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In Reply Refer to:

AESO/SE
02-21-90-F-119
02-21-91-F-406
22410-2007-F-0081

May 15, 2008

Memorandum

To: Area Manager, Bureau of Reclamation, Phoenix, Arizona

From: Field Supervisor

Subject: Reinitiated Biological Opinion on Transportation and Delivery of Central Arizona Project Water to the Gila River Basin in Arizona and New Mexico and its Potential to Introduce and Spread Nonindigenous Aquatic Species

Thank you for your request to reinitiate formal consultation with the U.S. Fish and Wildlife Service (Service) under section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), on transportation and delivery of water through the Central Arizona Project (CAP) in the Gila River basin and its potential to introduce and spread nonindigenous aquatic species. This biological opinion (BO) is a reinitiation of the April 17, 2001, biological opinion for the Gila River basin (Gila BO, 2-21-90-F-119) and replaces the draft Biological Opinion of June 11, 1999, on the same subject for the Santa Cruz River (SCR) subbasin (Santa Cruz BO, 2-21-91-F-406). Your request was dated December 22, 2006, and received by us on December 28, 2006. The consultation request for the Santa Cruz has been withdrawn.

You requested reinitiation of consultation to include the SCR subbasin and to consider impacts to the endangered Gila chub (*Gila intermedia*) with designated critical habitat and threatened Chiricahua leopard frog (*Rana chiricahuensis*). Thus, this BO covers changes to the Gila BO, effects to the Gila chub and Chiricahua leopard frog in the entire Gila River basin, and includes the SCR subbasin.

You requested formal consultation on threatened loach minnow (*Tiaroga cobitis*) with designated critical habitat, threatened spikedace (*Meda fulgida*) with designated critical habitat, endangered Gila topminnow (*Poeciliopsis o. occidentalis*), endangered razorback sucker (*Xyrauchen texanus*) with designated critical habitat, Gila chub with designated critical habitat, and Chiricahua leopard frog. You also requested concurrence with your determination that the proposed action may affect, but is not likely to adversely affect, the threatened Apache trout (*Onchyrhynchus apache*), endangered desert pupfish (*Cyprinodon macularius*), threatened Gila trout (*Onchyrhynchus gilae*), and endangered Sonora tiger salamander (*Ambystoma tigrinum stebbensi*). We concur with your determinations. The rationale for our concurrences is in Appendix 1.

This reinitiated BO addresses all changes in effects of the action on the endangered Gila topminnow, razorback sucker, Sonora tiger salamander, and desert pupfish, and the threatened spikedace, loach minnow, Apache trout, and Gila trout for the Gila River basin. We will consider effects to the Gila topminnow in the SCR subbasin, as well as effects to the Gila chub and Chiricahua leopard frog for the entire Gila River basin.

This biological opinion is based on the 1994 and 2001 Gila BOs, and the Draft 1999 Santa Cruz BO, which are incorporated here by reference (USFWS 1994, 1999b, 2001c); information used in the preparation of all BOs; the 1994, 1996, 2001, and 2006 biological assessments (BA) (USBR 1994, 1996, 2001, 2006); multiple official correspondence; comments from the applicants and Bureau of Reclamation (Reclamation) on various draft biological opinions; telephone conversations; electronic mail; meetings; data in our files; and other sources of information. References cited in this biological opinion are not a complete bibliography of all references available on the species of concern, the effects of the proposed action, or on other subjects considered in this biological opinion. A complete administrative record of this consultation is on file in this office.

CONSULTATION HISTORY

More detailed information on the topics discussed in this section, including dates of meetings, letters, and memoranda, can be found in the administrative record and is summarized in the biological assessment and previous documents. The consultation history is complex because of the separation of the Gila basin and SCR subbasin for consultation purposes, and their subsequent recombination; the number of times consultation was reinitiated in the Gila basin; the rendering of jeopardy and draft biological opinions; and the length of time that consultation has occurred over the issue of nonindigenous species. Appendix 2 lists the various section 7 consultations that have been done on the CAP.

APPLICANTS

Because of the separate but parallel tracks that consultation on the Gila basin and SCR subbasin took, applicant status was granted by Reclamation at different times for each consultation (Table 1). All the entities listed below are considered applicants for this consultation.

TABLE 1. LIST OF APPLICANTS FOR THIS CONSULTATION AND THE DATES THEY WERE GRANTED APPLICANT STATUS FOR PREVIOUS CONSULTATIONS.

Applicant	Gila Basin	Santa Cruz Subbasin
Central Arizona Water Conservation District	2000	1995
Tucson Water	-	1996
Tohono O'odham Nation	-	1996
Farmer's Investment Company	-	2000
Gila River Indian Community	2000	-

BIOLOGICAL OPINION

PROPOSED ACTION

The CAP was constructed to provide a long-term, non-groundwater, water source for municipal, industrial, and agricultural (Indian and non-Indian) users in central and southern Arizona. The water provided through the CAP aqueduct is Arizona's remaining entitlement to the flow of the Colorado River. The water is taken from the Colorado River at Lake Havasu and is conveyed 336 miles (540 kilometers) across the state in a series of large, open, concrete-lined aqueducts (Figure 1). Construction began in 1973, and the system was declared substantially completed in 1993 (CAWCD 1995). The proposed action is the same as that described in the Gila BO and the Santa Cruz BO. There have been few changes since then, with the exception of some new recharge projects and water uses, and additional conservation measures.

Figure 1. Map of the Gila River basin, showing major rivers and the route and primary features of the Central Arizona Project canal.

Most details of the CAP aqueduct and its associated features, especially for the Gila River basin exclusive of the SCR subbasin, were provided in Reclamation's various biological assessments (Reclamation 1994, 1996, 2001, 2006) and our various biological opinions (USFWS 1994, 1999b, 2001c), and are not repeated here in detail. The CAP was authorized by Congress in the

Colorado River Basin Project Act of 1968 as a system to use Arizona's apportionment of Colorado River water. The purpose is to deliver Colorado River water to municipal, industrial, and agricultural users in central and southern Arizona. There are a series of 14 pumping plants along the canal that raise water to higher elevations. Dozens of turnouts for agricultural, municipal, and industrial uses are present, including several that supply water to groundwater recharge projects within or close to 100-year floodplains.

Santa Cruz River Basin

The part of the CAP considered in the SCR subbasin under this consultation is the 93-mile (150 km) segment that begins at the Pima Lateral turnout near Florence, and ends at the present aqueduct terminus near Pima Mine Road and the Interstate 19 interchange about 15 miles (24 km) south of Tucson (Figure 2). Although water deliveries through the Pima Lateral, Kleck Road, and Casa Grande Extension turnouts were considered in the 1994 Gila BO and its subsequent 2001 revision (USFWS 1994, 2001c), that analysis considered movement of fish through those turnouts directly into the Gila River or into the Santa Cruz River and then downstream into the Gila River. This consultation also considers the movement of those nonindigenous fish and other species through those turnouts upstream into the SCR subbasin, and into the rest of the Gila basin.

Discretionary Reclamation actions for CAP are only a part of a highly complex water delivery system. The system also includes significant State and private actions, and some aspects of CAP include inextricably intertwined Federal and State or private actions and responsibilities (Table 2).

The effects to listed species from the Federal portion of the overall CAP are dependent upon, and cannot be logically analyzed in isolation from, the remainder of the CAP system. Although section 7 consultation applies to Federal actions only, once a Federal action triggers consultation for CAP, then the entire CAP project falls under the purview of the consultation as interrelated or interdependent actions. The environmental baseline of the consultation considers earlier completed Federal actions, such as construction of CAP, earlier State and private activities in relation to CAP, as well as other State, Tribal, local, and private actions already affecting the species or that will occur contemporaneously with the consultation in process. Central Arizona Water Conservation District (CAWCD), a political subdivision of the State, conducts operation and maintenance of the CAP and delivery of water. The operation and maintenance of CAP by CAWCD is done under contract with Reclamation. Thus, operations and maintenance has a federal nexus, and is part of the proposed action under consultation. Delivery of CAP water for M&I entails three-party subcontracts among CAWCD, Reclamation, and the cities. Water deliveries to Tribes, where the Federal government holds the contract, are also a Federal action. However, past water deliveries are part of the environmental baseline. A number of private actions using CAP water, such as some recharge projects, are also interrelated, interdependent, and cumulative to the proposed Federal action. Many recharge projects are likely to have a Federal nexus.

Capacity of the aqueduct in the SCR subbasin is 1,245 cubic feet/second (cfs) (35 cubic meters per second [m^3/sec]) from the Brady Pumping Plant to the Lower Raw Water Impoundment where the flow is divided between two terminus points. The Snyder Hill Pumping Plant, with a capacity of 350 cfs (10 m^3/sec), pumps treated municipal water to the Clearwell Reservoir. The

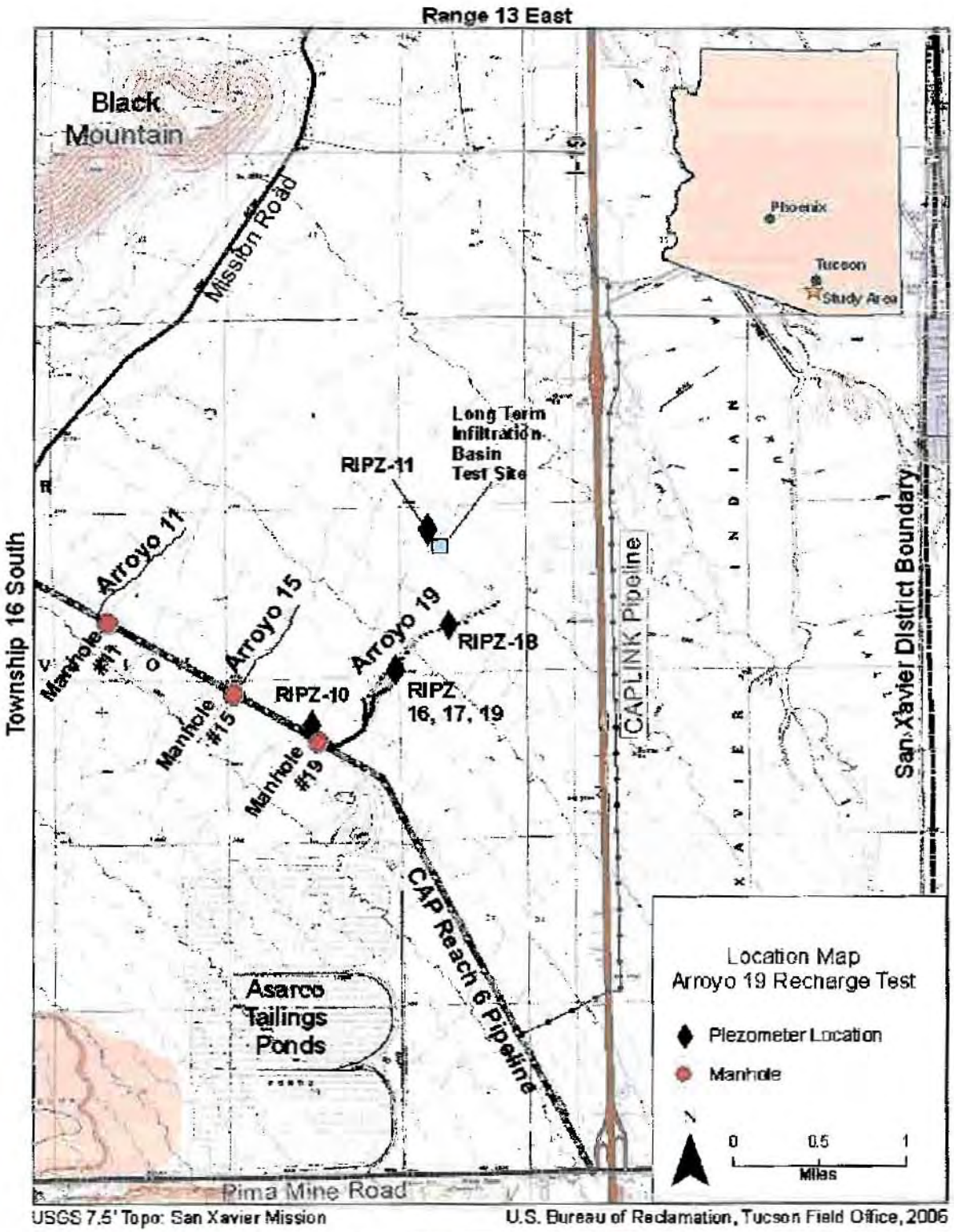

Figure 2. Southern terminus of the Central Arizona Project, south of Tucson, Arizona.

Table 2. Responsible parties for actions related to CAP[1] in Arizona.

ACTION	FEDERAL	STATE	TRIBAL	PRIVATE
Ownership of aqueduct and facilities[2]	Reclamation			
Construction of aqueduct and facilities[2]	Reclamation			
Construction of CAP water storage facilities (not including storage of water taken by contractors/subcontractors)[2]	Reclamation			
Operation and maintenance of aqueduct and facilities[2,3]	Reclamation (pre-1993)	CAWCD (post-1993)[5]		
Allocation and reallocation of CAP water[2]	Reclamation			
Delivery of water to CAWCD (contract holder)[2]	Reclamation			
Delivery of water to Tribes (contract holder)[2]	Reclamation			
Delivery of water to subcontractors[2,3]	Reclamation	CAWCD		
Potential CAP water exchanges[2]	Reclamation			
Construction of new aqueduct features and facilities, including water turnout facilities[2,3]	Reclamation	CAWCD		
Conducting and maintaining cultural and environmental mitigation features/actions[2]	Reclamation			
Stocking of fish and wildlife into local waters which may have CAP water as a source (such as Town Lake)[4]		AGFD		
Regulation of fishing, stocking of fish/wildlife/plants, aquaculture in CAP aqueduct[2,3,4]	Reclamation	CAWCD AGFD ADA		
Regulation of fishing, stocking of fish/wildlife/plants, aquaculture in local waters, which may have CAP water as a source[4]		AGFD ADA		
Use of CAP water[3,4]		CAWCD	X	X
Construction, operation, and maintenance of water use facilities[3,4]				X
Construction, operation, and maintenance of water use facilities on Tribal lands[2,3,4]	Reclamation		X	
Use of effluent and other water made available by CAP water[4]			X	X

Table 2. Responsible parties for actions related to CAP[1] in Arizona.

ACTION	FEDERAL	STATE	TRIBAL	PRIVATE
Recharge facilities and operation [4]		X	X	X

[1] The party, which has final authority or approval rights to the action. This may not be the entity that actually does the action. The focus here is which types of ownership have discretionary actions that are subject to Endangered Species Act review.
[2] Part of the proposed action; includes actions that are interrelated and interdependent
[3] Part of the environmental baseline
[4] Part of cumulative effects
[5] Under contract with Reclamation

ADA = AZ Dept. of Agriculture
AGFD = AZ Game and Fish Department
CAP = Central AZ Project
CAWCD = Central AZ Water Conservation District

Black Mountain Pumping Plant, with a capacity of 208 cfs (6 m^3/sec), pumps raw CAP water to the terminus that is located just south of Pima Mine Road and just west of Interstate 19. The 14 turnouts along this reach of CAP serve 23 water users (Table 3). Additional turnouts may be constructed, and users may change over the 100-year life of the project. We considered the potential effects of such additional features not currently part of the proposed action in this biological opinion. However, the standard triggers for reinitiation of consultation apply. Besides the users listed in Table 3, deliveries of CAP water may be made on an intermittent or one-time basis, and CAP water may be transferred, leased, or exchanged to other parties.

Substantial agriculture exists in the SCR subbasin, and CAP water for agricultural use is delivered through 13 of the 14 turnouts in the subbasin. Water is conveyed from the main aqueduct via open canals that deliver water to irrigated fields. Some of these canals have direct connections with surface drainages, such as the Florence-Casa Grande Canal to the Gila River. Others do not normally have direct connection, but may have periodic connections through temporary small pumped turnouts for recharge projects, irrigation return flows, excess water sumping, or system cleanouts, or may have unanticipated connections during flooding or when canal components fail along, across, or near streams. Any system components that are located within the channel or floodplain of a stream are considered likely to have some connection to surface flows at some time. This may result from canals or sumps being inundated during high flood events or from siphons, dikes, or canals being washed out, thus allowing mingling of CAP and surface waters.

Agricultural practices vary over space and time, and are expected to change over the 100-year project life. The fields in the Santa Cruz River subbasin primarily use level-basin irrigation, where irrigation return systems are not necessary. However, at times throughout the 100-year project life, agricultural uses could either regularly or under special circumstances place excess irrigation water into the Santa Cruz (either directly or via tributary drainages) or dump excess irrigation water into sumps (ponds) found within the floodplains of the SCR and its tributaries. Use of CAP agricultural water for aquaculture may result in a number of practices that may

Table 3. Turnouts and allocations for CAP water users[1] south of the Gila River in southern Arizona.				
CAP Turnout Name	Entity	Allocation (acre-feet/year)	Status[2]	Class of Allocation[3]
Pima Lateral[4]	Gila River Indian Community Coolidge	311,800 (173,100 CAP; 138,700 settle.) 2,000	2 3	Indian M&I
Kleck Road[4]	Hohokam Irrigation District	Annual excess water contract entitlement based on availability	1	NIA
Casa Grande Extension[4]	Hohokam Irrigation District	Annual excess water contract entitlement based on availability	1	NIA
Santa Rosa	Ak Chin Chui Chu Casa Grande Eloy Maricopa-Stanfield Irrigation & Drainage District Central Arizona Irrigation & Drainage District Arizona State Land Department	75,000 (58,300 CAP, 50,000 settlement)[6] 8,000 (8,000 CAP, settlement[7]) 8,884 2,171 Annual excess water contract entitlement based on availability Annual excess water contract entitlement based on availability 9,026	1 3 3 3 1 1 3	Indian Indian M&I M&I NIA NIA NIA
Central Main	Central Arizona Irrigation and Drainage District	Annual excess water contract entitlement based on availability	1	NIA
South Main	Central Arizona Irrigation and Drainage District	Annual excess water contract entitlement based on availability	1	NIA
Cortaro-Marana	Town of Marana	47	1	M&I
Wildlife	None			
Schuk Toak	Schuk Toak	16,000 (10,800 CAP, 5,200 settlement)	2	Indian
Tucson	Tucson	144,172	1	M&I

Table 3. Turnouts and allocations for CAP water users[1] south of the Gila River in southern Arizona.

CAP Turnout Name	Entity	Allocation (acre-feet/year)	Status[2]	Class of Allocation[3]
	Del Lago (Vail) Water Co.	1,857	3	M&I
	Flowing Wells Irrigation District	4,354	3	M&I
	OroValley Water Utility	10,305	2	M&I
	Metropolitan Water Improvement District	13,460	2	M&I
	Spanish Trail Water Co.	3,037	3	M&I
	Arizona State Land Dept.	14,000	3	M&I
	Avra Cooperative	808	3	M&I
Pascua Yaqui	Pascua Yaqui	500 (500 CAP, settlement[9])	2	Indian
San Xavier 1 and 2	San Xavier	50,000 (27,000 CAP, 23,000 settlement)	2	Indian
Terminus	Green Valley Domestic Water Improvement District	1,900	2	M&I
	Community Water Co. of Green Valley	2,858	2	M&I

[1] Only users that have executed CAP water service contracts are listed. Deliveries to other users may be made on an intermittent or one-time basis.

[2] Status 1 = currently taking CAP water; status 2 = currently planning distribution systems; status 3 = no immediate plans for distribution systems.

[3] M&I = municipal and industrial use, NIA = non-Indian agricultural use.

[4] These users and turnouts were also included in the earlier CAP/Gila biological opinions.

[5] Settlement negotiations currently underway will likely result in the allocation of additional supplies to the Gila River Indian Community.

[6] 33,300 acre-feet of the Ak-Chin CAP allocation has been assigned to the San Carlos Apache Tribe as part of its water rights settlement.

[7] The Chui Chu District of the Tohono O'odham Nation is expected to enter into settlement negotiations.

[8] Share of total State Land Department allocation expected to be used in the Tucson Area.

[9] The Pascua Yaqui Tribe may request to initiate settlement negotiations.

allow perennial or periodic connections between CAP waters and Santa Cruz subbasin surface waters.

Besides normal agriculture deliveries, Central Arizona Irrigation and Drainage District, Maricopa-Stanfield Irrigation and Drainage District, Cortaro-Marana Irrigation District, and BKW Farms have all received CAP water as part of the State of Arizona's in-lieu recharge program (where groundwater use is replaced with CAP water use). Whether and to what extent this program will continue in the future is uncertain. In-lieu groundwater recharge deliveries are not limited to CAP subcontractors and may result in agricultural use of CAP water in areas outside the service areas of CAP subcontractors. Other entities may also receive such CAP deliveries within the 100-year life of the project.

Although an original purpose of CAP was to provide agricultural water, municipal and industrial (M&I) is the fastest growing portion of CAP water use and is expected to become dominant over the 100-year project life. The purpose, mechanisms, and locations of M&I use are quite variable, and are expected to change significantly. At present, there are 14 entities in the Santa Cruz sub-basin M&I allocations of CAP water being considered in this consultation (Table 3), and their areas of water use are located along the SCR from near the mouth upstream to Green Valley, with the greatest use being in the Tucson and Green Valley areas.

Use of M&I water generally falls into two categories:

1) Water treated to meet drinking water standards - Treated water has been filtered and disinfected or otherwise rendered completely free of living organisms. In general, use of treated water has no likelihood of transport of nonindigenous species.

2) Recharging the water to the aquifer – Using shallow constructed basins or natural channels the water is allowed to infiltrate to the groundwater table. The water may then be recovered by nearby wells. Arizona statutes also allow recharge by replacing groundwater used for agriculture with CAP water.

Presently, the City of Tucson and the Northwest Municipal Water Providers (NWMWP; Towns of Oro Valley and Marana, the Metropolitan Domestic Water Improvement District and the Flowing Wells Irrigation District) are all recharging at least a portion of their CAP water allocations. All are developing firm plans for direct use of CAP water for potable purposes. Associated with the direct delivery for the NWMWP is the construction of a 3,000 acre-foot (37,000 cubic decameters [dam^3]) terminal storage reservoir.

Currently, CAP water for M&I purposes in the SCR basin is utilized completely via recharge and recovery. The water is directly recharged either in constructed basins or in natural channels, or as in-lieu recharge for agriculture, as described previously. Table 4 shows existing or proposed recharge projects within the Santa Cruz subbasin and includes recharge projects that are currently permitted by the Arizona Department of Water Resources (ADWR 2006) as well as a variety of other projects for which information was available (RRC 1996, SXD 1999).

Table 4. Tucson Active Management Area underground storage facilities, Arizona.

PROJECT NAME & DESCRIPTION	DURATION	WATER SOURCE	RECHARGE BY	ANNUAL AMOUNT (acre-feet)
Sweetwater Recharge Facilities. Recharge via basins.	07/07/97 to 10/25/2008	effluent	Tucson Water	6,500
Santa Cruz Managed Recharge Project, from Roger Road to Ina Road via streambed.	5/05/00 to 05/31/2019	effluent	Tucson Water & Reclamation	9,307
Lower Santa Cruz Replenishment Project. Recharge via basins.	11/28/03 to 02/28/19	CAP	CAWCD, Robson Communities, AWBA, MDWID, Marana	50,000
Marana High Plains Effluent Recharge Project. Recharge basins.	09/26/05 to 09/26/2007	effluent	CMID	600
Avra Valley Recharge Project via basins.	03/27/98 to 03/27/2018	CAP	CAWCD, MDWID, AWBA, Marana	11,000
Pima Mine Road Recharge Project. Recharge via basins.	05/24/04 to 09/06/2020	CAP	CAWCD, Tucson, AWBA, Green Valley DWID	30,000
Central Avra Valley Storage & Recovery Project. Recharge basins.	10/01/05 to 10/01/2025	CAP	Tucson, AWBA	80,000
South Avra Valley S&RP via basins.	Proposed	CAP	Tucson	60,000
Robson Ranch Quail Creek. Recharge via basins.	12/17/03 to 04/02/2021	effluent	Robson Ranch Quail Creek	2,240
Lower SCR Managed Recharge Project. Via streambed from Ina Road to Trico Road.	11/4/03 to 11/30/2023	effluent	Tucson, MDWID, Oro Valley, Pima Co., Reclamation	43,000
San Xavier District Arroyos*. Recharge via arroyos.	not applicable	CAP	Reclamation, SXD	
Cortaro Marana Irrigation District indirect recharge.	02/17/04 to 04/02/2008	CAP	Spanish Trail, MDWID, Marana, Flowing Wells	20,000
BKW Farms in-lieu recharge.	01/14/04 to 01/31/2009	CAP	Tucson, AWBA, MDWID, CAWCD	16,615

Kai Farms in-lieu recharge -Red Rock in Picacho.	01/14/04 to 12/30/06	CAP	MDWID, CAWCD, Vail WC, Spanish Trail, Oro Valley, Tucson, AWBA	11,231
BKW /Milcwidc in-lieu recharge.	01/14/04 to 01/31/2009	CAP	CAWCD, Tucson	627
Kai-Avra GSF in-lieu Recharge at AVID.	01/14/04 to 04/02/2008	CAP	MDWID, AWBA, Tucson	12,513
Farmers Investment Company in-lieu recharge.	3/01/04 to 12/31/2016	CAP		22,000
Source: http://www.azwater.gov/dwr/Content/Find_by_Program/Recharge/pdf_files/Semiannual.pdf * information added to ADWR list				

The two types of water being used for artificial recharge are CAP and treated effluent, with about 85 percent coming from CAP. Recharge may be conducted in a variety of locations and designs, including off-channel basins, within natural channels or streams and river floodplains, in constructed wetlands, or in-lieu of groundwater use. To convey the water to the recharge location, pipelines or canals are used. Treated effluent would only be a concern if the quality of the water can sustain fish.

The length of conveyance features can be up to 15 miles, and recharge basins vary from a few acres to several hundreds of acres in size. Recharge basins are typically operated so that they completely dry up periodically, so that the basin bottoms can be disked or scraped to maintain infiltration effectiveness.

In-channel recharge projects involve simply allowing the water to flow down natural drainage channels, such as the SCR or arroyos tributary to the Santa Cruz. Check dams are typically used to slow the flow, decrease erosion, and increase infiltration. Similar to basins, operation of in-channel recharge projects includes intermittent drying of the channel for an extended period to maintain effective infiltration rates. There are two projects using in-channel recharge. Treated effluent is recharged in the SCR from about Prince Road to Trico Road. Several entities accrue credits from this recharge. The San Xavier District (SXD) and Reclamation are operating a CAP recharge project that uses several small arroyos tributary to the SCR (Figure 2). Although not the primary purpose, the SXD Arroyos project may also provide riparian and wildlife enhancement.

Connection between CAP water and Santa Cruz subbasin natural surface waters will rarely occur for recharge projects within stream channels or on floodplains. Recharge flows are curtailed when possible under normal operation, if rainfall or significant natural flows are predicted or expected. Off-channel basins are unlikely to have such connection so long as they are located outside of areas that would be flooded or are protected from flooding, as all are.

Several Indian communities in the action area have executed contracts for CAP water service. In addition, CAP water has been used in settling Indian water rights claims. Most of the water is expected to be used for agriculture, although some will be stored using recharge and restoration of in-stream flows.

The Ak-Chin Indian Community has been receiving irrigation water through the Santa Rosa Canal since 1987 and is expected to continue to do so. While the Chui Chu District of the Tohono O'Odham Nation is also likely to receive its water through the Santa Rosa Canal, definite plans for use await water settlement negotiations. The Pascua Yaqui Tribe has tentative plans to develop part of their reservation west of the CAP Black Mountain Pipeline for agriculture and recharge.

The Tohono O'odham Nation Shuk Toak District has been using their CAP water for agriculture. The SXD is storing some water by recharging in arroyos and using some water for environmental (riparian) restoration projects. They began using some of their CAP water for

agriculture in 2007. An in-lieu groundwater savings project with ASARCO was being planned, but is in doubt due to the company filing for bankruptcy.

Interrelated actions are those that are part of a larger action and depend upon that action for their justification, while interdependent actions are those that have no independent utility apart from the action under consultation (50 CFR 402.02). In other words, if those actions would not occur "but for" CAP, they meet the regulatory definition of interrelated and independent actions to CAP and their effects must be considered in this consultation. While a wide variety of private, State, and Tribal actions may qualify as interrelated or interdependent to the CAP, the following discussion is limited to those that would affect the introduction, survival, or spread of nonindigenous aquatic species and their ability to affect listed species.

The relationship among interrelated and interdependent actions, cumulative effects, and indirect project effects is confusing and may overlap. See Appendix 3 for definitions and information on how these various parts of a section 7 analysis relate. Because of the delay in time inherent in indirect effects and the consequent intervening levels of related causation, it may become difficult to separate completely the indirect effects of the Federal action from direct or indirect effects of non-Federal actions that are interrelated and interdependent.

Various uses of CAP water by State, Tribal, and private entities are interrelated and interdependent actions that would not occur but for CAP. Some actions that might occur in the absence of CAP, using water from other sources, may not be interrelated and interdependent, but are cumulative to the Federal action and will be addressed later in the cumulative effects section (see also Appendix 3).

A secondary, but important, interrelated and interdependent action for CAP is the urban, suburban, and small-lot ranchette development that is occurring to accommodate the increasing human population made possible, in part, by CAP water. These actions are an indirect effect of both the interrelated and interdependent CAWCD action of water delivery and the discretionary Federal CAP action (see Appendix 3). Rapid growth is common in areas that receive water through CAP or that have benefited from increased surface or groundwater because of CAP water becoming available elsewhere (Arizona Department of Economic Security 2001).

The increase in human population in the Gila River basin in turn fuels a need for additional water, particularly in areas of CAP "exchanges" where outlying communities exchange or sell their CAP allocations for rights to local water or for funds with which to develop additional surface or groundwater supplies. Three biological opinions on effects of these "exchanges" to listed species have already been issued, one for the upper Gila River in New Mexico, one for the upper Verde River, and one for the middle Verde River (see Appendix 2). However, many of the water development actions expected due to exchange of CAP allocations, and the induced growth that may result, do not involve Federal actions, funds, or permits. In general, those actions would not occur except for the CAP allocation, therefore they are interrelated and interdependent to the CAP and their effects must be considered as part of the analysis of the consultation. To the extent to which some of this water development might occur in the absence of CAP, using water from other sources, those uses may not be interrelated and interdependent,

but are cumulative to the Federal CAP action, and will be addressed later in the cumulative effects section.

Human population increases in the basin accelerate demand for use of public lands and for creation of impounded waters for recreation (see U.S. Army Corps of Engineers 1997). Increasing recreation increases the likelihood of human introduction and transport of nonindigenous aquatic species through a variety of mechanisms, causes greater demand for sport fish stocking, and increases live bait use (USFWS 2001a, 2001b). Wetlands, impoundments, and streamflows established for recharge purposes using CAP water may be used to satisfy some of these recreational needs and so play both a direct and an interdependent and interrelated role in this consultation. Other lakes and ponds for water storage or for decorative or recreational use may use CAP water. Construction, operation, and stocking of nonindigenous species into any of these water bodies may be an intricate mix of Federal and non-Federal actions. An example of this is Tempe Town Lake, which was constructed by private and local governmental parties, authorized by the U.S. Army Corps of Engineers under section 404 of the Clean Water Act, filled with CAP water delivered by CAWCD from the federally owned CAP aqueduct, and stocked by Arizona Game and Fish Department (AGFD) using funding, in part, from the Service's Federal Aid program.

Creation of wetlands or impoundments may be a direct part of the proposed action if the water placed into these is delivered from CAP, as it is in the Granite Reef Underground Storage Project (see USBR 2001). However, some wetlands or impoundments may not directly use CAP water but may still be interrelated and interdependent actions to the proposed CAP action, if they would not occur except to implement CAP deliveries.

Project Changes Since 2001 in the Gila River Basin Exclusive of the SCR Subbasin

The previous consultations on CAP considered operation and maintenance by CAWCD as an interrelated and interdependent action. However, operation and maintenance by CAWCD is done under contract to Reclamation. Thus, it is part of the proposed action, and is analyzed as such in this BO. Operation includes the delivery of water through the main canal and the lateral canal, and operation of the pumping stations. Maintenance includes, but is not limited to, drying and dredging of the canal, sumps, laterals, and pumping stations. Other maintenance actions may include nonindigenous mussel control or repairing various parts of the canal system and the fish barriers.

These changes include addition of several groundwater recharge projects that use CAP water and have potential to establish populations of fish, if only temporarily. The Agua Fria Recharge Project along the Agua Fria River near 99th Avenue and Jomax Road consists of four miles (6 km) of managed in-channel recharge and 100 acres (40 ha) of constructed spreading recharge basins. The permitted capacity of this project is 100,000 acre-feet per year (af/yr)(123,350 dam^3/yr), and it lies completely within the 100-yr floodplain of the Agua Fria River. It became operational in 2002.

The Hieroglyphics Mountain Recharge Project consists of 38 acres (15 ha) of constructed spreading basins outside any 100-yr floodplain, and is permitted to recharge up to 35,000 af/yr (43,000 dam). This project is located where 163rd Avenue intersects the CAP aqueduct, and became operational in 2003.

The Tonopah Desert Recharge Project became operational in 2006, and is located outside any 100-yr floodplain about seven miles northwest of Tonopah. It consists of 206 acres (83 ha) of constructed spreading basins, and is permitted to recharge up to 150,000 af/yr (185,000 dam).

The Superstition Mountains Recharge Project is in the design and permitting phase, and is estimated to begin construction and operation soon. Located near Queen Creek (the stream, not the city) in the far eastern Phoenix valley, it is expected to store up to 85,000 af/yr (105,000 dam) via spreading basins.

Conservation Measures

Conservation measures are actions to benefit or promote the recovery of listed species that are included in the project description as an integral part of the proposed action. They serve to minimize or balance some project effects.

Nonindigenous fishes and other aquatic organisms that reside in Lake Havasu and other system waters can gain access to the CAP aqueduct, where they can be transported, escape, or be moved into surface waters of the Gila River basin via irrigation systems and drains, recharge basins, major surface water interconnections, and people. As described in the various CAP BAs and BOs, conservation measures to minimize this threat or attempt to recover listed fishes in lieu of threat removal include: 1) construction and operation of barriers to upstream fish movement; 2) monitoring of fishes; 3) funding for conservation of native fishes; 4) funding for control and management against nonindigenous fishes; and 5) information and education. In addition, Reclamation has added a conservation measure to fund a Chiricahua leopard frog "head start" program and provide for other conservation actions. Together these provisions address the CAP-mediated nonindigenous aquatic species problem at multiple levels in an attempt to provide a comprehensive treatment. The proposed action includes five conservation measures designed to protect listed species. These are based on reasonable and prudent alternatives developed for the original 1994 BO, which were later modified and incorporated as conservation measures by Reclamation in the 2001 consultation and further modified and proposed by Reclamation here. The measures, as listed below, differ from those described in the June 11, 1999, draft Santa Cruz BO and are organized differently.

Construction and Operation of Barriers to Upstream Fish Movement

Several drop barriers to prevent or hinder upstream movements of nonindigenous fish and other aquatic organisms into high-value native fish and amphibian habitats are completed or proposed for construction. However, they may not be completely effective because some species may be moved above the barriers by humans, birds, and other animals; and under certain circumstances of flooding or damage, the barriers may become ineffective. Sites were selected primarily to

protect existing populations of listed fishes or facilitate the repatriation and stocking of native fishes upstream of the barrier. The protection against nonindigenous species these barriers will provide in many instances will also benefit other listed and unlisted native aquatic biota, including leopard frogs, gartersnakes, and mud turtles.

Reclamation or its designate will maintain the barriers as needed over the 100-year life of the CAP. Maintenace of barriers is currently done by CAWCD under contract with Reclamation. Barrier maintenance could include, but is not limited to, installing gabions and riprap, or pouring concrete. Final siting and design of the barriers will be mutually agreed among Reclamation and the Service, in consultation with the Arizona and New Mexico Departments of Game and Fish (AGFD and NMDGF) through the existing CAP Policy and Technical committees that were established to oversee implementation of the CAP conservation measures, and the land owner or manager.

Note that one or two fish barriers on the San Pedro River originally stipulated in the 1994 and 2001 BOs (USFWS 1994, 2001a) were replaced with a conservation measure to construct three San Pedro River tributary barriers (Redfield, Hot Springs, and O'Donnell canyons) after searches for acceptable mainstem sites were exhausted. In addition, a proposal carried through much of the Santa Cruz consultation to construct two fish barriers on the mainstem SCR in Pima County was replaced by a proposal to construct a single mainstem barrier plus three SCR subbasin tributary barriers. Most recently, the proposal for a single mainstem SCR barrier was dropped in favor of extending the period of fund transfers to the Service (see below). Finally, only two of the following three fish barriers proposed for the SCR subbasin are intended to be constructed: Redrock Canyon, Sheehy Spring, or Sonoita Creek (the Cottonwood Spring fish barrier has already been completed). Together these will fulfill Reclamation's commitment to construct three tributary barriers in the SCR subbasin and address the potential effects from CAP water deliveries to those entities listed on Table 3, whether for direct delivery or recharge.

The following is a list of barriers that have been completed or are scheduled for completion as identified in this BO:

a. Redrock Canyon, Santa Cruz Co., AZ—Primary purpose is to protect existing populations of Gila topminnow and Chiricahua leopard frogs, and facilitate replication of the Sheehy Spring population of Gila chub.

b. Sheehy Spring, Santa Cruz Co., AZ—Primary purpose is to protect existing populations of Gila chub and facilitate replication of one of the SCR subbasin populations of Gila topminnow. It may also protect the Huachuca water umbel and Canelo Hills ladies' tresses, two endangered plant species occurring there.

c. Sonoita Creek, Santa Cruz Co., AZ—Primary purpose is to protect existing populations of Gila topminnow and Chiricahua leopard frog, and facilitate replication of one of the SCR subbasin populations of Gila chub.

d. Aravaipa Creek, Pinal Co., AZ (completed)—Primary purpose is to protect existing populations of loach minnow and spikedace.

c. Blue River, Greenlee Co., AZ—Primary purpose is to protect existing populations of loach minnow and Chiricahua leopard frog, and to facilitate replication of the Eagle Creek or New Mexico Gila River populations of spikedace.

f. Bonita Creek, Graham Co., AZ—Primary purpose is to protect existing population of Gila chub and to facilitate replication of Eagle Creek populations of spikedace and loach minnow, and Gila topminnow and desert pupfish.

g. Cottonwood Spring (Sonoita Creek), Santa Cruz Co., AZ (completed)—Primary purpose is to protect existing populations of Gila topminnow and Chiricahua leopard frog. It may also protect populations of Huachuca water umbel and the candidate Huachuca spring snail.

h. Fossil Creek, Yavapai-Gila Co., AZ (completed)—Primary purpose is to protect existing populations of Chiricahua leopard frog and to facilitate replication of the Verde River or Aravaipa Creek population of spikedace and the Aravaipa Creek population of loach minnow, desert pupfish, Gila topminnow, and razorback sucker.

i. Hot Springs Canyon, Cochise Co., AZ—Primary purpose is to protect existing population of Gila chub and to facilitate replication of Aravaipa Creek populations of spikedace and loach minnow.

j. O'Donnell Canyon, Santa Cruz Co., AZ—Primary purpose is to protect existing populations of Gila chub, Gila topminnow, and Chiricahua leopard frog.

k. Redfield Canyon, Cochise Co., AZ—Primary purpose is to protect existing populations of Gila chub and Chiricahua leopard frog and facilitate replication of Aravaipa Creek populations of spikedace and loach minnow.

l. Tonto Creek drainage, Gila Co., AZ (stream not yet identified)—Primary purpose is to protect existing population of headwater chub and facilitate replication of the East Fork White River population of loach minnow and an undetermined population of spikedace. Spring Creek is a potential site for the barrier.

m. Verde River, Yavapai Co., AZ—Primary purpose is to protect existing population of spikedace and facilitate replication of Aravaipa Creek population of loach minnow.

Reclamation will construct a single fish barrier at these sites, of a design similar to those completed on Aravaipa, Sonoita, or Fossil creeks. Siting and design will be subject to agreement between Reclamation and the Service, with appropriate review and input from AGFD, the landowner, and experts on southwestern fishes, hydrology, and nonindigenous species invasions. Reclamation will maintain the barriers in good operating condition for the expected 100-year life

of CAP. Management actions upstream of these barriers (e.g., stream renovation, species repatriation) will be the responsibility of the Service or AGFD, but may be funded through the existing Fund Transfer Program. Reclamation or its designate will monitor fish populations upstream of each constructed barrier for a period of five years following construction, unless such monitoring is redundant to that conducted by other agencies. Monitoring is intended to evaluate the success of the barriers in preventing invasions of nonindigenous fishes.

The goal for construction of these barriers is to have them all completed within 15 years from the date of a finalized biological opinion, with a minimum of three to be completed during each of the consecutive five-year periods. However, experience has shown that construction schedules often lapse due to environmental, social, and political controversies that invariably arise when attempting to place fish barriers on dwindling multiple-use surface waters. For these reasons, Reclamation proposes a series of five-year reviews of the progress of fish barrier construction among Reclamation, the Service, AGFD, and NMDGF. Such reviews will evaluate the status of the barrier construction program, assess impacts of potential construction delays to goals of the biological opinion, and determine if rescheduling can be accommodated. Modification of the list of streams on which to construct barriers may also be necessary during these reviews if feasibility studies determine construction is not possible. We assume barrier construction will take the entire 15 years, and analyzed the effects accordingly. Because we considered the impacts from barrier construction, additional consultation on barrier construction may not be needed, unless it is outside the parameters we analyzed or the allowed incidental take.

Three electrical fish barriers have been constructed to hinder or prevent upstream movements of nonindigenous fish and other aquatic organisms from the CAP canal to surface waters of the Gila River basin. These are located on the Salt River Project (SRP) South and Arizona canals immediately downstream from Granite Reef Diversion Dam, and on the San Carlos Irrigation Project (SCIP) Florence-Casa Grande Canal immediately above China Wash. Reclamation or its designate will ensure the continuous operation and maintenance of these barriers throughout the 100-year project life of the CAP. Reports that review the effectiveness of the operation and maintenance of the electrical barriers will be provided to the CAP Policy and Technical committees at 10-year intervals.

Monitoring of Fishes

The purpose of the monitoring is to establish baseline data on the presence and distribution of nonindigenous fishes in targeted stream and canal reaches and to detect changes in species assemblages and distributions. Because of limitations of knowledge and technology and because the largest threat is expected to come from nonindigenous fish, this monitoring is targeted at fish. However, we expect that limited information will also be gathered on distribution of some of the more obvious new nonindigenous amphibians, reptiles, or invertebrates, including when new species appear. Monitoring will be done according to already-established protocols (Clarkson 1996, Allison 2000); any proposed revisions will be subject to review by the CAP Policy and Technical committees. Reclamation will notify the Service, AGFD, and NMDGF of any detection of a nonindigenous fish from an area where it had not previously been found, by telephone or email within five days of the collection. Reports of annual monitoring will be

submitted to the Service and interested parties each year, and five-year comprehensive reports that evaluate data trends will be similarly prepared and distributed. The following waters will be monitored annually by Reclamation or it's designate throughout the 100-year life of the CAP, unless other State or Federal programs provide for such monitoring:

- CAP aqueduct;
- Salt River Project Arizona Canal, above and below the electrical barrier;
- Salt River Project South Canal, above and below the electrical barrier;
- Florence-Casa Grande Canal, above and below the electrical barrier;
- Salt River between Stewart Mountain and Granite Reef Diversion dams;
- Gila River between Coolidge and Ashurst-Hayden Diversion dams;
- San Pedro River downstream of the U.S.-Mexico border; and
- Cienega Creek Preserve.

Conservation of Native Fishes Funding

The purpose of this funding is to undertake conservation actions toward protection and recovery of spikedace, loach minnow, Gila topminnow, razorback sucker, Gila chub, and other Gila River basin native fishes by implementing existing and future recovery plans. These funds are not intended to be applied toward Chiricahua leopard frog except as they may provide ancillary benefits. Highest priorities of this fund are to protect existing populations of listed fishes or to replicate wild populations to protected wild sites. These actions are intended to balance threats from the CAP that cannot feasibly be removed or prevented. The most problematic species for CAP mediated impacts are Gila topminnow, spikedace, razorback sucker, and loach minnow. CAP funded activities should concentrate on those four species. However, it is recognized that Reclamation does not bear the entire responsibility for complete recovery of these species, since CAP is not the sole, and may not be the immediate, cause of their deteriorated status.

The threat from nonindigenous species invasion and spread, via CAP, is extremely difficult to control effectively. Although effective for fish, the barriers may not be effective for most invertebrates or plants. Techniques for removing or controlling invading nonindigenous species are expensive, often environmentally damaging, and generally have a low level of success. It is not feasible to achieve full removal of jeopardy with protective measures alone. To deal with that difficulty, funding recovery actions is to implement the recovery plans for those species, thus improving their status throughout their range and making them less vulnerable to serious decline or extinction because of unalleviated adverse effects from CAP.

Reclamation will make available a sum of $275,000 annually for 16 years, beginning in fiscal year 2007 (nine years of funding have already been provided). The addition of $25,000 per year above the amount analyzed in the 1994 and 2001 biological opinions will accommodate conservation needs for new species listings and inflationary pressures against the fund. In addition, Reclamation will continue funding this conservation measure for an additional five years (starting at year 26) at $275,000 annually as partial substitution for any lost recovery potential of the now-abandoned SCR mainstem barrier. Extension of this funding source past 25 years will accommodate some of the continued need for conservation activities.

These monies either will be transferred to us to administer (administrative support costs will be added [currently 22%]), or retained by Reclamation for approved projects that they administer. Reclamation also agrees to reimburse the Service for administrative costs of funds that previously have been transferred but not yet expended. The CAP Policy and Technical committees will mutually agree upon expenditure of these funds. Fund transfers will occur before the end of each Federal fiscal year. We will submit a brief annual report to Reclamation that details expenditures of the fund and how they contributed to recovery of listed fishes in the Gila River basin.

Control and Management Against Nonindigenous Aquatic Species

The purpose of this item is to accomplish control or removal of nonindigenous aquatic species, and to enable research needed to accomplish such actions. The goal of these actions is to directly control threats from CAP introduced or mediated nonindigenous species as well as to enhance the status of affected species through recovery (by nonindigenous management) to compensate for threats from CAP that cannot feasibly be removed or prevented. These funds are not intended to be applied toward Chiricahua leopard frog except as they may provide ancillary benefits. In some cases, it may be appropriate to fund research directed toward improving technologies to control nonindigenous organisms, but the highest priority of this fund is to achieve on-the-ground control. These actions are intended to compensate for threats from the CAP that cannot feasibly be removed or prevented.

Reclamation will make available a sum of $275,000 annually for 16 years, beginning in fiscal year 2007 (nine years of funding have already been provided). The addition of $25,000 per year above the amount determined in the 1994 and 2001 biological opinions will accommodate control activities against nonindigenous species associated with addition of the SCR subbasin to the project area, new species listings, and inflationary pressures against the fund. In addition, Reclamation will continue funding this conservation measure for an additional five years (starting at year 26) at $275,000 annually as partial substitution for any lost nonindigenous control potential of the now-abandoned SCR mainstem barrier. Extension of this funding source past 25 years will accommodate some of the continued need for conservation activities.

These monies will either be transferred to us to administer (administrative support costs will be added), or retained by Reclamation for approved projects that they administer. Reclamation agrees to reimburse us for administrative costs of funds that previously have been transferred but not yet expended. The CAP Policy and Technical committees will jointly agree upon