally before the project was built. Although steep, the stream channel includes bends, areas of widening, and in some reaches,vegetation that would likely attenuate a flow of 43 cfs.

f. Schedule for Deconstruction/ Return of Flow

Under Public Service's proposal, full flow would be returned to Fossil Creek below Fossil Springs dam no later than December 31, 2004. Public Service proposes to begin removing the Fossil Springs dam in September 2007, and estimates that the work would take about 18 to 22 weeks. Public Service proposes to start removing the Fossil Creek dam in September 2004, and estimates the work could run 6 to 8 weeks.

The FWS recommends that full flows not be returned to Fossil Creek and the Fossil Springs dam remain in place prior to completion of the Bureau of Reclamation's native fish restoration project to prevent upstream access by nonnative species (letters from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, December 23, 2002, in Arizona Public Service Company, 2002h; and Ester M. Pringle, Acting Regional Director, U.S. Fish and Wildlife Service, Albuquerque, New Mexico, June 7, 2002, respectively).

The Forest Service recommends full flows not be returned to Fossil Creek prior to the completion of the Bureau of Reclamation's restoration project and that the Fossil Springs dam not be removed until habitat for the native fish has been successfully established. The Forest Service later clarified it doesn't intend the fish restoration project and the timing of the return of full flows to Fossil Creek to be required mitigation measures related to Public Service's surrender application or anticipate a connection to or conflict with the proposed license surrender. The Forest Service says it would work with Public Service on scheduling issues if any should arise (letter from Harv Forsgren, Forest Service, Regional Office, Albuquerque, New Mexico, April 11, 2003). The Forest Service also recommends that deconstruction work not be carried out during the spring or summer to avoid disturbance to sensitive species.

The Bureau of Reclamation proposes to carry out a native fish restoration project that would include: (1) constructing a concrete barrier with a drop height of 5 feet on Fossil Creek to prevent nonnative fish from migrating up Fossil Creek from the Verde River; (2) eradicating nonnative fish between the Fossil Springs diversion dam and the barrier using a piscicide; and (3) restocking with native fish that would be removed from the stream before the piscicide treatment (U.S. Bureau of Reclamation and Forest Service, 2003).[13] The Bureau of Reclamation is considering two alternative sites for the barrier: (1) about 4.5 miles upstream from the Verde River, within the Mazatzal Wilderness; and (2) immediately outside the Mazatzal Wilderness boundary near the Forest Road 502 bridge over Sally May Wash. The Bureau of Reclamation would construct the barrier in the autumn of 2004, and then carry out chemical treatments of the stream.

[13] The Bureau of Reclamation's long-term plans for the reach upstream of the fish barrier include repatriation of native fishes, and public education about the importance of native fish communities and the impact of the casual introduction of nonnative species.

The return of full flows to the stream would create additional habitat for nonnative and native fish. Any competition for habitat could be avoided by eradicating nonnative fish from the stream prior to the return of full flows. Additionally, it would be easier to carry out an eradication of nonnative fish while the streamflow is reduced, and such a program would likely be more effective with reduced flows. We conclude that it would be beneficial to the existing native fish community not to return full flow to Fossil Creek or deconstruct the Fossil Springs dam until the Bureau of Reclamation's proposed fish restoration project is completed. The Bureau of Reclamation's schedule is already well-integrated with Public Service's schedule for returning full flow to the stream and removing the Fossil Springs dam. Should there be any proposed change to a surrender schedule after it has been approved by the Commission, however, Public Service would be required to submit any new schedule to the Commission for approval.

Public Service's proposed timing of removal activity would avoid disturbance to aquatic species during critical seasons and meet the Forest Service's concern about timing, and there would be no overlap in the disturbances from the Fossil Springs and Fossil Creek dam removals. Sensitive aquatic species are discussed below and in the Terrestrial Resources section.

g. Water Rights

The Forest Service recommends that Public Service transfer and assign to the Forest Service all water rights for Fossil Creek, including water rights for all tributaries and all springs, and change the beneficial uses for stream flow to wildlife, including fish and recreation (letter from Harv Forsgren, Regional Forester, Forest Service, Regional Office, Albuquerque, New Mexico, February 20, 2003). Although the Settlement Agreement states that Public Service would assign ownership of its water rights to the Forest Service, such assignment is a legal issue not appropriately addressed in an environmental assessment.

h. Stehr Lake

Public Service proposes to remove the earth dams that form Stehr Lake and revegetate the site. In their comments on the surrender DEA, Sally Stefferud and the Center for Biological Diversity recommend that Public Service take care during the draining of Stehr Lake to avoid any potential transfer of nonnative fish into Fossil Creek or the Verde River. Such a transfer would jeopardize the success of native fish restoration in Fossil Creek. Therefore, should the Commission approve the surrender application, a measure requiring Public Service to develop a detailed plan to drain Stehr Lake to prevent the transfer of nonnative fish into other waters would prevent the spread of nonnative fish in the project area.

As mitigation for the loss of the sport fishery at Stehr Lake, Public Service proposes to

fund a one-time stocking of largemouth bass and bluegill, not to exceed $5,000, to assist the Game and Fish in developing a fishery at Tremaine Lake, a 400-acre lake within the Coconino National Forest on the Mogollon Plateau (Arizona Public Service Company, 2002).

Game and Fish agrees with Public Service's original proposal (letter from Duane L. Shroufe, Director, Arizona Game and Fish Department, Phoenix, Arizona, April 18, 2002, in Arizona Public Service Company, 2002i). The FWS was concerned that nonnative fish stocked in Tremaine Lake could move into Hay Lake, a downstream lake being restored for native wetland-dependent species (letter from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, December 23, 2002, in Arizona Public Service Company, 2002d). On March 7, 2003, Public Service, Game and Fish, the Forest Service, and the Natural Resource Conservation Service met to attempt to resolve their differences about stocking Tremaine Lake (letter from Nick Svor, Manager, Generation Engineering Services, Arizona Public Service Company, Phoenix, Arizona, July 25, 2003). At the meeting, the FWS and the Forest Service agreed that Game and Fish's proposal to stock bluegill and bass in Tremaine Lake was appropriate. Although environmental analysis would be needed, Game and Fish said that stocking could begin in the spring of 2004. The summary also indicated that Game and Fish had held four public meetings statewide relating to stocking fish, but that there was minimal public participation at those meetings. In its comments on the surrender DEA, Game and Fish states that Public Service, FWS, the Forest Service, and Game and Fish have agreed to treat stocking Tremaine Lake as a separate issue from public access to and recreational facilities at Stehr Lake.

The Forest Service was concerned that stocking was agreed to between Public Service and Game and Fish without coordination with the Coconino National Forest. The Forest Service stated that access to Tremaine Lake is limited and no recreational amenities exist at the lake. Management of recreation activities would be necessary and the Forest Service would require a National Environmental Policy Act analysis prior to any stocking activity. The Forest Service has not scheduled or guaranteed such an analysis at this time (letter from Ken Anderson, District Ranger, Coconino National Forest, Sedona, Arizona, December 19, 2002, in Arizona Public Service Company, 2002h).

Public Service says that fishing at Stehr Lake is limited, and Game and Fish reports that responses to inquiries about the public's angling experiences at Stehr Lake are usually negative. The Forest Service estimates the fishery at 200 angling days per year (Stefferud, 2000). Reasons for the lack of quality fishing include the reduction of the lake area to 5 surface acres because of sediment deposition, encroachment of cattails over a significant portion of the lake, poor shoreline access for anglers, and lack of amenities.

In the surrender DEA, we concluded that the loss of Stehr Lake would not be a significant fishery loss. In reviewing the meeting summary and comment letters on the surrender DEA, we did not find any indication that the Stehr Lake fishery is more significant

than our initial analysis concluded in the surrender DEA. Therefore, mitigation for the loss of Stehr Lake's fishery would not be necessary, should the Commission approve the license surrender. Other measures related to the Stehr Lake site are discussed in the Terrestrial Resources and Aesthetics, Recreation, and Land Use sections.

i. Sensitive Species

The Forest Service states that its designated sensitive aquatic species that have the potential to be negatively affected by dam removal are the headwater chub and roundtail chub (letter from Ken Anderson, District Ranger, U.S. Forest Service, Sedona, Arizona, February 18, 2003).[14]

The headwater chub (*Gila nigra*) is restricted to the Gila River Basin, in the middle to headwater reaches of mid-sized streams. Habitat for this species includes pools associated with cover, such as deep places near obstructions, large pools, or undercut banks in mid-sized streams (Arizona Public Service Company, 2002a). Spawning occurs in the spring from late March to April (Arizona Public Service Company, 2002a). Fertilized eggs are broadcast over sandy-rocky substrates. After hatching, fry inhabit water along the streambanks and shallow backwaters, where they use macrophytes for protection (Arizona Public Service Company, 2002a). Principle food items of chubs in Fossil Creek consist of larval insects, ostracods, and plant material (Arizona Public Service Company, 2002a).

The roundtail chub (*Gila robusta*) occurs in the mainstem and tributaries to the Verde and Salt Rivers, although populations have declined considerably during the past few decades (Arizona Public Service Company, 2002a). Habitat for the roundtail chub includes cool to warm water, mid-elevation streams and rivers where typical adult microhabitat consists of pools to 8 feet deep adjacent to swifter riffles and runs, and cover is usually present (Arizona Public Service Company, 2002a). Smaller chubs generally occupy shallower, low-velocity water adjacent to undercut banks. Roundtail chubs appear to be selective in their choice of pools, as they are commonly found to congregate in certain pools, and are not found in similar nearby pools (Arizona Public Service Company, 2002a). Young chubs feed on small insects, crustaceans, and algal films, while older chubs move into moderate-velocity pools and runs to feed on both terrestrial and aquatic insects along with filamentous algae (Arizona Public Service Company, 2002a). Large roundtail chubs take small fish and terrestrial animals such as lizards that fall into the water (Arizona Public Service Company, 2002a). Roundtail chub breed early in summer, often near beds of submerged vegetation or other kinds of cover as

[14] Sensitive species are designated by the Regional Forester, who designates them because they exhibit low population numbers, have highly restricted ranges for which National Forests make up a significant portion of the species' habitat, or significant detrimental impacts to the population may occur from management practices.

spring runoff is subsiding (Arizona Public Service Company, 2002a). Fertilized eggs are randomly scattered over gravel substrate.

Currently, in Fossil Creek, headwater chub is found only above the Fossil Springs dam, and roundtail chub and a hybrid of *Gila nigra* and *Gila robusta* are found only downstream of the dam, mostly in a 5-mile reach below the Irving powerhouse (letter from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, July 2, 2003). The FWS's concern is that should roundtail chub gain access upstream of the dam, it would hybridize with the headwater chub, potentially causing the loss of headwater chub above the dam. As we say above, leaving a portion of the dam in place would provide a barrier to fish accessing habitat upstream of the Fossil Springs dam.

The return of full flows to the stream would create substantially more habitat and more complex habitat, including enhanced pools, side channels and backwaters, and travertine formations in the 4.5 miles below Fossil Springs. For both species, adults prefer pool habitat, while fry prefer slow moving edge waters. Further, adult and fry of both species feed on a variety of items that would be found in increasing numbers with restored flows and enhanced travertine deposition.

We conclude that both headwater and roundtail chub would benefit from the increased habitat available with full or partial dam removal and the return of full flows to Fossil Creek. Both species would further benefit if the Bureau of Reclamation is able to eradicate nonnative fish from the stream prior to any deconstruction of the Fossil Creek dam.

Unavoidable Adverse Impacts: Instream and land-based deconstruction work has the potential to adversely affect fisheries through the release of sediments and leaks or spills of hazardous substances; however, scheduling deconstruction work to avoid important seasons for sensitive species, monitoring suspended sediment, including a stop-work provision should the state’s suspended sediment standard be exceeded, and implementing a plan for storage and handling of hazardous substances would reduce this potential to minor impacts.

3. Terrestrial Resources

Affected Environment: From about 1875 to the mid-1920's, thousands of head of cattle grazed the area below the Mogollon Rim. Grazing eliminated ground cover and resulted in erosion throughout most of Arizona (Hunt et al., 1992). The Forest Service now manages grazing in the Fossil Creek area. As we discuss in the section on aesthetics, recreation, and land use, grazing pressure has declined in recent decades, and the vegetation of the project area is recovering from its effects.

The Fossil Creek canyon is surrounded by upland chaparral habitat, typically made up of plants such as shrub live oak, mesquite, agave, prickly pear, catclaw acacia, hackberry,

juniper, and singleleaf pinyon pine.

The Fossil Creek canyon supports extensive riparian vegetation. Riparian vegetation is a rare and extremely valuable resource in the arid project area. National Wetlands Inventory maps, based on 1980 aerial photography, show that a total of 205.0 acres of riparian vegetation occurs from Fossil Springs down to the Verde River. Of this total, 117.6 acres are mixed broadleaf riparian forest, 78.8 acres are mixed broadleaf riparian shrub-scrub, and 8.7 acres are palustrine forest.

Riparian vegetation occupies an area between 10 feet and 80 feet on each side of the creek (Forest Service, 1990). Following is a description of riparian vegetation types found along the project reach. For a more detailed description, see Arizona Public Service Company, 1992, exhibit E and volume III.

As we noted in the section on aquatic resources, cobbles and boulders make up the most common substrate on Fossil Creek. The riparian vegetation associated with cobble and boulder areas has a canopy dominated by Arizona alder, Arizona sycamore, Fremont cottonwood, and green ash. The average height of dominant trees is 37.4 feet. Mature trees make up only 1.5 percent of the woody vegetation: seedlings make up 88.1 percent, saplings 7.6 percent, and pole-sized trees (diameter at breast height between 1 inch and 20 inches) 2.7 percent. The seedlings and saplings are most commonly willow and ash near the creek, and sycamore further away from the water. Herbaceous cover averages 7.5 percent near the creek and 1.4 percent on the upland side of the riparian zone.

Sand and silt make up another substrate type along Fossil Creek. Cottonwood is usually the dominant tree species associated with this substrate, but sometimes willows, ash, or alder dominate. The average height of dominant trees is 41.6 feet. Seedlings, predominantly ash or willow near the creek, make up 92.8 percent of the woody vegetation, saplings 5.1 percent, poles 1.6 percent, and mature trees 0.5 percent. Ash and willow seedlings dominate the streamside. Herbaceous cover ranges from 41.7 percent near Fossil Creek to 32.3 percent on the upland side of the riparian zone. Emergent vegetation, such as spikerush, Torrey's rush, tule bulrush, and cattail, is more likely to occur on a sand/silt substrate than the other substrate types.

Riparian vegetation also grows in small areas of sand and silt associated with shelves of bedrock extending into the creek. Bedrock sites are lightly vegetated, with scattered trees and usually no herbaceous vegetation. Arizona alder is usually the dominant overstory tree in these bedrock substrate areas, but cottonwood or sycamore sometimes dominates. Most of the trees--98.8 percent--are seedlings, however, of which ash is the predominant species.

The Forest Service manages the Fossil Springs Botanical Area, a 20-acre riparian deciduous forest, located upstream of the project. Compared to the riparian zone downstream

from the Fossil Springs dam, the Botanical Area has a higher proportion of understory vegetation, including grasses, ferns, and shrubs (Overby and Agyagos, 2000).

Stehr Lake, the project regulating reservoir, supports an extensive tract of emergent aquatic vegetation (Arizona Public Service Company, 1992, license application, volume III, figure 34). Cattails occupy 13 acres of the lake, and Torrey's rush borders it. The cattails in the northeast part of the lake are dying and being replaced by a drier riparian vegetation type. The east shore of the lake mainly supports grass, with scattered willows, ash, and mesquite. On the south, where heavy recreational use occurs, the lake is bordered with Gooddings willow. The west side of the lake is bordered by willows, cottonwoods, hackberry, ash, and walnut.

Large mammals in the project area include mule deer, black bear, and mountain lion. Smaller mammals include coyote, javelina, bobcat, otter, beaver, muskrat, raccoon, kit fox, desert cottontail, skunk, and a variety of bat species.

Riparian habitat along the Verde River and tributaries like Fossil Creek provide important breeding and wintering habitat for birds. Carothers and Johnson (1970) found that 54.6 percent of all nesting birds in the Verde River valley had their natural habitat limited to riparian vegetation, 29.1 percent weren't dependent on riparian vegetation but used it when available, and 14.5 percent were chiefly dependent on riparian vegetation, but would also nest away from large trees (found only near water). Many of these nesting birds are neotropical migratory birds such as cuckoos, flycatchers, vireos, warblers, orioles, tanagers, and grosbeaks. Other birds include Gambel's quail, canyon wren, black-chinned hummingbird, Lucy's warbler, yellow warbler, summer tanager, and Lincoln's sparrow (Arizona Public Service Company, 1992, license application, exhibit E, table 20; Forest Service, 1994; U.S. Fish and Wildlife Service, 1993).

Raptors in the project area include sawwhet owl, common black-hawk, American peregrine falcon, red-tailed hawk, Harris hawk, golden eagle, and bald eagle. (See the section on threatened and endangered species for a discussion of bald eagle use of Fossil Creek.) Waterfowl seen using habitat at Stehr Lake include mallard and eared grebe.

a. Forest Service Management Indicator Species

The Arizona gray squirrel, which the Forest Service classifies as a Management Indicator Species, may occur in the project area. The Forest Service states, however, that no gray squirrels have been reported in the Fossil Creek area (Forest Service, 2002).

A number of bird species that the Forest Service classifies as Management Indicator Species are known to occur in the project area. Eight Management Indicator Species for riparian habitat--Lucy's warbler, yellow-breasted chat, warbling vireo, western wood pewee,

summer tanager, Bell's vireo, common black-hawk, and hooded oriole–have been observed in the project area. Lucy's warbler utilizes mesquite forests, mountain foothills, and willow and cottonwood groves, and nests in riparian brush and woodlands. Lucy's warbler has been sighted at Fossil Springs and in the reach upstream of the Irving powerhouse. The yellow-breasted chat is found in riparian areas with small trees and dense shrubs, and has been seen at Fossil Springs, along Fossil Creek, and at Stehr Lake. Warbling vireo inhabits open deciduous and mixed woodlands, and riparian forests and thickets, nesting in shrubs or low trees. In the project area, the warbling vireo has only been sighted at Fossil Springs.

The western wood pewee is a common species, found in a number of habitat types, including open, mature pine forest; pine-oak-aspen woodlands; wooded canyons; orchards; and towns. The western wood pewee utilizes mature riparian trees for nesting. In the project area, the western wood pewee has been observed at Fossil Springs and along Fossil Creek. The summer tanager and the hooded oriole inhabit riparian woodlands. These two species have been observed at Fossil Springs, along Fossil Creek, at Stehr Lake, and in the Childs powerhouse area. Bell's vireo prefers dense, low, shrubby vegetation consisting of willow, mesquite, and seep willow (Arizona Public Service Company, 2002h). Bell's vireo has been sighted at Fossil Springs, along Fossil Creek, and at Stehr Lake (Overby and Agyagos, 2002). The common black-hawk depends on mature broadleaf trees, such as cottonwood and sycamore, along perennial streams for nesting (Arizona Public Service Company, 2002g). Public Service saw the black-hawk in its 1991 wildlife surveys along Fossil Creek and at the Fossil Springs area (Arizona Public Service Company, 1992, license application, exhibit E, volume III, task 3.2). The Forest Service has noted the black-hawk also at Stehr Lake (In: Arizona Public Service Company, 2002g).

The hairy woodpecker is a Forest Service Management Indicator Species for snags. The hairy woodpecker inhabits deciduous and coniferous forests and nests in live or dead trees. In the project area, the hairy woodpecker has only been sighted at Fossil Springs.

Macroinvertebrates, many species of which occur in Fossil Creek, have been designated by the Forest Service as Management Indicator Species for late seral, high and low-elevation riparian areas.

b. Forest Service Sensitive Species

Five animals that the Forest Service manages as sensitive species have been sighted in the project area: common black-hawk, Bell's vireo, American peregrine falcon, western yellow-billed cuckoo, and lowland leopard frog.

There are two peregrine falcon breeding areas on cliffs near Fossil Creek, one about 1.5 miles away and the other about 4 miles away (personal communication, Laurie Ward, Nongame Birds Field Projects Coordinator, Arizona Game and Fish Department, Phoenix,

Arizona, November 30, 1994). Western yellow-billed cuckoo has been observed along Fossil Creek (Agyagos, 2002).

The Forest Service has expressed particular concern about the effects of the proposed action on the sensitive lowland leopard frog. This species has been observed at Fossil Springs, within the Irving reach, and just upstream of the confluence of Fossil Creek with the Verde River (EnviroNet, 1998). This amphibian breeds in a variety of natural (rivers, permanent streams, beaver ponds, and springs) and man-made (livestock drinkers, canals, and ornamental backyard ponds) aquatic systems. Shallow water with emergent and perennial vegetation provides basking habitat, and deep water, root masses, undercut banks, and debris piles provide potential winter hibernation sites and refuge from predators (Arizona Public Service Company, 2002g). The lowland leopard frog has been found in a number of locations in the Tonto National Forest, indicating good distribution, but on the Coconino National Forest, the species has been documented in only four areas, one of which is Fossil Springs and Creek (Overby and Agyagos, 2000). The Forest Service believes that the Fossil Springs area above the dam supports the largest and most stable population of lowland leopard frogs on the Coconino National Forest. Current survey data indicate that the creek below Fossil Springs dam does not support reproducing populations of this amphibian. Potential causes for the absence of reproducing populations are the presence of predaceous nonnative fish species, predaceous crayfish, and lack of suitable habitat (Overby and Agyagos, 2000).

An additional six sensitive terrestrial plant and animal species may occur in the project area but have not been observed (letter from Ken Anderson, District Ranger, Red Rock Ranger District, Coconino National Forest, Sedona, Arizona, In: Arizona Public Service Company, 2003). A sensitive mammal that may occur is the southwestern river otter. Sensitive herptiles in the project area could be Mexican garter snake, narrowhead garter snake, and Arizona toad. A tiger beetle (*Cicindela hirticollis corpuscula*) is a sensitive invertebrate that may occur in the project area. Tonto Basin agave is the only sensitive plant likely to occur.

Public Service notes that its wildlife surveys didn't detect the narrowhead garter snake and identified only three small areas of suitable habitat (Arizona Public Service Company, 1992, license application, exhibit E). Public Service did not identify the Tonto Basin agave in the course of surveys it conducted for the Arizona agave (EnviroNet, 1998). Public Service didn't survey the project area for any other sensitive species that may occur in the project area.

Environmental Impacts:

a. Effects of Full Flows on Riparian Vegetation and Wildlife

DIRECT EFFECTS

Riparian areas are very valuable for biological diversity, in addition to providing flood and erosion control and recreational opportunities. But riparian habitat is declining in abundance and quality throughout Arizona and the nation. Dahl (1990) reviewed estimated losses of wetlands in the United States between 1780 and the 1980's and reported a 36-percent loss for Arizona. Therefore, the wetland and riparian habitat supported by Fossil Springs and Creek is a limited and valuable resource.

Full flows would increase the elevation of the canyon substrate's wetting front. Over the short term, the saturation tolerance of some existing vegetation along Fossil Creek would be exceeded, and that vegetation would die. But over the long term, the increase in the wetting front might allow riparian vegetation to grow farther from the water's edge and thus to have a greater chance of surviving floods. The Fossil Creek canyon is narrow, however, and this narrowness may prevent riparian vegetation from expanding laterally to exploit the wetter substrate to a great extent.

Travertine formation in the Irving reach might benefit riparian vegetation growth in that reach by providing areas where sediment would be trapped and provide a substrate for more plant establishment.

The effects of full-flow releases on riparian vegetation and wildlife downstream from the Fossil Springs dam would be the same whether that dam is lowered 6 feet, lowered 14 feet, removed completely, or left in place.

Under present conditions, the lush vegetation of the Fossil Springs Botanical Area, upstream from the Fossil Springs dam, is partly maintained by the springs' flow and partly by the higher water table created by the small project impoundment. The more of the Fossil Springs dam that is removed, the greater the adverse effect on the Fossil Springs Botanical Area would be. Thus the no-action alternative, in which the dam is left whole, and the alternative of leaving the dam in place but halting flow diversions would have no adverse effect. Lowering the dam 6 feet would have less of an adverse effect than lowering the dam 14 feet, while removing the dam completely would have the greatest adverse effect. The Forest Service estimates that about one-third to one-half of the riparian habitat associated with the springs between the dam and the topographic nickpoint about 600 feet upstream from the dam would be seriously affected if complete dam removal occurs (Overby and Agyagos, 2000).

The Forest Service recommends that Public Service be required to monitor the success of the development of replacement riparian habitat for the lowland leopard frog downstream of Fossil Springs dam. The Forest Service also recommends that Public Service be required to monitor the presence, distribution, and abundance of special-status species (such as sensitive species and Management Indicator Species) to document that these animals persist and to identify if they are dispersing and using habitat downstream from the Fossil Springs dam. Finally, the Forest Service recommends that Public Service be required to implement adaptive management to ensure that the lowland leopard frog and other special-status species are able to maintain their populations until the Fossil Springs Botanical Area and Fossil Springs dam areas stabilize after partial or full removal of the dam.

Public Service agrees with the Forest Service that an adaptive management approach should be taken during the removal of project facilities and the restoration of the site. Public Service expresses concern, however, that adaptive management could lead to never-ending management responsibilities.

The monitoring and adaptive management measures the Forest Service recommends would ease the transition from a regulated to an unregulated stream system for many wildlife species. We agree with Public Service, however, that if the project is retired, there should be a cut-off date for Public Service's responsibilities at Fossil Creek. Should the Commission approve the license surrender, an appropriate cut-off date for any monitoring and adaptive management activities would be December 31, 2009, the date specified in the Settlement Agreement for the completion of the Removal and Restoration Plan activities.

INDIRECT EFFECTS--RECREATION

Recreational activities in the project area include swimming, hiking, camping, fishing, and wildlife viewing. Full flows may have an indirect adverse effect on Fossil Creek's riparian resources from increased recreational use. Public Service has observed reduced vegetative understory in areas of easy recreational access along Fossil Creek. The Forest Service has observed declines in vegetation numbers and plant health at Fossil Springs caused by the heavy amount of recreational use at the springs. As many as 150 people were at the springs during one weekend in the summer of 1993.

If full flows are restored, recreational use of Fossil Creek is expected to increase, as we discuss in the section on aesthetics, recreation, and land use. The reasons for this expected increase include the formation of relatively rare travertine basins and falls and the creation of pools suitable for swimming and angling. Evidence supporting this view was obtained during Public Service's development of the application for relicense. A news release was issued about Public Service's minimum flow studies in at least one newspaper. The news release said that more water would be flowing in the Fossil Creek channel during the sampling period. As a result, visitor use of the project area increased. In one area next to the Irving bridge, 30 cars

were parked. Over 50 people were observed recreating in the creek at this one spot.

Recreationists directly affect vegetation by trampling or by harvesting wood for campfires. Arizona State Parks (1989) finds that impacts to wildlife from recreation use can occur indirectly through habitat degradation and destruction, or directly through human contact and disturbance. Many wildlife species, such as the common black-hawk, are sensitive to human disturbance. Increased flows in Fossil Creek that increase recreational opportunities may decrease habitat suitability for black-hawks. However, as noted by Arizona State Parks (1989), recreational facilities should be sited or re-located in areas where impacts to habitat or direct encounters to terrestrial resources would be minimized.

b. Effects on Stehr Lake

The greatest effect on terrestrial resources of returning full flows to Fossil Creek would be experienced at Stehr Lake and the riparian and wetland habitat it supports, which would be lost soon after project flow diversions cease.

Stehr Lake, the regulating reservoir of the Childs Development, was originally 23 acres in size. Sediment accumulation during over 80 years of project operation has reduced the lake's depth and size and permitted the establishment of about 13 acres of cattails. Monotypic stands of cattails have reduced overall habitat value (Sojda and Solberg, 1993), leading to a decrease in wildlife species diversity.

If power generation at the project ceases, no flow would be diverted into the Childs conduit and Stehr Lake would dry up. (This impact would occur whether the Fossil Springs dam is lowered by 6 feet, lowered by 14 feet, left in place, or removed entirely.) Public Service proposes to breach the two earth-filled Stehr Lake dams after the lake water has receded. The emergent and riparian vegetation that the lake supports would die. Public Service would cut or turn over the cattails into the soil to reduce any future fire hazard.

Riparian habitat around Stehr Lake is used by special-status species such as the yellow-breasted chat, summer tanager, hooded oriole, and Bell's vireo. And as we discuss in the section on threatened and endangered species, the wetlands supported by Stehr Lake could provide habitat for the endangered Yuma clapper rail, although surveys have not detected the species there. This wetland and riparian habitat would shift to woody and herbaceous vegetation, such as mesquite, due to succession after full flows are restored to Fossil Creek and the lake's water supply is shut off. With the exception of the Yuma clapper rail, however, all of these special-status species are also known to occur along Fossil Creek. Therefore, the loss of Stehr Lake's wetland and riparian habitat would not likely have a significant effect on the yellow-breasted chat, summer tanager, hooded oriole, or Bell's vireo because these birds could utilize Fossil Creek habitat. We discuss the effect of this habitat loss on the Yuma clapper rail in the section on threatened and endangered species.

The Forest Service recommends that Public Service take the following measures to restore the Stehr Lake site to its pre-project condition: (1) contour the soil to match the surrounding natural grade; (2) retain existing native trees; (3) cut or turn over cattails to reduce future fire hazards; (4) plant disturbed areas with native vegetation; and (5) monitor water-dependent trees for mortality during the deconstruction period and remove dead and hazardous trees at the completion of deconstruction activities (Forest Service, 2003). These measures eventually would restore the Stehr Lake area to habitat similar to its natural, pre-project condition after flows to the lake cease. Implementation of these measures would not add significantly to project retirement costs.

c. Effects of Deconstruction Activities

The proposed removal of most of the project facilities, regardless of whether the Fossil Springs dam is partially removed, completely removed, or left in place, would disturb existing vegetation. In addition, the combination of ground disturbance and increased traffic on project roads could promote the invasion of noxious weeds.

Public Service has prepared Revegetation Guidance for the proposed facility removal and site restoration activities (Arizona Public Service Company, 2002d). Revegetation would aid in promoting establishment of native plant species and in preventing erosion, nutrient loss, and establishment of nonnative plants. The guidance states that disturbed areas associated with deconstruction areas would be seeded with mixes that are weed-free, composed of native seed only, and approved by the Forest Service. In some locations, trees and shrubs would be planted to provide initial canopy cover and structure for wildlife, and to provide better erosion control and bank stability. Public Service's guidance states that revegetation success would be monitored annually for a period agreed upon by Public Service and the Forest Service. Second plantings may be necessary if the first revegetation efforts are not successful.

Public Service's Revegetation Guidance describes in general terms measures to take to restore the project site. A more detailed, site-specific revegetation plan, prepared in consultation with the Forest Service, would be needed before the start of any ground-disturbing activities.

The project area has not been surveyed for noxious plant species that may be spread by deconstruction activities. Invasive or noxious plant species known to occur in the Fossil Creek Planning Area are tamarisk, Himalayan blackberry, bur clover, horehound, Johnson grass, and silverleaf nightshade. Public Service has prepared Noxious Weed Guidance (Arizona Public Service Company, 2002e). A more detailed, site-specific noxious weed management plan, prepared in consultation with the Forest Service, would be needed before the start of any ground-disturbing activities.

Bats may be using the eight project tunnels as roosts. Species that have the potential to be affected by the proposed project retirement include Allen's big-eared bat, which is a Forest Service High Priority Species. This species primarily dwells in caves and abandoned mine shafts within mountainous pine, pine/oak, and pinyon-juniper forests (Agyagos, 2002). Public Service proposes to install bat grates at the tunnel mouths to allow continued use while rendering the tunnels inaccessible to the public, in addition to concrete caps (letter from Nick Svor, Manager–Generation Engineering Services, Arizona Public Service Company, Phoenix, Arizona, July 8, 2003).

The Forest Service recommends that Public Service conduct bat surveys, including exit counts and roost inspections, to determine the presence of bats in the project tunnels and the identification of species. The Forest Service further recommends that if surveys show that bats are occupying a site, Public Service should provide effective access for bats by installing bat grates or other species-suitable control (concrete, rock, and/or fencing) that would prevent access by the public. Public Service's proposal to install grating in addition to concrete at all tunnel closures would preserve or enhance bat habitat and eliminate the need for monitoring.

The Forest Service recommends that Public Service avoid deconstruction activities that could result in aural or visual disturbance of special-status bird species in the riparian areas of Fossil Creek and Stehr Lake from February 15 through August 31. If deconstruction activities must occur within 0.25 miles of riparian areas during that time period, the Forest Service further recommends that Public Service conduct surveys for common black-hawks (sensitive and Management Indicator Species) and yellow-billed cuckoos (sensitive and candidate species); if the surveys identify nesting birds, Public Service should establish a 0.25-mile activity buffer around those locations for the duration of the species-specific breeding season (March 1 to July 30 for the black-hawk, June 1 to August 31 for the cuckoo). Public Service agrees to these recommendations.

We agree that the Forest Service's recommended measures would avoid or mitigate deconstruction activity disturbance of special-status birds such as the common black-hawk and yellow-billed cuckoo.

The Forest Service recommends that during project retirement and deconstruction activities that Public Service avoid removal, modification, or destruction of any *Agave* plant species to protect rare agaves and various rare invertebrates that depend on agaves for parts or all of their life cycles. This measure would mitigate the effects of the proposed action on these terrestrial resources.

Unavoidable Adverse Impacts: Riparian habitat in the Fossil Springs Botanical Area and near the Childs tailrace would decrease. The wetland and riparian habitat supported by Stehr Lake would be lost. As discussed above, however, increased flows in Fossil Creek would provide habitat for some of the species that currently use these areas.

4. Threatened and Endangered Species

Affected Environment: The following federally listed threatened, endangered, proposed, or candidate species may occur in the vicinity of Fossil Creek: bald eagle (threatened), Mexican spotted owl (threatened), southwestern willow flycatcher (endangered), Yuma clapper rail (endangered), yellow-billed cuckoo (candidate), razorback sucker (endangered), Colorado pikeminnow (experimental, nonessential),[15] loach minnow (threatened), spikedace (threatened), Chiricahua leopard frog (threatened), and Arizona agave (endangered).

a. Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is designated as a Management Indicator Species for low-elevation (1,500 to 3,500 feet) riparian habitat in the Tonto National Forest's Land and Resource Management Plan (Forest Service, 1985).

Most of Arizona's known breeding population nests on the Salt and Verde drainages. The Verde River system had eight breeding areas (out of the state's 28 as of 1990) that have produced 120 eaglets in 107 years of nest occupancy (Hunt et al., 1992). The nearest breeding area--the East Verde breeding area--is on the Verde River, about 3 miles downstream of the confluence with Fossil Creek. Seven nests have been known from the East Verde breeding area: four on cliffs, two in live cottonwood trees, and one in a cottonwood snag. Telemetry during the 1987 nesting season showed that the East Verde male flew up the Verde River as far as the Childs powerhouse (Hunt et al., 1992). The male visited Fossil Creek a number of times early in April, foraging for spawning suckers, and used hunting perches 2.5 miles up Fossil Creek. Hunt et al. (1992) say that the East Verde site's seclusion from human disturbance has probably contributed to its history of being the second most productive bald eagle breeding area in Arizona.

In 1998, an active bald eagle nest was found in the Cold Water breeding area, which is located at the confluence of Cold Water Creek and the Verde River, about 0.6 miles north of the Childs powerhouse (Forest Service, 2000). In 1998, the nest failed to produce young.

Bald eagles aren't known to use Stehr Lake, although the lake and its shoreline may provide foraging and nesting habitat.

[15] Experimental, non-essential populations are treated as species proposed for listing as threatened for purposes of Section 7 consultation under the Endangered Species Act [50 CFR § 17.83 (2002)].

In addition to the breeding population, eagles from northern states and provinces winter in Arizona. They usually arrive in the project area in late October or early November and leave in early to mid-April.

b. Mexican Spotted Owl

The Mexican spotted owl (*Strix occidentalis lucida)* is one of three subspecies of spotted owl found in the United States.[16] The Mexican spotted owl inhabits canyon and montane forest habitats across a range that extends from southern Utah and Colorado through Arizona, New Mexico, and west Texas, to the mountains of central Mexico (U.S. Fish and Wildlife Service, 2001).

The vegetative communities and structural attributes used by the Mexican spotted owl vary across the subspecies' range, but they consist primarily of warm-temperate and cold-temperate forests, and, to a lesser extent, woodlands and riparian deciduous forests (U.S. Fish and Wildlife Service, 2001). The Mexican spotted owl is a Forest Service Management Indicator Species for the late seral stage of mixed conifer and spruce/fir forests (Forest Service, 2002a). On the Coconino National Forest, the Mexican spotted owl occupies mixed conifer and ponderosa pine/gambel oak vegetation types, usually characterized by high canopy closure, high stem density, multi-layered canopies within the stand, numerous snags, and downed woody material (Forest Service, 2002a). Much of the time, suitable nesting and roosting habitat is located on steep slopes or in canyons with rocky cliffs, where dense vegetation or crevices or caves provide cool microsites for nests and roosts. Spotted owls have been known to nest in riparian gallery forests (U.S. Fish and Wildlife Service, 1995a).

The FWS has designated critical habitat for the spotted owl, but not in Gila and Yavapai counties, where the Childs Irving Project is located (U.S. Fish and Wildlife Service, 2001).

The Mexican spotted owl occurs within the Coconino National Forest's 36,260-acre Fossil Creek Planning Area (Agyagos, 2002). Three Mexican spotted owl protected activity centers (PAC's)–Sandrock, Calf Pen, and Horse--are located in the northeastern portion of the planning area.[17] PAC's are areas of at least 600 acres around known owl sites that contain the best nesting and roosting habitat in the area (U.S. Fish and Wildlife Service, 1995a). None of the three Forest Service PAC's are located in the project area. Surveys have not been conducted for Mexican spotted owls in the project area. The FWS says, however, that

[16] The other two subspecies are the northern spotted owl and the California spotted owl.

[17] As of 2001, there were 179 PAC's for spotted owl in the Coconino National Forest.

according to the Recovery Plan for the Mexican spotted owl (U.S. Fish and Wildlife Service, 1995a), the riparian area along Fossil Creek and the Verde River qualified as restricted habitat, and the lands within the Mazatzal Wilderness Area[18] boundaries, and the Fossil Springs Botanical Area qualify as protected habitat (letter from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, February 26, 2003, in Arizona Public Service Company, 2003). FWS further states that currently there is not suitable nesting habitat in the immediate project area: the riparian habitat along Fossil Creek does not provide the density and structure needed for good nesting habitat, and the Fossil Springs area provides suitable habitat structure, but its small size probably precludes its use by nesting owls.

c. Southwestern Willow Flycatcher

The Southwestern willow flycatcher (*Empidonax trailii* extimus) occurs in riparian habitats along rivers, streams, and other wetlands in the Southwest from May until August or September, when it migrates south to Mexico, Central America, and perhaps northern South America for the winter. This bird nests in thickets of trees and shrubs 13 to 23 feet tall, with a high percentage of canopy cover and dense foliage up to 13 feet above the ground. Habitat patches as small as 1.23 acres can support one or two nesting pairs of willow flycatchers (U.S. Fish and Wildlife Service, 1995). The willow flycatcher forages for insects within and occasionally above dense riparian vegetation. Extensive loss and modification of riparian habitats have occurred throughout much of Arizona, and southwestern willow flycatcher habitat is now largely absent or changed to poorer quality in the state.

Game and Fish (2003) conducts annual willow flycatcher surveys throughout Arizona, although not at Fossil Creek. FWS states that based on 2003 survey information to date, there are currently 348 flycatcher territories, 278 pairs, and 216 nests in Arizona (letter from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, July 2, 2003).

The Forest Service has conducted limited surveys for the willow flycatcher in riparian habitat at the springs, along Fossil Creek for 4 miles downstream of the springs, and at Stehr Lake. The Forest Service did not observe any willow flycatchers.

Public Service has also conducted willow flycatcher surveys (EnviroNet, 1998). Public Service examined USGS topographic maps, National Wetland Inventory maps, and aerial photographs as its initial step in identifying suitable willow flycatcher habitat. Then, on April 16, 1998, Public Service surveyed by helicopter habitat along Fossil Creek from Fossil Springs to the confluence of the creek with the Verde River, Stehr Lake, and the Verde River

[18] The Mazatzal Wilderness is located near or adjacent to the project, extending from about 0.5 mile south of the Irving plant to where the Childs tailrace discharges into the Verde River.

near the Childs powerhouse. These surveys identified three areas in the vicinity of the project that could have suitable habitat for the willow flycatcher. The three areas are:

- Area 1, located along Fossil Creek, about 800 feet downstream from the Irving powerhouse;
- Area 2, located along Fossil Creek, about 1.2 miles downstream of the Irving powerhouse; and
- Area 3, located along Fossil Creek, about 2 miles downstream from the Irving powerhouse.

Public Service conducted three surveys of these areas for potential suitable habitat according to the Sogge et al. (1997) protocol. Public Service detected no southwestern willow flycatchers in any of the three surveys.

The FWS has designated as critical habitat riparian areas within 328 feet (100 meters) of the edge of the Verde River from upstream of the town of Cottonwood (which is upstream of Fossil Creek's confluence with the river) down 90 miles to Horseshoe reservoir and two of the river's tributaries, Wet Beaver Creek and West Clear Creek.[19] Fossil Creek wasn't included in the critical habitat designation, so only the confluence of the creek with the Verde River within 328 feet of the river is critical habitat. The FWS states that primary constituent elements of the designated willow flycatcher critical habitat include the riparian ecosystem, including areas where dense riparian vegetation is not present, but may become established in the future.[20]

The current project boundary includes the following structures in the Childs area: the powerhouse, the substation, the switchyard, two shops, two office buildings, five houses for Public Service employees, a guest house, a domestic water treatment facility, and one unidentified building (Arizona Public Service Company, 1992, license application, Exhibit G-17). All these structures except the water treatment facility are located within willow flycatcher critical habitat, which includes areas within 328 feet of the Verde River.

The following description of potential willow flycatcher habitat in the Childs area is based on a July 19, 1996, site visit by Forest Service personnel. Woody vegetation in the

[19] Federal Register, volume 62, no. 140, July 22, 1997, and no. 161, August 20, 1997.

[20] Primary constituent elements are those physical and biological features of a landscape that a species needs to survive and reproduce. See 50 CFR §424.12.

Childs area consists of willows, ash, mesquite, sycamore, and cottonwood. The vegetation of the dispersed camping area south (downstream) of the Childs powerhouse includes most of the large sycamores and cottonwoods (up to 60 feet tall) growing in the Childs riparian zone, but lacks an understory. A trail used by recreationists extends upstream from the south camping area, passing the Childs powerhouse via a bridge, about 15 feet from the building, over the tailrace. An area of dense, multistoried riparian vegetation, 0.5 acres to 0.75 acres in size, is located adjacent to the tailrace, and between the bridge and the Verde River. This riparian vegetation is associated with tailrace discharges of up to 41 cfs. The Forest Service closed the dispersed campground north (upstream) of the Childs powerhouse in 1986; the campground site is vegetated by willows, mesquite, and, close to the river, small cottonwoods, but not as densely as the tailrace area.

Another area of willow flycatcher critical habitat related to the project exists where Fossil Creek flows into the Verde River, about 3 miles downstream from the Childs powerhouse. Under existing conditions, this reach of Fossil Creek has a minimum flow of 2 cfs. Vegetation in this area is characterized by widely scattered ash, hackberry, and sycamore (Sullivan and Richardson, 1993).

d. Yuma Clapper Rail

The Yuma clapper rail (*Rallus longirostris yumanensis*) occurs in freshwater marshes along the lower Colorado River, the Colorado River delta, and the west coast of Mexico from Sonora to Nayarit.

In the fall of 1997, wintering calls from a Yuma clapper rail population (15 to 50 individuals) in Tavasci Marsh, east of the Verde River upstream from the Childs powerhouse, were recorded (EnviroNet, 1998). Surveys were conducted at Tavasci Marsh during the 1998 breeding season to verify the wintering calls; rails were detected at Peck's Lake/Tavasci March in August (letter from Harv Forsgren, Regional Forester, Forest Service, Regional Office, Albuquerque, New Mexico, July 1, 2003).

Stehr Lake is the only part of the project area that currently could provide marsh habitat for the Yuma clapper rail. Public Service surveyed Stehr Lake on April 28, 1998, and May 27, 1998, but detected no Yuma clapper rails (EnviroNet, 1998).

e. Yellow-billed Cuckoo

The yellow-billed cuckoo (*Coccyzus americanus*), which is a candidate for listing as threatened or endangered and a Forest Service sensitive species, is a neotropical migrant that nests and forages in large tracts of undisturbed riparian deciduous forest where willow, cottonwood, sycamore, or alder occur. The yellow-billed cuckoo breeds from southern Canada south to the Greater Antilles and Mexico. This bird is common east of the Continental

Divide. The species' range and population numbers have declined substantially in the west, however, over the past 50 years, and now Arizona probably contains the largest remaining yellow-billed cuckoo population west of the Rocky Mountains (U.S. Fish and Wildlife Service, 2001a). Loss or degradation of the riparian habitat upon which this species depends is believed to be a major factor in this decline.

Wildlife surveys that Public Service conducted in 1991 along Fossil Creek and Stehr Lake did not detect this species (Arizona Public Service Company, 1992, relicense application, vol. 3). The Forest Service reports, however, that one of its biologists detected a yellow-billed cuckoo in the Fossil Creek riparian area (Agyagos, 2002).

f. Razorback Sucker

Razorback sucker (*Xyrauchen texanus*) was once common and widespread in warmwater reaches in many medium and large-sized streams in the Colorado River Basin, including the Verde River. It was used extensively as food by aboriginal cultures, and supported a commercial fishery as recently as 1949 (Bestgen, 1990). The species has minimal potential for sport fishing, but a high intrinsic value as an endemic of the Colorado River Basin and is scientifically interesting because of its unique morphology and variable life history. Razorback sucker may grow to 39 inches in length and weigh 11 to 13 pounds. Most, however, are smaller. Sizes of 18 to 30 inches in length are reported in Lake Mohave, Arizona. Adults can be identified by an abrupt sharp-edged dorsal keel behind their heads, thought to be an adaptation for strong river currents (Tyus, 1997). Razorback sucker grow about 2 to 3 inches per year, during the first 6 years, but later growth is very slow, as little as 1 inch per year (Bestgen, 1990). Sexual maturity is reached at about 14 inches (Barrett, 1992).

A large, long-lived, and potentially migratory species, razorback sucker historically survived in naturally fluctuating riverine environments because of an ability to spawn in a variety of flow conditions, early spawning and high fecundity. Its large adult size and longevity would allow it to survive through several consecutive seasons of no or low reproduction and recruitment, as occurred in the unregulated Colorado River Basin (Bestgen, 1990). Razorback sucker are adapted to periodic extreme flow regimes, turbulent waters, high turbidities, and warm water temperatures and show a unique tendency among native Colorado River mainstream fishes in that seasonal and perhaps year-round use of lentic and backwater environments is common (Tyus, 1997).

Early observers described "springtime runs" of razorbacks and other large-river fishes from mainstream environments into smaller tributaries, and frequently referred to spawning concentrations in small tributaries in the lower Colorado River Basin (Bestgen, 1990). Razorback sucker are sometimes found in tributaries or off-channel habitats prior to, or during, the presumed spawning season. The precise role of such habitats in the life history of the razorback sucker is unknown but may be related to feeding, resting, spawning, egg

maturation, or other activities associated with reproduction (Bestgen, 1990). Spawning in the lower Colorado River Basin occurs from January through April (Tyus, 1997). In the Verde River, razorback sucker fossil records have been found near Perkinsville, Arizona, about 75 miles upstream of the confluence of the Verde River and Fossil Creek (Minckley, 1993). The last reported collection of this species as wild in the Verde River was in 1954.

By 1981, the razorback sucker was recognized as being in danger of extinction (Barrett, 1992). The FWS and Game and Fish developed a Memorandum of Agreement to undertake a 10-year recovery program in an effort to delay or avoid its federal listing as an endangered species. During the recovery effort, over 10 million razorback sucker were stocked in the Verde and Salt River Basins, including 10,000 fingerlings in Fossil Creek above and below the Fossil Springs dam and 20,650 razorback of various sizes in the Verde River in the vicinity of the Childs powerhouse and the confluence of the Verde River and Fossil Creek (Barrett, 1992; Hendrickson, 1993; EnviroNet, 1998). Intensive recapture surveys found 519 total surviving razorback suckers, most in the upper Verde Basin (Hendrickson, 1993). In September 1990, 13 sub-adult razorback suckers were captured above the Fossil Springs dam; and using the capture depletion method, the population size at the springs was estimated to be 16 (Barrett, 1992). In 1994, 1995, and 1996, Game and Fish surveyed the reach from the Fossil Springs dam downstream to the Irving powerhouse using less intensive methods as part of a study of Verde River tributaries to determine the distribution of roundtail chub (Roberson et al., 1996). In 1996, Game and Fish added collection sites above the Fossil Springs dam and below the Irving powerhouse. No razorback suckers were observed or collected during this 3-year study.

After the surrender DEA was issued, Game and Fish and FWS commented that Fossil Creek downstream of Fossil Springs dam has been intensively surveyed since 1996 by multiple groups using multiple techniques (e.g., electrofishing, trammel netting, fall fish counts, and snorkel surveys). These surveys did not detect the presence of razorback sucker, although the stream below Fossil Springs dam is clear and flows are less than 5 cfs, making the probability of detecting razorbacks relatively high (letters from John Kennedy, Habitat Branch Chief, Arizona Game and Fish Department, Phoenix, Arizona; July 1, 2003, and Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, October 6, 2003).

The FWS has designated the Verde River, within the river's 100-year floodplain, from about Perkinsville downstream to Horsehoe dam as critical habitat for razorback sucker. This area includes the Verde River at its confluence with Fossil Creek, at the Childs powerhouse, and all of the Verde River between these two points.[21] The 100-year floodplain of the Verde River includes the Childs tailrace. Stocking of razorback sucker in the Verde River continued

[21] 59 Fed. Reg. 13,374-13,400 (1994).

into the 1990's, using juveniles about 12 inches long (EnviroNet, 1998). Surveys during 1989 and 1990 captured nine razorback suckers in the Verde River from the Childs powerhouse to a point about 19 miles upstream of the powerhouse (Hendrickson, 1993).

Primary constituent elements determined by the FWS to be necessary for the survival and recovery of the razorback sucker are water quality and water quantity delivered to a specific location in accordance with a hydrologic regime that is required for a particular life stage; areas that are inhabitable by fish for use in spawning, nursery, feeding, and rearing, or corridors between these areas; and food supply, predation, and competition, "although predation and competition are out of balance due to introduced nonnative fish species in many areas."[22]

g. Colorado Pikeminnow

The Colorado pikeminnow (*Ptychocheilus lucius*) is the largest member of the minnow family in the Colorado River Basin. Historically it was reported to reach lengths up to 1.8 meters (5.8 feet) and weights up to 36 kilograms (79 pounds), although confirmed sizes are smaller (U.S. Fish and Wildlife Service, 2002). They are long-lived, reaching over 40 years of age (U.S. Fish and Wildlife Service, 2002). Habitat for the Colorado pikeminnow consists of rivers with high silt content, warm water, turbulence, and variable flow by season below elevations of 4,000 feet above MSL (U.S. Fish and Wildlife Service, 2002). Migration movements of up to 200 miles have been reported, and fidelity to spawning grounds has been observed (Arizona Public Service Company, 2002a). Spawning occurs over clean cobbles and rubble in relatively swift waters from April through August in the upper Colorado River Basin. Juveniles utilize slackwater, backwater, and side channel areas with low or no current velocity and silt/sand substrates. Larger individuals are found in turbid, deep and strongly flowing waters. Young may enter the drift as larvae and be transported long distances, perhaps 100 miles, before settling into a nursery site (Arizona Public Service Company, 2002a). Backwaters may be important nursery areas for young pikeminnow. Young are highly mobile and may move among habitat types, but appear to seek out sites that provide the greatest warmth (Arizona Public Service Company, 2002a).

Colorado pikeminnow were extirpated from the lower Colorado River Basin in the 1970's (U.S. Fish and Wildlife Service, 2002), but were reintroduced in the Salt and Verde Basins in the 1980's as an "experimental, non-essential" population, meaning that their loss wouldn't be likely to appreciably reduce the likelihood of the survival of the species in the wild (Hendrickson, 1993). A total of 623,000 Colorado pikeminnow, generally less than 5 inches in length, were stocked to the Verde and Salt Rivers, including 10,000 at the Childs powerhouse in 1985 (Hendrickson, 1993).

[22] 59 Fed. Reg. 13,378 (1994).

During collection efforts to assess the success of the reintroduced fish, 56 Colorado pikeminnow were captured in the Verde River in November 1987 and February 1988. Forty-three of these were captured about 25 miles upstream of the Childs plant, and the remaining ones were captured further upstream. Public Service (2002a) states that the species may be present upstream or downstream of the Childs plant.

The only remaining wild populations of Colorado pikeminnow are in the upper Colorado River Basin, where they are listed as endangered. The FWS has determined that recovery is only necessary for the upper Colorado River Basin, although the need for recovery in the lower Colorado River Basin will be reviewed every 5 years (U.S. Fish and Wildlife Service, 2002). No critical habitat has been designated for the Colorado pikeminnow.

h. Spikedace and Loach Minnow

The spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*) are riffle-dwelling minnows, about 3 inches long that were federally listed by the FWS as threatened species on July 1, 1986, and October 28, 1986, respectively. Both species are endemic to the upper Gila River Basin and historically occurred in the Verde River. Both may have occurred in Fossil Creek historically. Currently, the nearest spikedace population is in the upper Verde River outside of the project area (Marsh, 1991). Currently, there are no loach minnow populations remaining in the Verde River (Marsh, 1991a).

On April 25, 2000, the FWS designated the lower 4.7 miles of Fossil Creek (from its confluence with the Verde River upstream to an unnamed upstream tributary), as critical habitat for the spikedace and loach minnow.[23] Also designated is the Verde River from the Fossil Creek confluence upstream and including the Childs powerhouse site. The critical habitat designations are applied to the 100-year floodplain of the listed reaches in Fossil Creek and the Verde River, including the Childs tailrace. In listing the Fossil Creek reach for critical habitat, the FWS stated that the reach contains all primary habitat elements for spikedace and loach minnow except sufficient discharge. The FWS further stated that the operators of the Childs Irving Project have agreed to provide enhanced flows to lower Fossil Creek, although the amount of flow restoration to the stream "is still under negotiation."[24]

Primary constituent elements that the FWS determined are critical to recovery habitat that are common to the spikedace and loach minnow include permanent, flowing, unpolluted

[23] 59 Fed. Reg. 13,378 (1994).

[24] 65 Fed. Reg. 24,331 (2000).

water; living areas for larvae with slow to moderate velocities in shallow water with abundant cover; water temperature ranges of 35-85 degrees Fahrenheit (^{o}F), an abundant aquatic insect food base; periodic natural flooding; an unregulated hydrograph, or if modified, a hydrograph that will support a native fish community; and habitat devoid of nonnative fish, or in which nonnative species are at levels that allow persistence of the native species.

Additional primary constituent elements listed by FWS for spikedace include living areas for adults with slow to swift flow velocities in shallow water with shear zones where rapid flow borders slower flow; areas of sheet flow at the upper ends of mid-channel sand/gravel bars and eddies at downstream riffle edges; living areas for juveniles with slow to moderate flow velocities in shallow water with moderate amounts of instream cover; sand, gravel and cobble substrates with low to moderate amounts of fine sediment and substrate embeddedness; pool, riffle, run and backwater habitat components; and low stream gradient.

Additional primary constituent elements listed by the FWS for the loach minnow include living areas for adults with moderate to swift velocities in shallow water with gravel, cobble and rubble substrates; living areas for juveniles with moderate to swift flow velocities in shallow water with gravel, cobble and rubble substrates; spawning areas with slow to moderate flow velocities in shallow water with uncemented cobble and rubble substrate; low amounts of fine sediment and substrate embeddedness; riffle, run and backwater habitat components; and low to moderate stream gradient.

i. Chiricahua Leopard Frog

There are 1997 records of the threatened Chiricahua leopard frog (from the Walts and Buckskin livestock watering tanks, a few miles north of Fossil Creek (EnviroNet, 1998). The frogs found at those tanks are the "rim" form of the Chiricahua leopard frog, which may be described as a separate species. The range of the species' rim form includes disjunct populations along the southern edge of the Colorado Plateau (Mogollon Rim and White Mountains) and headwater drainages to the south in Arizona and New Mexico. The elevation range of the rim form throughout the Mogollon Rim and the White Mountains is estimated to be from 3,500 feet up to 8,890 feet, most commonly occurring above 5,300 feet.

Public Service surveyed Fossil Creek, the project flume, Stehr Lake, and nearby livestock tanks for Chiricahua leopard frogs from July 29 to August 2, 1998 (EnviroNet, 1998). The only possible suitable habitat in the project area was found to be upper Fossil Creek, above the Irving powerhouse. No Chiricahua leopard frogs were found. The Forest Service states, however, that a single survey is not adequate to determine the absence of this species, and that since Fossil Springs and the upper part of Fossil Creek are within its known elevation range, the Chiricahua leopard frog may occur in the project area (letter from Harv Forsgren, Regional Forester, Forest Service, Regional Office, Albuquerque, New Mexico, July 1, 2003).

j. Arizona Agave

Arizona agave (*Agave arizonica*) is a plant that occurs in the transition zone between oak-juniper woodland and mountain mahogany-oak scrub at 3,000 feet to 6,000 feet elevation (EnviroNet, 1998). Its known habitats are characterized by steep, rocky slopes, but it can occur on drainage bottoms or relatively gentle slopes or saddles (Rutman, 1992). The closest known occurrences of this agave are Star Valley, about 25 miles southeast of the project, and the New River Mountains, 48 miles south of the project. This plant is anticipated to also grow in the Mazatzal Mountains, which at their closest are 6 miles south of the project area (Rutman, 1992).

Public Service conducted surveys for the Arizona agave in the project area on May 26-28, 1998 (EnviroNet, 1998). In the upper reaches of the project area, from the Fossil Springs dam downstream to the Irving powerhouse, Public Service surveyed the tract between the access road and 20 feet to the opposite side of the project flume. There are areas without access roads within the project boundary between the Irving powerhouse and Stehr Lake, so Public Service surveyed belts of at least 20 feet on either side of the project flume. In areas where the access road existed but diverged from the flume, Public Service conducted belt transects, about 60 feet wide. Public Service also surveyed the grounds of both the Irving and the Childs powerhouses. No Arizona agaves were observed during the surveys.

Environmental Impacts: Table 3 summarizes our findings regarding the effects of the proposed surrender on threatened, endangered, and candidate species, and where applicable, their critical habitats.

a. Bald Eagle

All four action alternatives–lowering Fossil Springs dam by 6 feet, lowering Fossil Springs dam by 14 feet, leaving Fossil Springs dam intact, and removing Fossil Springs dam completely–would involve ceasing project power generation and releasing full flows into Fossil Creek below the Fossil Springs dam. The release of full flows would enhance Fossil Creek's fish populations, and thus would increase the bald eagle prey base.

Under the proposed action, Stehr Lake would dry up. Fish and waterfowl supported by Stehr Lake would be lost, and thus the lake's potential eagle foraging habitat would also be lost. Water-dependent trees along the lake would probably die, resulting in a loss of potential nesting habitat. All four action alternatives would have these effects.

Powerline collision is one of the causes posited in the death of a bald eagle in Arizona. The transmission facilities included in the project license consist of (1) a 6.31-mile-long line connecting the Irving Development with the Childs Development and (2) a 200-foot-long line

connecting the Childs step-up substation to the switchyard. (A transmission line crosses the Verde River about 0.25-miles downstream of the Childs powerhouse, but that transmission line isn't part of the project.) Public Service proposes to remove the project transmission facilities, but would leave the Childs substation and those electrical system facilities required to continue serving customers. The removal of the project transmission facilities, which would occur in all four action alternatives, would decrease the risk of bald eagles colliding with powerlines in the project area.

Table 3. Effects of the proposed surrender on threatened, endangered, and candidate species.[1]

Species	**Status**	**Effect**
Bald eagle	Threatened	Not likely to adversely affect
Mexican spotted owl	Threatened	Not likely to adversely affect
Southwestern willow flycatcher	Endangered	Not likely to adversely affect
Critical habitat		Likely to adversely affect
Yuma clapper rail	Endangered	Not likely to adversely affect
Yellow-billed cuckoo	Candidate	Not likely to adversely affect
Razorback sucker	Endangered	Likely to adversely affect
Critical habitat		Likely to adversely affect
Colorado pikeminnow	Experimental nonessential	Would not jeopardize continued existence
Spikedace and loach minnow	Threatened	No effect
Critical habitat		Likely to adversely affect
Chiricahua leopard frog	Threatened	Not likely to adversely affect
Arizona agave	Endangered	No effect

[1] Source: the staff.

The two project transmission lines are unlikely to be electrocution hazards to bald eagles under current conditions because the reach of Fossil Creek that eagles use isn't near the Irving-to-Childs line and the Childs line is too short. Removal of those lines, however, would ensure that no electrocution hazard exists.

Surrender of the project license under any of the four action alternatives, leading to the restoration of full flows in Fossil Creek and the removal of project transmission facilities, would have a beneficial effect on bald eagles by increasing their prey base and decreasing their risk of powerline collision and electrocution. We discount the possibility of an adverse effect resulting from the loss of potential nesting and foraging habitat at Stehr Lake, because eagles have never been observed at the lake. Therefore, the proposed surrender would not likely to adversely affect the bald eagle.

b. Mexican Spotted Owl

FWS states that currently the immediate project area does not support suitable Mexican spotted owl nesting habitat: the riparian habitat along Fossil Creek does not provide the density and structure needed for good nesting habitat, and the Fossil Springs area provides suitable habitat structure, but its small size probably precludes its use by nesting owls (letter from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, February 26, 2003, in Arizona Public Service Company, 2003). Restoring full flows to Fossil Creek, as would occur under all four action alternatives, may increase the density and structure of riparian habitat along Fossil Creek if the width of the canyon permits, improving the nesting habitat value. Therefore, the proposed license surrender would not likely to adversely affect the Mexican spotted owl.

c. Southwestern Willow Flycatcher

The Southwestern willow flycatcher uses riparian vegetation for nesting and foraging. If the width of the Fossil Creek canyon permits, the restoration of full flows under any of the four alternatives would enhance riparian vegetation and thus conditions for this species. Riparian habitat at the confluence of Fossil Creek and the Verde River, within critical habitat for the species, may be enhanced. At the same time, the cessation of the Childs tailrace discharge would adversely affect the small area of dense riparian vegetation along the tailrace, also within critical habitat for the bird. Therefore, the proposed surrender would be likely to adversely affect designated critical habitat for the Southwestern willow flycatcher.

In conclusion, surrendering the project license and restoring full flows to Fossil Creek under all four action alternatives would not likely to adversely affect the endangered Southwestern willow flycatcher, but it would likely to adversely affect its critical habitat.

d. Yuma Clapper Rail

Stehr Lake is the only part of the project area that could currently provide Yuma clapper rail habitat. Restoring full flows to Fossil Creek under all four action alternatives would cut off the water that sustains the lake, and potential Yuma clapper rail marsh habitat would be lost. Surveys of Stehr Lake, however, did not detect this species. Therefore, surrendering the project license and restoring full flows to Fossil Creek would not likely to adversely affect the Yuma clapper rail.

The Forest Service states that if Public Service returns full flows to Fossil Creek, there is potential for cattail stands of 0.5-acre size to become established along the stream, providing potential nesting habitat that would compensate for the loss of habitat at Stehr Lake (letter from Harv Forsgren, Regional Forester, Forest Service, Regional Office, Albuquerque,

New Mexico, July 1, 2003). This potential would further ensure that the proposed action would not be likely to adversely affect the Yuma clapper rail.

e. Yellow-billed Cuckoo

The yellow-billed cuckoo (*Coccyzus americanus*) is associated with large tracts of riparian forest. If the width of the Fossil Creek canyon permits, the restoration of full flows under all four action alternatives would enhance riparian vegetation and thus nesting and foraging conditions for this species. Therefore, project license surrender and restoration of full flows to Fossil Creek would not be likely to adversely affect this candidate species.

f. Razorback Sucker

The 10-year recovery effort by FWS and Game and Fish failed to establish the razorback sucker in most areas of release because of predation by nonnative fish, possibly parasites, and habitat fragmentation, but found that its growth and survival rate appear predictable if hatchery-produced razorback sucker are released to isolated, predator-free habitats (Hendrickson, 1993). Predation on eggs and larvae is thought to be a major factor limiting recruitment to the juvenile life stage. Hatchery-produced razorback juveniles introduced into some streams in the Gila and Verde River drainage showed a marked tendency for downstream dispersal (Bestgen, 1990). Mass downstream movements at night were documented while very little upstream movement was noted (Bestgen, 1990). Tyus (1997) suggests that the tendency to enter the drift suggests that the species moves from spawning to nursery habitats.

With 13 captured sub-adult survivors from fewer than 10,000 introductions above the Fossil Springs dam, Fossil Creek had a considerably higher survival rate than the millions that were released in the Salt and Verde River Basins, and is more than what is known to have been recently produced by the wild population in the lower Colorado River at Lake Mohave (letter from Ken Anderson, District Ranger, U.S. Forest Service, Sedona, Arizona, February 5, 1999). The size of the recaptured razorbacks above the Fossil Springs dam shows that Fossil Creek is suitable for survival and growth to sub-adult stages (Barrett, 1992).

The survival of the other razorback suckers stocked at Fossil Springs and downstream of Fossil Springs dam is not known. Those stocked below the Fossil Springs dam could have survived and moved out of Fossil Creek into the Verde River. Those stocked upstream of the dam may have washed over the dam during floods and survived in Fossil Creek or the Verde River or may have been entrained at the project's Fossil Springs intake. The Forest Service found that it's probable that razorback sucker persist in Fossil Creek because it is exceedingly difficult to detect individuals that are numerically rare in the fish assemblage, particularly in deep water and complex habitats that are hard to sample (letter from Ken Anderson, District Ranger, U.S. Forest Service, Sedona, Arizona, February 5, 1999)

On October 13, 1999, Game and Fish collected two razorback suckers in Stehr Lake and released them back into the lake, and on September 6 and 7, 2000, Game and Fish collected 10 razorback suckers at Stehr Lake and, after measuring, weighing, and tagging them, relocated them to the Verde River near the Childs powerhouse (letters from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, July 2, 2003, and October 6, 2003). It's not known if the razorback suckers were transplanted from another location or reached the lake through entrainment of fingerlings stocked above the dam in 1988, although the FWS states that it's more likely that the razorback suckers were released into Stehr Lake (letter from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, October 6, 2003). For a long-lived fish such as razorback sucker, occasional recruitment to the Verde River from Fossil Creek could mimic what would have been found in a natural setting (letter from Ken Anderson, District Ranger, U.S. Forest Service, Sedona, Arizona, February 5, 1999). Episodic flood events in Fossil Creek could result in several strong cohort groups of razorback sucker co-occurring in the Verde River (letter from Ken Anderson, District Ranger, U.S. Forest Service, Sedona, Arizona, February 5, 1999).

The FWS advised the Commission by letter dated December 8, 1998, that the absence of this species would be difficult to demonstrate with the complexity of the Fossil Springs habitat and recommended that, for purposes of Section 7 consultation, the Commission assume that the species is present (letter from Sam Spiller, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, December 8, 1997, in EnviroNet, Inc., 1998). The FWS continues to find that the absence of razorback sucker above the Fossil Springs dam cannot be inferred because of the limited effectiveness of backpack electrofishing in deep pool habitat and the instream habitat complexity above the dam. The FWS states that while snorkeling surveys and trammel netting have been conducted above the dam, they were done sporadically and for short time periods. The favorable habitat conditions such as pools, increased volume of flow, and the absence of nonnative fishes suggest that razorback sucker could be present and that surveys above the dam have not been intensive enough to infer the species' absence (letter from Steven L. Spangle, Field Supervisor, U.S. Fish and Wildlife Service, Phoenix, Arizona, October 6, 2003).

Razorback suckers upstream of the Fossil Springs dam could migrate downstream after partial or full removal of the dam and benefit from the travertine habitat created by the return of full flows or move on to the Verde River. Any razorback suckers above the dam from the 1988 stocking would be adult-sized and able to navigate any obstacles in the stream. Should reproduction have occurred above the dam, some young razorback suckers may be lost as a result of downstream movement concurrent with sediment movement. We conclude, however, that the long-term benefits to the survivors from the newly created travertine habitat and from the potential use of Fossil Creek as a protected grow out reach for hatchery-produced juveniles would provide benefits that would outweigh the potential loss of some

individuals.[25]

The last reported capture of razorback sucker in Stehr Lake was about 3 years ago, and the captured fish were released into the Verde River. Although it is unknown whether razorback sucker continue to reside in Stehr Lake, we would need to proceed as if the species were present in the lake. If inflow to the lake is discontinued, a plan would be needed to capture and transport any razorback sucker in Stehr Lake to an appropriate location. Such a razorback sucker removal plan, prepared and implemented by Public Service in consultation with the FWS, Forest Service, Game and Fish, and the Bureau of Reclamation, and submitted to the Commission for approval prior to implementation, would be effective in protecting any razorback sucker in Stehr Lake if the Commission approves the surrender application.

Razorback sucker are known to occur in the Verde River in the vicinity of the Childs powerhouse. The powerhouse discharge currently enhances flow in a 3-mile reach of the Verde River that is within a reach of federally designated critical habitat for the razorback sucker that is more than 100 miles long. Table 4 shows the average monthly streamflows for the Verde River about 18 miles upstream of the Childs powerhouse. As seen in the table, flows in the Verde River would be most affected by cessation of power generation at Childs during May through December, when the Childs discharge would exceed 10 percent of the Verde River flow. In June, the lowest flow month, the Childs discharge would account for about 30 percent of the average flow in the Verde River. From January through April, the Childs discharge would provide less than a 10-percent increase in the Verde River flow.

Table 4. Average monthly streamflow in the Verde River near Camp Verde about 18 miles upstream of the Childs powerhouse.[1]

Month	Streamflow (cfs)	Month	Streamflow (cfs)
Jan	605	Jul	112
Feb	993	Aug	206
Mar	1,324	Sep	232
Apr	665	Oct	192
May	130	Nov	209
Jun	82	Dec	298

[1]USGS gage No. 09506000 from April 1, 1934, through September 30, 2002.

The proposed return of full flows to Fossil Creek would result in a corresponding

[25] Although not part of the action under consideration here, a multi-agency planning effort is underway to turn Fossil Creek into a refuge for native aquatic species. One element of this may be the introduction of hatchery-produced razorback sucker (letter from Ken Anderson, District Ranger, U.S. Forest Service, Sedona, Arizona, February 5, 1999).

reduction of about 43 cfs into the 3-mile reach of the Verde River. Spawning generally occurs from January through April, when Verde River flows are higher (table 4). The 43-cfs discharge to the Verde River from the Childs powerhouse likely provides some additional habitat benefits for razorback sucker during low-flow periods; however, if there were no discharge from the Childs plant, flows in the 3-mile reach would not be reduced below the existing inflows from the Verde River upstream of the 3-mile reach, and the affected reach represents a small portion of the over 100 miles of continuous critical habitat that is designated in the Verde River. Public Service proposes to leave the Childs tailrace intact, avoiding any disturbance in the 100-year floodplain of the Verde River.

We conclude that if project generation ceased, inflow would be cut off to Stehr Lake and any razorback suckers in the lake would be affected. They would, however, benefit from a plan prepared and implemented by Public Service, in consultation with the Forest Service, FWS, Bureau of Reclamation, and Game and Fish, to salvage and transplant any razorback sucker found in Stehr Lake to another location where they would be expected to survive. We conclude that any juvenile or adult razorback sucker above the Fossil Springs dam would benefit by full or partial removal of the dam because they would out-migrate to Fossil Creek, where the return of full flows would provide enhanced habitat or on to the Verde River where protected critical habitat is available. If reproduction has occurred above the dam, we conclude that there is some potential for young razorback suckers to be lost if washed downstream concurrently with sediment. The species is adapted to sediment-producing streams, however, and the young are known to migrate downstream after hatching. Young razorback suckers washed below the dam site would enter enhanced travertine habitat created by the return of full flows to Fossil Creek, but could also be subject to predation by nonnative fish if the Bureau of Reclamation's effort to eradicate nonnative fish from Fossil Creek is not successful.

In the Aquatic Resources section, we specify that it would be beneficial for Public Service to prepare and implement plans for erosion control, suspended sediment monitoring, and the use and storage of hazardous substances and to file these plans for Commission approval prior to the start of deconstruction. These measures would protect razorback sucker in Fossil Creek during any deconstruction of the Fossil Springs dam and razorback sucker and critical habitat in the Verde River during any deconstruction of the Childs facilities.

Given the potential for young razorback sucker to be lost from being washed over the Fossil Springs dam site concurrent with the release of sediments, we find that razorback sucker are likely to be adversely affected by full or partial removal of the Fossil Springs dam. Given that critical habitat for the razorback sucker in the Verde River would experience a reduction in flow, a primary constituent, we find that the reach is likely to be adversely affected. The proposed draining of Stehr Lake would be likely to adversely affect razorback sucker present in the lake, but implementing a plan to capture and relocate the fish would mitigate any adverse effects.

If power generation ceased and the Fossil Springs dam remained intact, the only change from the above descriptions of effects would be that any razorback above the Fossil Springs dam would continue to exist as at present.

g. Colorado Pikeminnow

Colorado pikeminnow do not occur in Fossil Creek, but are known to occur in the Verde River in the vicinity of the Childs powerhouse. As discussed for razorback sucker above, the additional discharge in the 3-mile reach currently provided by the Childs plant discharge likely provides some habitat benefits for Colorado pikeminnow during low-flow periods (table 4). Colorado pikeminnow spawning occurs from April to August in the upper Colorado River Basin, but may occur earlier in the lower Colorado River Basin because of earlier runoff. Because of the long migratory distances covered by these fish in reaching spawning grounds and the known tendency of larvae to drift long distances downstream, we conclude that any adverse effects for the Colorado pikeminnow in a 3-mile reach would be limited, and therefore, would not jeopardize the continued existence of experimental, nonessential species.

If power generation ceased at the project and the Fossil Springs dam remained intact, the continued existence of the Colorado pikeminnow would not be jeopardized for the reasons described above.

h. Spikedace and Loach Minnow

Because these species do not currently occur in Fossil Creek or the reach of the Verde River affected by the project, we find that the cessation of project operations and full or partial removal of the Fossil Springs dam would have no effect on the spikedace or loach minnow.

Because sediment can adversely affect the habitat of these small fish, we considered whether the 4.7 miles of listed critical habitat in Fossil Creek would be affected by the release of sediments from full or partial dam removal. Public Service (2002f) estimates that the weight of accumulated sediment behind the Fossil Springs dam is 36,600 tons and it could take several years to a decade for it to be flushed from the stream. Public Service estimates that flows equal to a 2-year recurrence event would have sufficient energy to move a portion of the sediments, and Monroe (2002) estimates that the flows of a 5-year recurrence event would be needed. Recurrence flows that would move sediment at the dam site are further discussed in the Geology and Soils Resources section.

Monroe (2002) estimates that the average annual sediment load for Fossil Creek above the dam would range from 10,310 to 44,900 tons, with highest annual yield for the watershed estimated at 234,600 tons. We conclude that the amount of sediment that would be released

for full dam removal would be close to the annual average for the watershed upstream of the dam. Therefore, should the dam be fully removed in an average sediment year, the maximum sediment transported would be in the estimated range of 46,310 to 80,900 tons, or well below the largest estimated volume for a 1-year period. The estimated sediment behind the top 6 feet of the dam is about 4,600 tons. If the top 6 feet of the dam were removed in an average annual sediment year, the estimated range for the year would be from 14,910 to 49,500 tons. If the top 14 feet of the dam were removed in an average sediment year, the estimated range would be proportional between the estimated ranges for full removal and the removal of the top 6 feet of the dam.

We find that the sediment stored behind the dam, even when adding the estimated load from the upstream watershed, would be within the capacity of the downstream channel to transport. Additionally, absent extreme storm events after the dam is removed, the sediments would be washed downstream over a number of years, further limiting any potential effects. Critical habitat for both species in Fossil Creek would be enhanced by the return of full flows because additional habitat would be created in currently dewatered areas, particularly riffle, run, and Edgewater habitat and the insect food base would increase.

Critical habitat for both species in the Verde River is likely to be adversely affected by a flow reduction of 43 cfs, a primary constituent element, in over 3 miles of listed critical habitat. Public Service proposes to leave the Childs tailrace intact, avoiding sediment disturbance in the 100-year floodplain, including the listed critical habitat. We find, however, that any adverse effects would be limited because flows in the project reach of the Verde River would not be reduced below the existing inflows from the Verde River upstream from the project reach, and the length of the 3-mile reach would be small compared to the number of designated critical habitat miles in the Verde River. Because the 4.7 miles of critical habitat in Fossil Creek that would be enhanced is longer than the 3 miles of critical habitat in the Verde River where flow would be reduced, we find that there would be a net gain in enhanced critical habitat in Fossil Creek.

As discussed in the Aquatic Resources section, critical habitat in Fossil Creek and the Verde River would benefit by the preparation and implementation of plans, in consultation with the Forest Service, FWS, Bureau of Reclamation, and Game and Fish, for suspended sediment monitoring and the storage and use of hazardous substances during deconstruction work.

Given that critical habitat for the spikedace and loach minnow in the Verde River would experience a reduction in flow, a primary constituent element, we find that the reach is likely to be adversely affected.

If power generation ceased at the project and the Fossil Springs dam remained intact, we find that the cessation of project operations would have no effect on the spikedace or loach

minnow because these species do not currently occur in Fossil Creek or the reach of the Verde River affected by the project. Listed critical habitat for both species in Fossil Creek would be enhanced, while listed critical habitat in the Verde River would be adversely affected as described above.

i. Chiricahua Leopard Frog

Public Service's survey found no Chiricahua leopard frogs. The Forest Service, however, states that a single survey in 1998 is not adequate to determine that this species is absent. We believe that the survey results cannot be ignored, but are willing to change our finding from "no effect" to the more conservative "not likely to adversely affect" that the Forest Service recommends. The proposed restoration of full flows and removal and restoration activities under all four action alternatives would not ~~be~~ likely to adversely affect the Chiricahua leopard frog.

j. Arizona Agave

The Arizona agave wasn't located by botanical surveys in the project area, so the proposed removal and restoration activities under all four action alternatives wouldn't affect this plant.

Unavoidable Adverse Effects: The razorback sucker is likely to be adversely affected by the potential loss of young razorback sucker coincident to sediment washing out from behind the Fossil Springs dam. Additionally, the razorback sucker in Stehr Lake would ~~be~~ likely to be adversely affected by the draining of Stehr Lake, although the implementation of a plan and transport them to a location where they would be expected to survive would mitigate any adverse effects. Cessation of power generation, and thus Childs tailrace discharges, would be likely to adversely affect designated critical habitat for the Southwestern willow flycatcher, razorback sucker, spikedace, and loach minnow by or in the Verde River.

5. Aesthetics, Recreation, and Land Use

Affected Environment

Variations in the State of Arizona's physical geography have a direct effect on its climate. The three basic climatic zones, desert, steppe, and highlands, cause temperatures to vary from below zero in the higher elevations during winter to over 110 ^{o}F in the desert during summer (Arizona State Parks, 1989a). This unique and diverse natural environment has contributed to an increase in the State's population, which is projected to increase through the year 2030. For the Childs Irving Project area, the Arizona State Comprehensive Outdoor Recreation Plan (SCORP) shows population increases for Gila County (29,255 in 1970 to 37,080 in 1980) and Yavapai County (37,005 in 1970 to 68,145 in 1980) (Arizona State Parks,

1989a). Thus, based on the Arizona SCORP and other plans (Arizona State Parks, 1989; Forest Service, 1987; Forest Service, 1985) we expect population growth to generate increased demand for the existing recreational resources within the river basin. Consequently, the State's climate and population, as well as its economic growth, provide significant recreational opportunities that contribute to a cumulative beneficial effect on recreation and aesthetics, as discussed below.

a. Aesthetics

Prominent visual features in the Childs Irving Project area include Fossil Creek Canyon; Mogollon Rim of the Colorado Plateau; Verde River Valley; fall foliage in the mountains surrounding Fossil Creek; and the Childs Irving Hydroelectric Project, especially the 16,578-foot-long Irving flume, which is a dominant feature viewed from Forest Road 708.

The visual qualities of the Fossil Creek bypassed reach are most often viewed at two different scales. Visitors to the area can get an overview of Fossil Creek from the roads and trails that provide access. In addition, these vistas often include, and may be dominated by, the mountainous Mogollon Rim of the Colorado Plateau. Many visitors also spend time examining at least a portion of Fossil Creek. The visual qualities of the landscape enjoyed by swimmers, hikers, picnickers, and others are likely to be dominated by the stream's water, boulders, and riparian vegetation (Arizona Public Service Company, 1993).

b. Recreation

The Fossil Creek watershed can be separated into seven recreation areas: the Mazatzal Wilderness, Fossil Creek Wilderness, Fossil Springs, Fossil Creek, Stehr Lake, Childs (dispersed camping area), and the Verde Wild and Scenic River.

MAZATZAL WILDERNESS

The Mazatzal Wilderness, which is administered by the Tonto National Forest, is located south of the project and includes the lower portion of Fossil Creek. Recreational use of this wilderness area is distinct from that of the project area largely because of difficult access from the Childs Irving Project area (Arizona Public Service Company, 1992, relicense application, vol. 3). The general remoteness and rugged terrain offer hiking, fishing, bird watching, and photography (Forest Service, 1987).

FOSSIL CREEK WILDERNESS

The Fossil Creek Wilderness boundary abuts the Fossil Springs area and is outside of the Childs Irving Project boundary. The area contains 10,433 acres and encompasses a steep, wide canyon at the edge of the Colorado Plateau. Recreation data figures indicate that visitor

use is light, making it one of the least-used wilderness areas on the Coconino National Forest. Published information about the wilderness typically highlights solitude as one of its key attributes.

The limited visitation is attributed to unavailable water, difficult access, and seasonally high temperatures. Visitor information data denote that a large portion of the Coconino National Forest's dispersed recreationists are seeking opportunities that offer a reprieve from Arizona's heat in the summer months as well as places that are easily accessible.

FOSSIL SPRINGS

Fossil Springs, where the springs that feed Fossil Creek surface, is a small, 6-acre wooded area that attracts many visitors. A wilderness ranger report shows that 155 visitors were observed at Fossil Springs on one summer Saturday. Activities at Fossil Springs include swimming, hiking, camping, fishing, wildlife viewing, and exploration of prehistoric ruins.

Most visitors access the springs via the Fossil Springs trail. This is a fairly steep trail that descends approximately 1,400 feet in elevation over a 4-mile length. Another popular access route is via the Flume Road (the Flume Road Trail). The Flume Road Trail is used by Public Service for maintaining the Irving flume. It is closed to public vehicular traffic due to its narrow width and blind curves. The Flume Road Trail is 4 miles long and is on a gentle grade. Access to the trailhead is upstream from Irving, about 5 miles from Strawberry and Pine, Arizona.

FOSSIL CREEK

The entire length of Fossil Creek was listed on the Nationwide Rivers Inventory of free-flowing rivers in 1993 (National Park Service, 2003) and is potentially eligible for inclusion in the Wild and Scenic Rivers system. The upper 7 miles of the creek, from the Fossil Springs dam to the Mazatzal Wilderness boundary has the potential classification of recreational. The lower 7 miles of the creek, from the Mazatzal Wilderness boundary to the Verde Wild River Area boundary, has the potential classification of wild. Fossil Creek’s Outstandingly Remarkable Values are geology, fish, wildlife, history, and other values.

The creek channel from the Fossil Springs dam to the Irving powerhouse receives limited use by recreationists. The rough and brushy terrain attracts only the hardiest hikers. During an August 1994, inventory, the Forest Service determined that the few camping areas being used were located less than 300 feet from a road and had pools of water nearby.

STEHR LAKE

Stehr Lake is located about 10 miles from the towns of Strawberry and Pine, Arizona. Local residents fish Stehr Lake for warmwater species, such as largemouth bass, channel

catfish, and common carp. The lake currently has less than 5 acres of open water because of sedimentation and emergent vegetation. Parking is limited and there are no built facilities. Although no use data has been collected, public use of Stehr Lake is reportedly light.

CHILDS

Childs is a dispersed camping area on the banks of the Verde Wild and Scenic River. It is 20 to 25 miles from the nearest paved road. This camping area is popular year-round. Visitor data indicates that, during a summer weekend in 1993, more than 75 people were camped at the Childs site. The popularity of the camping area is due to its scenery, isolation, water, and the proximity to the Verde Hot Springs, which is located on the south bank of the Verde River, a few hundred yards upstream of the Child powerhouse.

VERDE WILD AND SCENIC RIVER

Forty-one miles of the Verde River are designated Wild and Scenic. For the first 18.7 miles--from Beasely Flat just outside of Camp Verde to the Mazatzal Wilderness boundary--the river is labeled "scenic." From the Mazatzal Wilderness to the confluence of Red Creek the river is designated as "wild." The Childs powerhouse, which predates the wild and scenic designation, is located on the banks of the Verde River in the area labeled "scenic." The outstandingly remarkable values of the Verde Wild and Scenic River are historic and cultural resources, fisheries and wildlife, and scenery.

The Verde River provides excellent water-based recreation opportunities. Increasing demand for opportunities that cater to people interested in renting canoes, guided raft trips, shuttle services, and cultural studies creates small business opportunities along the Verde River. The Forest Service states that the restoration of flows to Fossil Creek will attract more visitors to the area and would likely increase recreation use in the Verde Wild and Scenic River corridor. The Forest Service also states that future recreation management is being addressed in the development of the Verde Wild and Scenic River Comprehensive River Management Plan (letter from Harv Forsgren, Regional Forester, Forest Service, Regional Office, Albuquerque, New Mexico, July 1, 2003).

The Forest Service determined, by letter dated July 1, 2003, that the Childs Irving Project license surrender would have no direct and adverse effects to the river's free-flowing condition, water quality, or outstanding remarkable values; will not invade the area or unreasonably diminish the values of the Verde Wild and Scenic River.

c. Land Use

The Fossil Creek area includes four range allotments: Fossil Creek (Coconino National Forest), Deadman Mesa (Tonto National Forest), Calf Pen (Coconino National Forest), and

Ikes Backbone (Tonto National Forest). Most of the Childs Irving Project area lies within the Fossil Creek allotment, which permits use for 477 cattle from November through April, as well as a temporary permit for eight cattle and five horses (letter from Michele James, Grand Canyon Trust, July 3, 2003) and the Deadman Mesa allotment, which permits use for 125 heads from October through May.

Fossil Springs is excluded from grazing through the use of fences with walk-through gates and horse gates. The northwest side of Fossil Creek (Coconino National Forest side) has been fenced from Fossil Springs downstream past the Irving powerhouse to the junction of Forest Roads 708 and 502 for about 45 years. Cattle have access to a 0.75-mile reach of the Coconino National Forest side of Fossil Creek, where private land abuts the stream, for 15 days during the winter. A 1.5-mile-long section of the southeast side of the stream (Tonto National Forest side), from Fossil Springs downstream, was fenced in 1995. Additionally, the Forest Service has applied new grazing utilization standards to cattle allotments on the Verde River that are designed to benefit habitat for the endangered razorback sucker by enhancing and restoring the ecological integrity of the river channel and floodplain (letter from Ken Anderson, District Ranger, U.S. Forest Service, Sedona, Arizona, February 5, 1999).

There are seven livestock watering tanks along the flume. These tanks are filled by siphoning water from the project flume for the purpose of watering cattle. Three of these tanks are located above the Irving powerhouse and four below.

Environmental Impacts: Project license surrender in accordance with the Settlement Agreement to first discontinue operation, and later to remove nearly all above-ground facilities would eventually restore visual quality, and sustain most recreational opportunities and land use in the area with minor short-term effects. Long-term effects on cattle grazing and associated use of the watering tanks, located along the flume, would occur.

a. Aesthetics

Construction equipment, noise, dust, traffic, erosion, and sedimentation associated with project removal activities under the four action alternatives would adversely affect aesthetics in the project area, in the short term for as long as it takes the disturbed sites to revegetate. Sedimentation effects from project facility removal could reach downstream to the Verde Wild and Scenic River, but again, those effects would be short-term.

Long-term enhancement of aesthetics would result from the removal of most project facilities, site restoration, the restoration of instream flows in the bypassed reach, and travertine deposition in the upper reaches of Fossil Creek. The major long-term benefits aesthetically from the four action alternatives would be the restoration of instream flows and travertine deposition. Based on Public Service video documentation of a range of flows in Fossil Creek between 5 to 43 cfs, there is a noticeable increase in visual character as flow

increases. Cascades between pools become more visually dominant, and pools are more distinct. With flows of 43 cfs, the deeper and faster moving water creates more whitewater and rapids, covering up cascades and boulders.

Travertine deposition in the upper reaches of Fossil Creek would create a stairstep pattern of pools or terraces that would be likely to significantly enhance scenic quality. Streams that support these travertine formations are quite rare. The nearest such stream, Havasu Creek, is located about 130 air miles from the project, on the Havasupai Indian Reservation south of Grand Canyon National Park. The tribe charges a reservation entrance fee and a fee for overnight camping (Havasupai Tribe, 2003). The travertine formations occur at the base of the 100-foot-high Havasu Falls, which can be reached only by foot or horse over a 10-mile-long trail of moderate difficulty. In contrast, although Fossil Creek does not have a waterfall like Havasu Falls, access to Fossil Creek's travertine reach would be considerably easier, and currently the Forest Service charges no fees.

The removal of the 16,578-foot-long Irving flume, which would occur as part of any of the action alternatives, would also be a significant improvement because it's one of the few project linear features that noticeably contrasts with the landscape. On the other hand, the project structures that are proposed to be left standing for historic interpretation would continue to detract from the natural-appearing landscape.

Regarding Fossil Springs dam, we consider four alternatives for removing the 25-foot-high concrete diversion dam: (1) retaining the existing structure; (2) lowering it by 6 feet and retaining the remaining structure; (3) lowering it by 14 feet or more and retaining the remaining structure; and (4) removing the entire structure. From a long-term aesthetics perspective, option (4) could have the most benefit by completely restoring the site to a pre-project condition. Options (2) and (3) would have some drawbacks because some scarring where the dam was lowered would be evident unless or until that area blends with the surface color and texture of the remaining undisturbed concrete. The more of the Fossil Springs dam that is removed, the greater the long-term adverse effect on the existing riparian vegetation growing upstream, as we discuss in the section on terrestrial resources, and the greater the adverse effect on the upstream scenic quality. It's difficult to evaluate the potential visual and auditory effects of water spilling over the dam or what remains of it under the first three options versus what the flow effect at the dam site might look like with the entire structure removed.

b. Recreation

Project retirement in accordance with the Settlement Agreement to first discontinue operation of the project, and then later remove most of the above-ground facilities, should significantly increase public interest in recreating in the bypassed reach of Fossil Creek over the baseline condition. New, year-round water-based recreation opportunities would be

created, and any resulting travertine formation could create a series of relatively rare basins and falls. Based on Public Service's video documentation of a range of flows up to 43 cfs and the current popularity of the Fossil Springs area, hiking, swimming, and tubing use of the formerly bypassed reach could become significant, depending on how the Forest Service manages public use of the resource.

Public Service's proposed Removal and Restoration Plan requires the removal of the flume road between the Irving powerhouse and the Fossil Springs dam. Although closed to public vehicular traffic, the flume road is used by hikers to access the Fossil Springs area. If the road is removed and the road bed revegetated as proposed, it may cease to be a viable route to access Fossil Springs. The surrender application and its Removal and Restoration Plan do not specify the disposition of other project roads. If the Commission approves the surrender application, a requirement for Public Service to consult with the Forest Service and prepare a plan for the final disposition of all project roads and bridges, taking into account the Forest Service's land management objectives, would mitigate any adverse effects of road removal on other resource uses.

Under all four action alternatives, the existing limited fishing opportunities at Stehr Lake would be lost.

c. Land Use

The Forest Service's new grazing utilization, previously mentioned, would reflect an integrated management approach that considers other resource values such as fishery habitat- - one that we find complimentary to the State of Arizona's objectives in its comprehensive plan entitled "Arizona Rivers, Streams, & Wetlands Study". With the implementation of livestock management decisions, vegetation cover should improve within the project vicinity. As a result, an increase in vegetation cover should decrease soil erosion and sedimentation into the watercourses and thereby, protect the fishery resource.

Under the four ~~action~~ alternatives, alternative water sources for cattle would have to be explored, because flume removal would render the watering tanks located along the flume useless. The Charles Ward Trust, which holds a Forest Service permit to graze cattle in the Fossil Creek Range Allotment within the Coconino National Forest, states that the proposed surrender would significantly impact its ability to graze cattle as provided by the permit (letter from Walter C. Richburg, Property Manager, Charles Ward Trust, July 7, 2003). The Forest Service manages this land for grazing and other purposes, and any alternative water sources should be addressed through the Forest Service.

Unavoidable Adverse Impacts: Under the four action alternatives, construction activity associated with the removal of most of the above-ground facilities would result in increased traffic, noise, and dust levels in the short term, and would temporarily affect the visual quality,

recreation, and land use in the project area. Fishing opportunities at Stehr Lake and cattle watering sources would be lost.

6. Cultural Resources

Affected Environment: Public Service conducted a cultural resources survey of the project area (Effland and Macnider, 1991; Macnider et al., 1991). The established FERC project boundary for the Childs Irving Project constituted the bulk of the area of potential effect (APE) for the original relicensing effort, and included lands around the Childs Irving Project facilities, Irving flume system, Childs flume system, Stehr Lake area, the right-of-way of a telephone line, and access roads. The APE also extended to several stretches along Fossil Creek outside the project boundaries of the Childs and Irving flume systems. These stretches along Fossil Creek were not inventoried, however. The 1991 survey identified a total of 54 archeological and historic sites in the project area, of which the following are listed, eligible, or potentially eligible for inclusion in the National Register of Historic Places (National Register): the Childs Irving Hydroelectric Facilities (Historic Facilities), a historic district listed in the National Register on August 9, 1991 (counted here as one site); and 48 archeological and historical sites. The Coconino National Forest identified an additional 12 archeological sites that lie outside the project area but within the Fossil Creek drainage (Neal, 2003).

a. Historic Facilities

The Historic Facilities were constructed in two phases: the Childs Development in 1908-1909, and the Irving Development in 1915-1916. The national significance of the Historic Facilities deals with the period from 1909 to 1920 involving the increased need for electricity to support the emerging mining, agricultural, and supporting commercial economies of central Arizona (Neal 2003). The two hydroelectric developments were critical in supplying Prescott, Phoenix, the Verde Valley, and surrounding communities with a reliable source of energy. The project works are considered eligible for inclusion in the National Register under Criterion A as a crucial source of electricity for Arizona during the first part of the twentieth century, and under Criterion C for their superb design and engineering characteristics, which reflect the simple but elegant efficiency of a hydroelectric system that was constructed in one of the most remote areas in the continental United States. Much of the project was hauled in pieces by mule train over 19th-century dirt roads and trails, and was principally built by Mexicans, Yavapai, and Apache laborers, the last of which a mere decade before had been prisoners of war with the United States.

The suitability for hydropower development along Fossil Creek had been recognized as early as 1901. At the time, smaller mining establishments in the copper-rich Jerome region were struggling to pay high energy costs for the importation of coal and petroleum, and for the generation of steam power. They realized that hydropower offered a much more affordable

rate on generating electricity. As a result, Mrs. Iva Tutt and a group of investors formed the Arizona Power Company in 1902 to begin preparation for the construction of two power plants along Fossil Creek (Effland and Macnider, 1991). Arizona Power Company began construction on the Childs Power Plant in April 1908. Between 1908 and 1909, approximately 600 men and 450 mules and burros were employed under the direction of Chief Engineer R.S. Masson during the power plant's construction. Due to the success of the Childs facility, the Irving Power Plant was constructed along similar lines between 1915 and 1916. Electricity was originally transmitted through two routes from the Childs powerhouse, the first running up the Verde Escarpment up across the Bradshaw Mountains to Jerome, and then through the Black Hills to Prescott. A second route for electric transmission from Childs formed a loop around the Verde Valley. After mining was exhausted in central Arizona by the beginning of the 1920's, the combined generation of the Childs Irving Project began to supply electricity to Phoenix. In fact, 70 percent of Phoenix's electricity was supplied by the project in 1920 (Effland, 1989). The two decades from 1920 to 1940 were considered as the formative period for the development of Phoenix, to which the Childs Irving Project was instrumental in its success. The Historic Facilities have been actively operated since they were built, with relatively minimal changes made to the district components and project operation.

As discussed above, the Historic Facilities are significant in two areas. First, they were instrumental in the economic development of Yavapai County from 1908 to 1920, providing the first reliable source of electrical service to the middle Verde Valley and nearby mining areas, and then for providing dependable electrical power for the rapid growth of Phoenix and vicinity from 1920 to 1940. Second, the Historic Facilities are a significant engineering feature, as an early working example of: (1) a simple engineering design for hydropower applied to a high-relief topography; (2) the efficient use of flows and design techniques to provide a high static head for generation; (3) the efficient use of flows and design to generate power at two separate power plants along the flow line; and (4) design innovations in the generating and transmission equipment that allow greater dependability in generating and distributing electrical power. In 1976, the American Society of Mechanical Engineers recognized the engineering significance of the Historic Facilities by designating them a National Historical Mechanical Engineering Landmark, number 11 in the Society's Landmark series.

As listed in the National Register, the Historic Facilities consist of 32 contributing buildings and structures (table 5).[26] An additional 27 noncontributing buildings and structures

[26] Refer to appendix C, National Register registration form for the Childs-Irving Hydroelectric Project, for more detail on the overall historic context, contributing and noncontributing elements, descriptions of major property types, and project works. Detail on the proposed disposition of property types associated with the Childs Irving Project can be sought in the associated Historic Properties Management Plan.

associated with the project are considered noncontributing elements (table 6). These latter elements are considered noncontributing because they have either been modified to the point of losing their overall historic integrity or were recently constructed. Nonetheless, the noncontributing buildings and structures are replacements in kind for the most part (replacement with similar modern counterparts).

b. Archeological and Historic Sites

The 48 potentially eligible sites in the project area and 12 additional sites along the Fossil Creek Drainage consist of four basic site types: (1) Southern Sinagua sites dating A.D. 800-1450, (2) Yavapai/Apache sites dating to the Protohistoric Period, (3) historic sites associated with the construction and operation of the Historic Facilities, and (4) multiple occupations of (1) (2), and (3) sites (table 7).

There are a variety of Southern Sinagua site types that have been located within the project area: (1) medium-size pueblos (habitation sites) (10 or more rooms) (one); (2) small pueblos (3 or more rooms) (habitation sites) (nine); (3) pothouses (early habitation sites) (one); (4) field houses (temporary use structures near farming areas) (eight); (5) agriculture areas (seven); (6) limited activity areas (temporary use areas) (eight); and (7) petroglyph sites (four). Most date A.D. 1125 to 1450. A group of seven sites, however, dates to A.D. 800 to 1125.

Table 5. National Register-contributing components of the Childs Irving Hydroelectric System[1]

Feature number	Property type/name	Location within system	Construction date
1	Capture point/Fossil Creek diversion dam	Irving	1915
3	Intake system	Irving	1915
5	Flume tunnel #1	Irving	1915
9	Inverted siphon (Hot Water Siphon)	Irving	1915
13	Sandbox and spill gate	Irving	1915
14	Penstock pipe	Irving	1915
15	Irving powerhouse	Irving	1915
17B	Storehouse and cottage	Irving	1915
18	Flume intake and forebay	Irving	1915
19	Concrete flume	Childs	1915 (in current form)
22	Flume tunnel # 1	Childs	1908-1909
23	Flume tunnel # 2	Childs	1908-1909

24	Sally Mae/Purple Mountain siphon intake	Childs	1908-1909
25	Sally May/Purple Mountain siphon	Childs	1908-1909
26	Flume bridge no. 2	Childs	1908-1909
27	Flume bridge no. 3	Childs	1908-1909
28	Flume bridge no. 4	Childs	1908-1909
29	End of Sally May/Purple Mountain siphon	Childs	ca. 1920
30	Steel flume on trestles	Childs	ca. 1920
31	Flume tunnel no. 3	Childs	1908-1909
33	Flume tunnel no. 4	Childs	1908-1909
35	Flume tunnel no. 5	Childs	1908-1909
36	Flume tunnel no. 6	Childs	1908-1909
38	Stehr Lake and dams	Childs	1908
39	Pressure tunnel intake	Childs	1908-1909
40	Flume tunnel no. 7	Childs	1908-1909
41	Reinforced concrete pipe	Childs	1908-1909
42	Stand pipe/surge tank	Childs	1908-1909
43	Penstock pipe	Childs	1908-1909
44	Childs powerhouse	Childs	1908-1909
46	Childs office/icehouse	Childs	1908-1909
None	Ash Creek transmission line	Childs	1908-1910 (for contributing portions)

[1]Neal, 2003.

Table 6. National Register-noncontributing components of the Childs Irving Hydroelectric System.[1]

Feature number	**Property type**	**Location within system**
2	Automatic cleaner	Irving
4	Steel flume on trestles	Irving
6	Three rock sheds	Irving
7	Three still wells	Irving
8	Siphon intake	Irving
10	Flume bridge no. 1	Irving
11	Flume bridge no. 2	Irving
12	Flume bridge no. 3	Irving

16	Irving substation/transformer	Irving
17A	Office and storage building	Irving
not listed	Irving houses	Irving
not listed	Foundations, pipes below grade	Irving
not listed	Flume bridge (APS no. 9)	Childs
not listed	Flume bridge (APS no. 3)	Childs
not listed	Flume bridge (APS no. 2)	Childs
20	Rock shed	Childs
21	Flume bridge no. 1	Childs
32	Flume bridge no. 5	Childs
34	Concrete trough	Childs
37	Flume bridge no. 6	Childs
45	Childs substation/transformer	Childs
47	Machine shop	Childs
not listed	Childs houses	Childs
not listed	Childs microwave stations	Childs
related transmission lines/substations	Cedar line	Related transmission lines/substation
related transmission lines/substations	Sycamore substation	" "
related transmission lines/substations	Polard Junction substation	" "
related transmission lines/substations	Walker substation	" "
related transmission lines/substations	Prescott substation	" "
related transmission lines/substations	Jerome substation	" "
related transmission lines/substations	Verde line	" "
	Copper Canyon substation	" "
	Irving line	" "

[1]Neal, 2003.

Table 7. Archeological and historic sites in the project area that are considered eligible to the National Register.[1]

Site No. (AR-03-04)	**Site type**	**Cultural affiliation**	**Time period**
01-258	Possible wickup site	Yavapai/Apache	Protohistoric
01-259	Sherd and flaked stone scatter	Southern Sinagua	A.D. 800-1125?
01-260	Possible pit house habitation	Southern Sinagua	A.D. 800-1125
01-261	Sherd and lithic scatter	Southern Sinagua	A.D. 800-1125
01-262	Agriculture, roasting feature	Southern Sinagua	A.D. 800-11124
01-265	Small pueblo, historic petroglyph	Southern Sinagua, Euroamerican?	
01-558	Artifact scatter with petroglyphs	Southern Sinagua	Undated prehistoric
12-04-694	Construction site, first generating station	Euroamerican	1908-1909
01-700	Possible agricultural site	Southern Sinagua, Euroamerican	A.D. 1125-1450 1902-1916
01-701	Flume tender's house site	Euroamerican	1915-1916+
01-702	Field house site with petroglyphs	Southern Sinagua	A.D. 1125-1425
01-703	Work camp	Yavapai/Apache, Euroamerican	1915-1916+
01-704	Farmstead	Southern Sinagua	
01-705	Agriculture, roasting features	Yavapai/Apache	Protohistoric
01-706	Pueblo, work camp	Southern Sinagua, Euroamerican	A.D. 1125-1425 1915-1940's
01-707	Agriculture	Southern Sinagua?	Undated prehistoric
01-708	Agriculture, roasting pit	Southern Sinagua, Yavapai/Apache	Camp Verde Phase?, Protohistoric?
01-709	Agriculture	Southern Sinagua	Undated prehistoric
01-710	Sherd and lithic scatter; camp?	Southern Sinagua	Undated prehistoric

01-711	Pueblo (human remains), work camp	Southern Sinagua, Euroamerican, Yavapai/Apache?	A.D. 1300-1425, 1915 to present
01-712	Work camp	Euroamerican, Yavapai/Apache?	1915-1916
01-713	Small pueblo	Southern Sinagua	A.D. 1150-1400
01-714	Pueblo, possible work camp	Southern Sinagua, Euroamerican, Yavapai/Apache?	A.D. 1125-1300?, 1900's-1930's
01-715	Petroglyphs	Southern Sinagau, Euroamerican	A.D. 1125-1450, 1900 to present
01-716	Schoolhouse	Euroamerican	1925-1948
01-717	Construction site	Euroamerican	1908-1909
01-718	Pithouse, work camp, refuse dump	Southern Sinagua, Euroamerican, Yavapai/Apache	Undated prehistoric, 1908-1930's
01-720	Construction site	Euroamerican	1908-1950
01-1132	Field house, roasting features	Southern Sinagua, Yavapai/Apache	Protohistoric
01-1133	Artifact scatter, roasting pit, camp, refuse dump	Southern Sinagua, Yavapai/Apache, Euroamerican	Protohistoric?, 1910's-1930's.
01-1134	Farmstead, roasting pit, can dump	Southern Sinagua, Yavapai/Apache?, Euroamerican	Camp Verde Phase?, unknown, recent
01-1135	Field house	Southern Sinagua	Undated prehistoric
01-1136	Habitation (Sally May house)	Euroamerican	1910's-1950's
01-1138	Work camp	Euroamerican	1908-1940's or 1950's
01-1139	Construction camp	Euroamerican	1908-1909
01-1140	Possible wickiup site	Yavapai/Apache	1910's-1920's
01-1141	Small pueblo	Southern Sinagua?	Undated
01-1142	Small pueblo with petroglyphs	Southern Sinagua, Euroamerican	Undated prehistoric, 1926
01-1143	Pueblo	Southern Sinagua	A.D. 1125-1300
01-1145	Small pueblo, can dump	Southern Sinagua, Euroamerican?	A.D. 1300-1425?, 1900-1930's
01-1146	Possible camp, refuse	Yavapai/Apache, Euroamerican	Post-1900
01-1147	Possible field house	Southern Sinagua	Camp Verde Phase
01-1148	Sherd and lithic scatter	Southern Sinagua	Undated prehistoric

01-1149	Small pueblo or farmstead	Southern Sinagua	Undated prehistoric
01-1150	Petroglyph panel	Southern Sinagua	Prehistoric, Protohistoric
01-1151	Roasting pit	Yavapai/Apache	Unknown
01-1152	Field house, work camp, trash dumps	Southern Sinagua, Yavapai/Apache	Undated prehistoric, 1908-1940's
01-1153	Work camp (West Portal)	Euroamerican	1908-1909+

[1]Adopted from Neal, 2003.

Table 8. Archeological and historic sites in the Fossil Creek Drainage.[1]

Site number	**Site type**	**Cultural affiliation**	**Time period**
01-258	Possible wickiup site	Yavapai/Apache	Protohistoric
01-703	Work camp	Yavapai/Apache, Euroamerican	1915-1916+
01-705	Agriculture, roasting features	Yavapai/Apache	Protohistoric
01-708	Agriculture, roasting pit	Southern Sinagua, Yavapai/Apache	Camp Verde Phase? Protohistoric?
01-718	Pithouse, work camp, refuse dump	Southern Sinagua, Euroamerican, Yavapai/Apache	Undated prehistoric, 1980-1940's
01-1132	Field house, roasting features	Southern Sinagua, Yavapai/Apache	Protohistoric
01-1133	Artifact scatter, roasting pit, camp, refuse dump	Southern Sinagua, Yavapai/Apache, Euroamerican	Undated prehistoric, 1980-1940's
01-1134	Farmstead, roasting pit, can dump	Southern Sinagua, Yavapai/Apache, Euroamerican	Camp Verde Phase?, unknown, recent
01-1140	Possible wickiup site	Yavapai/Apache	1910's-1920's
01-1146	Possible camp, refuse	Yavapai/Apache, Euroamerican	Post-1900
01-1151	Roasting pit	Yavapai/Apache	Unknown
01-1152	Field house, work camp, trash dump	Southern Sinagua, Yavapai/Apache	Undated prehistoric, 1908-1940's

[1]Adopted from Neal, 2003.

This group of seven sites, previously mentioned, is restricted to the Childs Development area, and ~~is~~ composed of one habitation site (the only pithouse site in the inventory), a field house, an agricultural site, and four limited activity areas.

The eligible Southern Sinagua sites are significant on an individual basis because each site has sufficient integrity to provide important information about different aspects of Southern Sinagua life of the area. The sites are also likely significant as an archeological district. The number and variety of the eligible sites suggest that a significant portion of the settlement system used to exploit the Fossil Creek area is still intact and represented by the sites, and that the sites can be more fully understood as a larger adaptive unit.

The Yavapai/Apache sites consist of (1) possible wickiups, (2) roasting pits, (3) agricultural areas, and (4) traditional cultural places. The sites are also considered significant on an individual basis in gaining more information on the change between the Southern Sinagua and Yavapai occupations, the relationship between the Yavapai and Apache cultures, and past and current lifeways of the Yavapai/Apache.

The historic sites in the project area associated with the construction and operation of the Historic Facilities are the following: (1) a school (one near Irving powerhouse); (2) construction sites/work camps/limited activity areas (nine for the Childs Development, six for the Irving Development); (3) habitation sites (two for the Childs Development, one for the Irving Development); (4) petroglyphs (two); and (5) a road. All except the school and one petroglyph date from A.D. 1902 to 1915 when the Childs and Irving developments were constructed. Seven sites in category (2) were abandoned at completion of construction of the developments; the others were kept in use for varying periods of time from the 1920's to the present. The school dates 1925 to 1948, the habitation sites 1910's to 1930's, 1910 to 1950's for the Childs Development, and 1915 to 1969 for the Irving Development. The road dates 1900's to 1920's.

A significant number of the original construction sites and maintenance areas for the Historic Facilities are still intact and retain integrity, and provide important information about construction and operation of the Historic Facilities. Although these sites have been determined eligible for inclusion in the National Register on an individual basis, their significance and the Historic Facilities themselves are probably better understood in terms of a historic district that includes both the Historic Facilities and these sites based on the settlement or land use system concept, stressing relationships and function as a unit suggested for the archeological district.

Environmental Impacts:

a. Previous Cultural Resource Compliance

For a new license, Public Service proposed a Programmatic Agreement (PA) and Appendix A to ensure that the project would continue to be operated as it has been in the past, so as not to have adverse effects on the historical integrity of the Historic Facilities District and the eligible archeological and historical sites. A number of measures and conditions were stated in the PA's attached Appendix A that Public Service would do to monitor, protect, or mitigate adverse effects to the Historic Facilities and eligible archeological and historical sites in consultation with the Forest Service, Arizona State Historic Preservation Officer (SHPO), and Yavapai-Apache Nation.

Commission staff revised the wording of Public Service's PA and Appendix A, but left the proposed measures and conditions essentially the same. The intended outcome of the PA was for Public Service to produce a cultural resources management plan (CRMP) that would be approved by the Commission and other consulting parties within 1 year after license issuance. The CRMP would have been used to carry out all proposed measures for resolving potential adverse effects to historic properties within the Childs Irving APE for the term of a new license. The PA would have been implemented as a condition of any new license, and was signed by Commission staff, Public Service, the SHPO, Forest Service, Yavapai-Apache Nation, and the Advisory Council on Historic Preservation. The PA would have gone into effect if a new license had been issued for this project.

b. Public Service's Proposal for Surrender of License, Based on the Settlement Agreement and Surrender Application

In the Settlement Agreement, Public Service did not offer any specific proposal for the treatment of the Historic Facilities, other than stating that it would leave intact the Childs powerhouse, Childs icehouse, the Stehr Lake outlet/pressure tunnel intake, and portions of the Sally May siphon as part of a historical record for the area. Public Service also provided a table in the Settlement Agreement that listed what eligible structures associated with the Historic Facilities would be removed as a result of surrendering the project and restoring the landscape. Public Service did not address any potential adverse effects to eligible archeological and historical sites previously located within the APE as a result of project surrender and restoration.

After the January 10, 2001, technical conference between Commission staff, Forest Service, Yavapai-Apache Nation, and other interested parties, and in the surrender application, Public Service acknowledged that it expects to identify a new APE as a result of project removal. Public Service further stated that modifications or additional APE's, along with protection and/or mitigation measures to existing historic properties, would be incorporated

into a CRMP that would in turn be implemented through a new PA for the license surrender.

In its first response to the Settlement Agreement in October 2002, the Forest Service stated that Public Service's Removal and Restoration Plan for project surrender did not address any protection or treatment of adverse effects to eligible structures associated with the Historic Facilities. The Forest Service further stated that the decision on which eligible structures to retain should be framed and influenced by the following criteria: (1) the cost of long-term management; (2) the value of those properties to interpretation of the Childs Irving Project; and (3) the historic significance of the property. As for eligible structures listed for destruction in Public Service's list, the Forest Service recommended retaining the surge tank, sections of the concrete flume, and certain powerhouse equipment in order to help with interpreting and understanding the history of hydroelectric development in the area.[27] As a condition of any surrender order by the Commission, the Forest Service in June 2002, also stated that a new PA needs to be developed to address all cultural resource concerns, including whether additional or different eligible structures associated with the Historic Facilities should be retained.

c. Effects of Surrender of License

Removing the majority of eligible structures under any of the four action alternatives would have an adverse effect on the integrity of the Historic Facilities for the following reasons: (1) the operation and maintenance of the Historic Facilities as a working project would be halted; (2) substantial portions of the project, such as the Irving flume, would be removed for safety and other reasons; and (3) there would be disturbance and vandalism of the remaining Historic Facilities from increased visitation and recreational use of the area from higher flows in Fossil Creek.

Eligible archeological and historical sites in the vicinity of the Historic Facilities would likely be disturbed by removal of facilities and inadvertent disturbance and vandalism that would occur with increased visitation and recreational use of Fossil Creek after project removal and overall restoration of the Childs Irving Project area. Disturbance and vandalism would be greater than in the no-action alternative, given higher flows in both reaches of Fossil Creek and the proximity of unattended Historic Facilities and archeological and historical sites to recreational activities.

In July 2002, and in response to Public Service's Settlement Agreement and surrender application, we followed with an additional information request (AIR) that Public Service provide us with a draft Historic Properties Management Plan (HPMP) that would clarify and

[27] The Deputy SHPO, in a letter to Public Service dated August 9, 2002, also advocated retaining equipment in the Childs powerhouse.

describe how Public Service intends to resolve adverse effects to all historic properties that might be affected by surrendering the project license.[28] We began with our expectations from the January 10, 2001, technical conference and follow-up March 26, 2002, telephone conference that Public Service was to: (1) do an analysis of the balance between retaining the technological integrity of the hydro facility and removing the facilities, (2) provide measures for protection of archeological resources during project removal and related deconstruction activities, (3) do an analysis of what additional adverse effects might occur to existing project facilities and archeological resources with increased visitation to the project area after cessation of generation and removal of project works, and (4) develop a management plan that incorporates the three items above, in addition to describing the new APE.

Based on the above written comments from the Forest Service, and discussions with Public Service, the Forest Service, SHPO, and Yavapai-Apache Nation, we instructed Public Service that it needed to incorporate into the HPMP the following items:

(a) a description of the project removal action and how it would affect historic properties located within the APE. This section also needs to describe specific effects such as erosion, added sedimentation, exposure from the drawdown of Stehr Lake, construction/deconstruction activities, structure removal, restoration/remediation efforts, increased vandalism, and recreation; and how any of these effects might have an impact on each of the historic properties;

(b) a detailed description of the APE as a result of project removal, including lands for site setup, staging areas, borrow pits, spoil areas, temporary structures, equipment lots, additional recreational activities, erosion and sedimentation above and below Fossil Springs dam, and areas exposed as a result of the permanent drawdown of Stehr Lake. The APE also needed to include all remediation activities that might affect historic properties;

c) a plan and timetable for the completion of additional cultural resources inventories needed as a result of the permanent drawdown of Stehr Lake and on other previously un-inventoried lands along Fossil Creek that might be included in the APE;

(d) a plan and timetable to conduct National Register eligibility evaluations of any newly discovered cultural resources as a result of additional cultural resources inventories;

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[28] The HPMP is essentially equivalent to past CRMP's filed with the Commission; however, the Commission and the Advisory Council have recently issued Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects that went into effect on January 11, 2002. As a result of these guidelines, Commission staff has agreed with the Advisory Council to call such management plans "HPMP's," instead of "CRMP's."

(e) a plan and timetable for completion of Historic American Buildings Survey and Historic American Engineering Record (HABS/HAER) documentation and recordation of all affected contributing elements related to the Childs Irving Historic Facilities District, as well as other eligible historic structures that might be located in the APE;

(f) an analysis of balancing between retaining the technological integrity of the hydro facility and the need for removal of some of the facility;

(g) an analysis of what additional increased visitation to the project area would occur after cessation of generation and removal of project works; and

(h) measures for mitigation and/or protection of historic properties that might be affected during dam removal and related deconstruction activities, including a recommended course of action resulting from the two analyses listed above.

Public Service filed a draft HPMP with the Commission on March 17, 2003. We issued a new draft Memorandum of Agreement (MOA) along with the draft HPMP for review and comment on April 8, 2003.[29] We received comments on the draft MOA and draft HPMP from the Forest Service, SHPO, Council, Yavapai-Apache Nation, and Public Service. Based on these comments, we resubmitted a final MOA on July 9, 2003, and confirmed that Public Service was in the process of revising the HPMP. We further convened a telephone conference on August 7, 2003, to follow up on any additional issue pertaining to revising the HPMP. The outcome of the August 2003, telephone conference was that Public Service would consult further with the involved parties in crafting the final HPMP, and would file a final revised HPMP with the Commission. Public Service filed its final revised HPMP on October 7, 2003.

To complete the Section 106 process, pursuant to the National Historic Preservation Act, we will issue a final MOA before the Commission takes any action on the surrender application; the MOA would implement the final HPMP in the event the Commission issues a surrender of license order for the Childs Irving Project.

The final HPMP includes the following provisions for Public Service to carry out for the resolution of potential adverse effects to historic properties, which include the Historic

[29] We are calling it a MOA--as opposed to a PA--since the Commission would no longer have jurisdiction over the project once all of the terms and conditions for the surrender have been met by Public Service. Technically, PA's are intended for longer-term programs such as a new license, whereas MOA's are designed for shorter-term programs such as a license amendment, or in this case, license surrender.

Facilities, and archeological and historic sites: (1) HAER documentation of all of the 32 contribution elements of the Historic Facilities, (2) additional audio and visual documentation of the Historic Facilities for future reference, (3) retention or partial retention of 17 of the contributing elements of the Historic Facilities for historical interpretive purposes, (4) relocation of other contributing and noncontributing elements of the Historic Facilities for interpretive purposes, (5) monitoring and protection procedures for all of the known archeological and historic sites within the APE, (6) procedures for protecting archeological and historic sites from inadvertent effects caused by project removal, (7) procedures for securing and protecting inadvertent discoveries for new sites and human remains (8) designation of project personnel for oversight and training purposes, and (9) contracting cultural resource professionals to carry out specific tasks requiring cultural resource expertise before and during project removal and site restoration.

d. Effects of Lowering the Fossil Springs Dam Crest by 6 or 14 Feet, or Total Removal of the Fossil Springs Dam

Regardless of whether the crest of Fossil Springs dam is lowered by 6 or 14 feet, or totally removed, adverse effects to the dam would be essentially the same, because the original integrity of the dam would be destroyed as a result of partial or total removal. Potential adverse effects to archeological sites near the dam would also be expected to be the same irrespective of either partial or total dam removal, since construction activities in and around the dam would not be significantly different. There would be some variation on erosion and sedimentation above and below Fossil Springs dam, depending on either partial or total dam removal. If only 6 feet of the dam crest were removed, it would be expected that less erosion or sedimentation would occur, which in turn would have less effect on adjacent archeological sites. Proportionally increased adverse effects would occur to adjacent archeological sites if 14 feet of the dam crest were removed, or if the entire dam were taken out.

e. Effects of Leaving the Fossil Springs Dam Intact

Leaving the Fossil Springs dam intact would not cause an adverse effect, because the dam is located on federal lands managed by the Forest Service and, therefore, would remain under federal protection. Furthermore, eligible archeological sites near Fossil Springs dam would not be adversely affected, since no construction activity would occur, and there would not be any increase in erosion or sedimentation as a result of partial or total dam removal.

Unavoidable Adverse Impacts: With implementation of the MOA and associated HPMP, there would be no unavoidable adverse impacts.

D. NO-ACTION ALTERNATIVE

Under the no-action alternative, the project would continue to operate as required by

the existing license. No new environmental protection, mitigation, or enhancement measures would be implemented, including provisions of the Settlement Agreement.

Travertine would continue to form on the project flume and other facilities, mostly below the Irving powerhouse. The aquatic community of Fossil Creek would remain the same: (1) headwater chub and roundtail chub would remain separated from each other by the Fossil Springs dam; (2) the native fish community upstream of the Fossil Springs dam would not be invaded by nonnative species from below the dam; (3) no suspended sediment monitoring or hazardous substance plan would be needed; (4) existing habitat throughout Fossil Creek would continue without any of the enhancements described in the section on aquatic resources; (5) a flow of 0.2 cfs would continue below the Fossil Springs dam, and (6) a flow of 2.2 cfs would continue to be discharged into the stream at the Irving powerhouse.

Conditions for the Colorado pikeminnow and for the razorback sucker and its critical habitat in the Verde River would continue as under existing conditions, with a 3-mile reach receiving 43 cfs from the Childs powerhouse discharge. Conditions for razorback sucker in Stehr Lake and Fossil Creek would continue as they currently exist. There would be no effect on the spikedace or loach minnow because neither species occurs in Fossil Creek or the reach of the Verde River affected by the project. Listed critical habitat for the spikedace and loach minnow would continue as under existing conditions.

Also under the no-action alternative, Stehr Lake would remain in place with its limited fishery; the lake would continue to fill with sediments, however, increasing cattail growth and progressively reducing the open water area, further limiting the fishery and restricting access for fishing.

Riparian vegetation supported by Fossil Creek would remain the same, except for effects caused by potential increase in recreation~~al~~ use.

Public Service's management has maintained the historic integrity of the hydroelectric project facilities and archeological sites in the vicinity of the project, so if Public Service continued to manage the project area as it had in the past, there would be no effect on cultural resources.

VI. DEVELOPMENTAL ANALYSIS

In this proceeding~~,~~ the Commission must decide whether or not to accept Public Service's application to surrender its hydropower license for the Childs Irving Project, remove most of the project facilities, and permanently restore full flow to Fossil Creek. Consequently, this section presents the costs of project removal in accordance with Public Service's proposed plan and any prospective modifications to that plan.

Under the proposed project license surrender, Public Service would terminate project operation on December 31, 2004--restoring full flow to Fossil Creek--and complete the restoration of the project site no later than December 31, 2009. The proposed site restoration plan requires the removal of most of the above-ground portions of the project's extensive water conveyance facilities. The Childs powerhouse, Childs icehouse, Stehr Lake outlet/pressure tunnel intake, and portions of the Sally May siphon would be kept as a historical record of the project and selected cottages at the Childs power plant site would remain for use by the Forest Service. The Childs substation is part of Public Service's integrated electric transmission system and would remain in service.

At the time of the surrender application filing, Public Service proposed to remove 6 feet from the top of the 25-foot-high by about 100-foot-long, concrete gravity Fossil Springs diversion dam. Based on subsequent consultation with the agencies and the Commission's AIR, Public Service looked at three other alternatives for the Fossil Springs dam: (1) leaving the dam in place, which would require structural stabilization to bring the dam into compliance with current factors of safety against failure; (2) lowering the dam by 14 feet or more, which would not require anchoring the remaining portion of the dam; and (3) complete dam removal. Information filed by Public Service following the issuance of the surrender DEA indicates that Public Service is now proposing to lower the dam by between 14 feet and complete removal. We consider all four of these action alternatives in this FEA.

A. COSTS OF PROJECT RETIREMENT ALTERNATIVES

Table 9 summarizes the estimated cost of the four retirement alternatives. We assume most of these costs would be incurred in the period after cessation of project operation on December 31, 2004, until completion of project retirement and facility removal no later than December 31, 2009. The majority of these costs would relate to removing almost 14 miles of project water conveyance structures in an environmentally sensitive way, and restoring project lands afterwards. As Table 9 shows, the cost of Fossil Springs dam removal under the three removal alternatives would be a relatively small part of the total.

Table 9. Estimated cost of Childs Irving Project retirement alternatives.[1]

Alternative	Estimated cost
Proposed plan with Fossil Springs dam left in place	$11,151,000
Proposed plan with Fossil Springs dam lowered 6 feet	$11,656,000
Proposed plan with Fossil Springs dam lowered 14 feet	$11,766,000
Proposed plan with Fossil Springs dam removed	$12,096,000

[1]Source: Arizona Public Service Company, 2002b.

B. COST OF ENVIRONMENTAL PROTECTION AND MITIGATION MEASURES

The cost estimates given in table 9 include the cost of Public Service's proposed erosion control and site revegetation and provisions for handling petroleum and hazardous products. Table 10 lists the estimated costs for measures recommended the Forest Service, and Game and Fish that we assume may not be included in the estimates provided by Public Service.

C. NO-ACTION ALTERNATIVE

The 7-MW Childs Irving Project would continue to operate as it does now, providing a dependable capacity of 4.2 MW and generating an average of 36,500 megawatt-hours (MWh) per year of electricity at a cost of about $827,440 ($23/MWh).

D. EFFECT OF PROJECT LICENSE SURRENDER ON ELECTRIC TRANSMISSION

The substation at the Irving powerhouse is not integral to Public Service's transmission system and would be removed, as would the wires and poles that carry the Irving output to the Childs substation. The Childs substation currently supports minor local distribution lines, but it too would be removed and the local service transferred to the Childs switchyard, which would be modified to accommodate this addition. There would be no other significant transmission effects from retiring the project.

Table 10. Estimated costs of environmental protection and mitigation measures considered for retiring the Childs Irving Project.[1]

Item description	Recommended by	Estimated cost
Provide funds to assist Game and Fish in developing Tremaine Lake fishery and restoring native fish to Fossil Creek	Game and Fish	$5,000
Implement a plan to monitor the development of riparian habitat for the lowland leopard frog downstream of Fossil Springs dam and, if necessary, implement adaptive management	Forest Service	$12,000
Implement a plan to monitor the presence, distribution, and abundance of special-status animal species to determine if they are using habitat downstream of Fossil Springs dam and, if necessary, implement adaptive management	Forest Service	$20,000
Implement a plan to avoid *Agave* plants during deconstruction	Forest Service	$3,000

[1]Source: the staff.

VII. COMPARISON OF ALTERNATIVES

As previously identified, Table 9 provides estimated costs of the Childs Irving Project four alternatives, including no action. In Table 11 we compare these four alternatives respective to each resource.

Table 11. Comparison of alternatives.[1]

Issue	Fossil Springs dam left intact	Remove top 6 ft of dam - about 19 ft remaining	Remove top 14 ft of dam - about 11 feet remaining	Dam fully removed
V.C.1 Geology and soils				
Erosion and sediment control plan (ESCP)	would provide protection during land-disturbing activities	would provide protection during land-disturbing activities and dam deconstruction	same as 6 ft	same as 6 ft
Travertine effects	long-term increase in travertine downstream of the dam	same as dam left intact	same as dam left intact	same as dam left intact
Sediment behind dam	no change	some sediment would wash out (about 6,000 cy); within stream capacity to handle	most sediment would wash out (about 14,000 cy); within stream capacity to handle	all sediment would wash out (about 25,000 cy); within stream capacity to handle
Channel morphology upstream of dam	no change	channel would return to pre-dam state upstream of remaining impoundment	channel would return to pre-dam state upstream of remaining impoundment	channel would return to pre-dam state
V.C.2 Aquatic resources				
Hazardous materials plan	would protect aquatic and terrestrial resources during deconstruction activities	same as dam left intact	same as dam left intact	same as dam left intact
Suspended sediment monitoring plan	would protect aquatic resources during deconstruction activities	same as dam left intact	same as dam left intact	same as dam left intact
Mitigation for loss of Stehr Lake	unnecessary, as Stehr Lake is not a significant fishery	same as dam left intact	same as dam left intact	same as dam left intact
Native fish upstream of the dam	no change (protected from nonnatives, but may wash over dam during high	protected from nonnatives, but more may wash over	protected from nonnatives, but more may wash over dam	may not be protected from nonnatives

Issue	Fossil Springs dam left intact	Remove top 6 ft of dam - about 19 ft remaining	Remove top 14 ft of dam - about 11 feet remaining	Dam fully removed
	flows)	dam during high flows than with dam left intact	during high flows than with 6 ft removed	
Fish habitat upstream of the dam	no change	pools lost from impoundment area.	pools lost from impoundment area.	pools lost from impoundment area.
Fisheries downstream of the dam	would improve (mix of natives and nonnatives) - BR/FS have proposed eradication of nonnatives and construction of a fish barrier to prevent additional nonnatives from accessing most of Fossil Creek, but final agency decisions are pending	same as dam left intact	same as dam left intact	same as dam left intact
Fish habitat downstream of the dam	return of full flows would enhance habitat by increasing the width and depth of the streamflow and adding to substrate and habitat complexity. Travertine deposits in Irving reach would greatly diversify habitat. *benefits contingent on whether disposition of water rights prevent rediversion.*	same as dam left intact	same as dam left intact	same as dam left intact
Schedule for dam deconstruction	N/A	begin 9/2007, lasting 18-22 weeks	same as 6 ft	same as 6 ft
Bypass channel at dam	N/A	constructed channel for streamflow to bypass impoundment and dam during deconstruction; streamflow would continue downstream of dam without interruption	same as 6 ft	same as 6 ft
Roundtail chub and headwater chub	roundtail chub prevented from hybridizing with headwater chub upstream of dam	same as dam left intact	same as dam left intact	more headwater chub may move downstream, increasing potential for hybridization downstream of dam site

Issue	Fossil Springs dam left intact	Remove top 6 ft of dam - about 19 ft remaining	Remove top 14 ft of dam - about 11 feet remaining	Dam fully removed
V.C.3 Terrestrial				
Revegetation plan for deconstruction areas	would provide revegetation of disturbed areas	same as dam left intact	same as dam left intact	same as dam left intact
Noxious weed management plan	would prevent noxious weed invasion of disturbed areas	same as dam left intact	same as dam left intact	same as dam left intact
Restoration plan for Stehr Lake	would provide restoration of disturbed areas	same as dam left intact	same as dam left intact	same as dam left intact
Riparian vegetation below dam	full flows would saturate and kill vegetation in channel, but would extend riparian vegetation laterally to extent of canyon width	same as dam left intact	same as dam left intact	same as dam left intact
	travertine formation could increase substrate for vegetation	same as dam left intact	same as dam left intact	same as dam left intact
Riparian vegetation above dam along the impoundment	no change	some riparian habitat along present impoundment would be lost (proportionate to full removal); and could be adversely affected by increased recreation activities	some riparian vegetation along present impoundment would be lost (proportionate to full removal), and could be adversely affected by increased recreation activities	1/3 to ½ of riparian vegetation along present impoundment could be lost; and could be adversely affected by increased recreation activities
Botanical area	no change	loss proportionate to full removal	loss proportionate to full removal	mostly lost due to lowered water table
Adaptive management and monitoring for sensitive and management indicator species downstream of the Fossil Springs dam	recommended in DEA , but for no longer than until all other removal and restoration activities are done	same as dam left intact	same as dam left intact	same as dam left intact
Stehr Lake	all wetland and riparian habitat at lake would be lost within a few years; includes habitat for yellow-breasted chat, summer tanager, hooded oriole,	same as dam left intact	same as dam left intact	same as dam left intact

Issue	Fossil Springs dam left intact	Remove top 6 ft of dam - about 19 ft remaining	Remove top 14 ft of dam - about 11 feet remaining	Dam fully removed
	or Bell's vireo (which also occur along Fossil Creek)			
Stehr Lake site restoration plan	would expedite return to habitat similar to pre-project conditions and reduce fire hazard	same as dam left intact	same as dam left intact	same as dam left intact
Bat grates for project tunnels	would provide tunnel access for bats	same as dam left intact	same as dam left intact	same as dam left intact
Avoid aural and visual disturbance to special-status birds in riparian areas of Fossil Creek and Stehr Lake from 2/15 through 8/31	would prevent disturbance to special-status birds	same as dam left intact	same as dam left intact	same as dam left intact
Conduct surveys for black hawks and yellow-billed cuckoos, if disturbance would occur during the above dates. If species found, set up 0.25-mi buffer zones around nesting sites	would prevent disturbance to nesting birds	same as dam left intact	same as dam left intact	same as dam left intact
Agave plant protection plan	would benefit *Agave* plants	same as dam left intact	same as dam left intact	same as dam left intact
V.C.4 Threatened and Endangered Species				
Federally listed threatened and endangered species				
Bald eagle *Threatened*	Not likely to adversely affect	same as dam left intact	same as dam left intact	same as dam left intact
Mexican spotted owl *Threatened*	Not likely to adversely affect	same as dam left intact	same as dam left intact	same as dam left intact

Issue	Fossil Springs dam left intact	Remove top 6 ft of dam - about 19 ft remaining	Remove top 14 ft of dam - about 11 feet remaining	Dam fully removed
Southwestern willow flycatcher *Endangered*	Not likely to adversely affect	same as dam left intact	same as dam left intact	same as dam left intact
Yuma clapper rail *Endangered*	Not likely to adversely affect	same as dam left intact	same as dam left intact	same as dam left intact
Yellow-billed cuckoo *Candidate*	Not likely to adversely affect	same as dam left intact	same as dam left intact	same as dam left intact
Razorback sucker *Endangered*	Likely to adversely affect in Verde River and Stehr Lake, and upstream of the Fossil Springs dam	same as dam left intact	same as dam left intact	same as dam left intact
Spikedace and loach minnow *Threatened*	No effect	same as dam left intact	same as dam left intact	same as dam left intact
Chiricahua leopard frog *Threatened*	No effect	same as dam left intact	same as dam left intact	same as dam left intact
Arizona agave *Endangered*	No effect	same as dam left intact	same as dam left intact	same as dam left intact
Critical habitat for federally listed species				
Southwestern willow flycatcher	Likely to adversely affect	Same as dam left intact	Same as dam left intact	Same as dam left intact
Razorback sucker	Likely to adversely affect in Verde River	Same as dam left intact	Same as dam left intact	Same as dam left intact
Spikedace and loach minnow	Likely to adversely affect in Verde River	Same as dam left intact	Same as dam left intact	Same as dam left intact
Experimental non-essential population				

Issue	Fossil Springs dam left intact	Remove top 6 ft of dam - about 19 ft remaining	Remove top 14 ft of dam - about 11 feet remaining	Dam fully removed
Colorado pikeminnow Experimental nonessential (treated as proposed)	Would not jeopardize continued existence	Same as dam left intact	Same as dam left intact	Same as dam left intact
V.C.5 Aesthetics				
Removal of project facilities	adverse effects from construction equipment, noise, dust, traffic, erosion, and sedimentation in the project area until revegetation occurs	same as dam left intact	same as dam left intact	same as dam left intact
	short-term sedimentation effects could reach downstream to the Verde Wild and Scenic River	same as dam left intact	same as dam left intact	same as dam left intact
	long-term enhancement of aesthetics would result from the removal of project facilities and site restoration	same as dam left intact	same as dam left intact	same as dam left intact
Removal of Irving flume	significant improvement because it's one of the few project linear features that noticeably contrasts with the landscape	same as dam left intact	same as dam left intact	same as dam left intact
Fossil Springs dam	remain unchanged, but would deteriorate and/or require maintenance	some scarring where the dam was lowered would be evident unless or until that area blends with the surface color and texture of the remaining undisturbed concrete	same as 6 ft	area would appear more natural
Return of full flows	improvement of visual character of flows over dam and downstream - cascades between pools become more visually dominant - pools become more distinct - the deeper and faster moving water would create more whitewater	dam would be less visually intrusive – veil of flow over dam would be less visually and auditorially interesting than over full height of intact dam - stairstep travertine	dam would be less visually intrusive than if top 6 ft were removed – veil of flow over dam would be less visually and auditorially interesting than if only top 6 ft of dam	no visual intrusion from dam – loss of visual and auditory benefit of veil of flow over dam - stairstep travertine terraces and pools

Issue	Fossil Springs dam left intact	Remove top 6 ft of dam - about 19 ft remaining	Remove top 14 ft of dam - about 11 feet remaining	Dam fully removed
	and rapids, covering up cascades and boulders – travertine formation and a full stream channel would greatly improve the appearance in the currently bypassed reach - the auditory effects would be more natural than under existing conditions – stairstep travertine terraces and pools would enhance aesthetics in upper Fossil Creek	terraces and pools would enhance aesthetics in upper Fossil Creek	were removed - stairstep travertine terraces and pools would enhance aesthetics in upper Fossil Creek	would enhance aesthetics in upper Fossil Creek
Recreation				
Bypassed reach	potential for significant increase in public use of bypassed reach, including hiking, swimming, tubing, and viewing of travertine formations - year-round recreation opportunities created	same as dam left intact	same as dam left intact	same as dam left intact
Stehr Lake fishery	limited fishing opportunity would be lost	same as dam left intact	same as dam left intact	same as dam left intact
Land use				
Water for cattle	without project flume, 7 existing watering tanks would be dry	same as dam left intact	same as dam left intact	same as dam left intact
V.C.5 Cultural				
Implement HPMP	would protect historic properties	same as dam left intact	same as dam left intact	same as dam left intact
Historic Facilities	new APE's likely to be identified	same as dam left intact	same as dam left intact	same as dam left intact
	operation and maintenance of Historic Facilities as a working project would be halted	same as dam left intact	same as dam left intact	same as dam left intact
	portions of the project, such as the	same as dam left intact	same as dam left intact	same as dam left intact

Issue	Fossil Springs dam left intact	Remove top 6 ft of dam - about 19 ft remaining	Remove top 14 ft of dam - about 11 feet remaining	Dam fully removed
	Irving flume, would be removed for safety and other reasons			
	increased disturbance and vandalism to remaining Historic Facilities from increased visitors and recreationists	same as dam left intact	same as dam left intact	same as dam left intact
Eligible archeological and historical sites in the vicinity of Historic Facilities	under HPMP, potential for disturbance would be minimized	same as dam left intact	same as dam left intact	same as dam left intact
Fossil Springs dam area	no effect to dam or nearby archeological sites	original integrity of dam destroyed and potential for disturbance to nearby archeological sites - erosion and sedimentation effects to arch sites would be proportional to amount of dam removed	same as 6 ft	no remnant of dam would remain

[1]Source: the staff.

In section V.C, Proposed Action and Action Alternatives, we looked at the environmental consequences of four alternatives for the Fossil Springs dam: (1) lowering the dam by 6 feet, as Public Service originally proposed in the surrender application; (2) lowering the dam by 14 feet or more, as Public Service currently proposes; (3) completely removing the dam; and (4) leaving the dam unaltered. These alternatives all assume that power generation would cease and that Public Service would dispose of the remainder of project facilities as specified in the Removal and Restoration Plan in the surrender application. Following is a comparison among the four action alternatives.

Our analysis shows that there would be no significant difference in the impacts of the four action alternatives for the following resources or issues: risk of hazardous substance spills; fish populations below the Fossil Springs dam; Stehr Lake's aquatic, wetland, and riparian resources; riparian vegetation along Fossil Creek; effects on threatened, endangered, and candidate species, and critical habitat for the razorback sucker, spikedace, and loach minnow; recreation; and grazing.

Of the four action alternatives, removing the dam completely would have the greatest positive effect on public safety, avoiding the need for continuing maintenance of the structure, and the greatest beneficial effect on aesthetics; and the greatest adverse effect on the Fossil Springs Botanical Area. On the other hand, if the dam is left intact, we would expect the following consequences: (1) the native fish community upstream of the dam would not be invaded by nonnative species from below the dam; (2) the Fossil Springs Botanical Area would return to habitat closer to that which occurred before project construction; and (3) some young razorback suckers, if any exist above the dam, would not be lost coincident to sediment washing out from behind the dam.

Because the Fossil Springs dam serves as a barrier that protects the native fish community upstream from being invaded by nonnative fish below the dam, retaining the dam intact would provide the greatest protection to the native fish community, and removing the dam entirely could allow nonnative access above the dam. But if either the top 6 or 14 feet of the dam is removed, the remaining structure still would be an effective barrier to nonnative fish.

Taking the top 6 feet off the dam would retain most of the sediment that the structure now impounds, and leaving the dam intact would retain all the sediment behind the structure. Lowering the dam by 14 feet or complete dam removal would allow most of the sediment to be transported downstream during high flows. Taking the top 6 or 14 feet off the dam or leaving the dam intact would allow travertine to continue to accumulate on the downstream face of the dam, as travertine does under existing conditions.

We conclude that removal of the top 14 feet of Fossil Springs dam represents the best

alternation for resource protection should the Commission approve the surrender application. Removal of the top 14 feet would provide a stable structure and address the Forest Service's concerns regarding ongoing maintenance. This option would also prevent nonnative fish from migrating upstream, thus preserving the native fish population established upstream of Fossil Springs dam.[30] In sum, we find that the following measures would provide appropriate resource protection and enhancement, should the Commission approve the surrender application: (1) controlling erosion and sedimentation; (2) allowing the sediment remaining behind the Fossil Springs dam site to wash out naturally; (3) revegetating disturbed areas; (4) controlling noxious weeds; (5) monitoring suspended sediment and halting work under wet conditions when excessive sediment delivery is possible, or the state standard for suspended sediment is exceeded; (6) preventing hazardous substance spills; (7) protecting *Agave* plants; (8) monitoring the success of the development of riparian habitat and the presence, distribution, and abundance of special-status species downstream from Fossil Springs dam, and, if necessary, implementing adaptive management measures to ensure that special-status species are able to maintain their populations until stabilization after the dam's removal, such monitoring and adaptive management measures to extend no longer than December 31, 2009; (9) restoring the Stehr Lake site to its natural, pre-project condition after flows to the lake cease; (10) installing bat grates at the mouths of the project tunnels to allow bats to use the tunnels for roosts while rendering the tunnels inaccessible to the public; (11) conducting bird nesting surveys for sensitive, candidate, and Forest Service Management Indicator Species in the project area, and if nests are identified, establishing deconstruction activity buffers around those locations for the duration of the species-specific breeding seasons; (12) salvaging any razorback sucker found in Stehr Lake and transporting them to a location where they would be expected to survive; (13) taking care during the draining of Stehr Lake to prevent the transfer of nonnative fish from the lake into Fossil Creek; and (14) leaving selected project facilities in place as part of a historical record of the area.

The above measures proposed by Public Service are consistent with the Settlement Agreement--with the exception of the amount of the Fossil Springs dam to be removed--and the recommendations of the resource agencies. In the surrender application, Public Service proposed to mitigate the loss of Stehr Lake's fishery by funding stocking at Tremaine Lake; this measure is not included in the Settlement Agreement. While we do not object to Public Service taking this measure of its own volition, we conclude that, given the low recreational value of Stehr Lake's fishery, requiring the Tremaine Lake mitigation would not be necessary should the Commission approve the surrender application.

[30] After any surrender order is issued, Public Service could request approval to remove more than the top 14 feet of the dam. Such an request would need to be prepared in consultation with the Forest Service, FWS, Game and Fish, and other interested entities to address the potential effects on aquatic and other resources.

IX. FINDING OF NO SIGNIFICANT IMPACT

Construction activity associated with the removal of above-ground facilities would result in increased traffic, noise, dust, erosion, and sedimentation in the short term, and would temporarily affect the visual quality, recreation, and land use in the project area. With our recommended measures, however, the resources of the project area would be protected during deconstruction of the project. Over the long term, about one-third to one-half of the riparian habitat associated with Fossil Springs between the Fossil Springs dam and the topographic nick point about 600 feet upstream from the dam would be affected; riparian habitat supported by tailrace discharges at the Childs powerhouse would decrease; and the fishery, wetland and riparian habitat, and recreational opportunities supported by Stehr Lake would be permanently lost. But also over the long term, the aquatic and recreational resources of Fossil Creek would significantly benefit from the restoration of full flows and the formation of travertine habitat, and riparian habitat along the creek may be enhanced.

Based on our independent analysis, the Settlement Agreement, and comments received from Public Service, State and federal resource agencies, Tribes, and the public, accepting the surrender of the license for the project would not be a major Federal action significantly affecting the quality of the human environment.

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