DRAFT ENVIRONMENTAL ASSESSMENT

FOR

RENOVATION OF STILLMAN LAKE TO REMOVE

NON-NATIVE FISHES AND REPATRIATE NATIVE SPECIES

Department of the Interior

U.S. Fish and Wildlife Service

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SUMMARY

The purpose of the proposed action is to restore and enhance the native fish community in the headwaters of the Verde River by eradicating non-native fish from Stillman Lake, Yavapai County, Arizona (Figure 1), and restocking the area with native fish, such as the endangered razorback sucker, and roundtail chub, a species of concern. Providing habitat for threatened and endangered species would aid in recovery of these species. Conservation actions that improve the status of species currently not listed would reduce threats to the species and minimize the likelihood of listing under the Endangered Species Act of 1973 (16 U.S.C. 1531-1544), as amended (ESA). Currently, our ability to effectively conserve and manage native fish in the upper Verde River is limited due to the presence of non-native fish and crayfish. This action would be undertaken cooperatively by the Arizona Ecological Services and Fishery Resources Offices of the U.S. Fish and Wildlife Service (Service) and the Arizona Game and Fish Department (AGFD), in coordination with other partners.

The preferred alternative would include the use of a chemical piscicide to remove non-native fish. The chemical renovation would occur during 2007. Following use of the piscicide, native species, such as razorback sucker (*Xyrauchen texanus*) and roundtail chub (*Gila robusta*) would be restocked into the lake. However, AGFD has a separate process to evaluate fish stocking that is outside of this NEPA process. Any stocking decision made as a result of this document will have to go through the internal AGFD process prior to fish being stocked into Stillman Lake and be coordinated with on-going stocking efforts in the Verde River watershed. It is anticipated that restocking efforts would be completed by winter 2007 and a long-term monitoring program would be initiated to evaluate success of the preferred alternative and for management of the re-established native fishery.

Conservation through re-establishment of native fishes in Arizona is consistent with the AGFD's "Wildlife 2006" (AGFD 2001) Nongame and Endangered Wildlife subprogram narrative and "Comprehensive Wildlife Conservation Strategy's" (AGFD 2006) Wildlife Action Plan, the goals of which include restoration of native biological diversity and recovery of imperiled species. The State of Arizona's Heritage and State Wildlife Grants Programs are consistent with recovering imperiled native wildlife and keeping common species common. Furthermore, through a June 2002 Memorandum of Agreement, the Service and AGFD have mutually agreed to participate in actions to improve the status of wildlife species-at-risk, such as the roundtail chub and other native fish.

The decision is whether the Service will, in cooperation with AGFD and others, 1) eradicate non-native aquatic species from Stillman Lake using chemical piscicide and restock the area with native fish; or 2) eradicate non-native aquatic species from Stillman Lake by removing the sediment berm, draining the lake,and using mechanical techniques to remove non-natives, and restock the lake with native fish; or 3) take no action on removing non-natives from the area. The Service, in coordination with AGFD, will make a decision on action to be taken after a 45-day public review of this draft environmental assessment, and after consideration of all public comments received during the comment period. If the alternative selected would cause significant adverse impacts on the human or natural environment, an Environmental Impact Statement would be prepared prior to implementing the alternative. If no significant adverse impacts are anticipated, we will prepare a Finding of No Significant Impact and a final environmental assessment. These documents will be posted on our website (http://www.fws.gov/southwest/es/arizona/) and mailed to those who provide comments on this draft or who request copies.

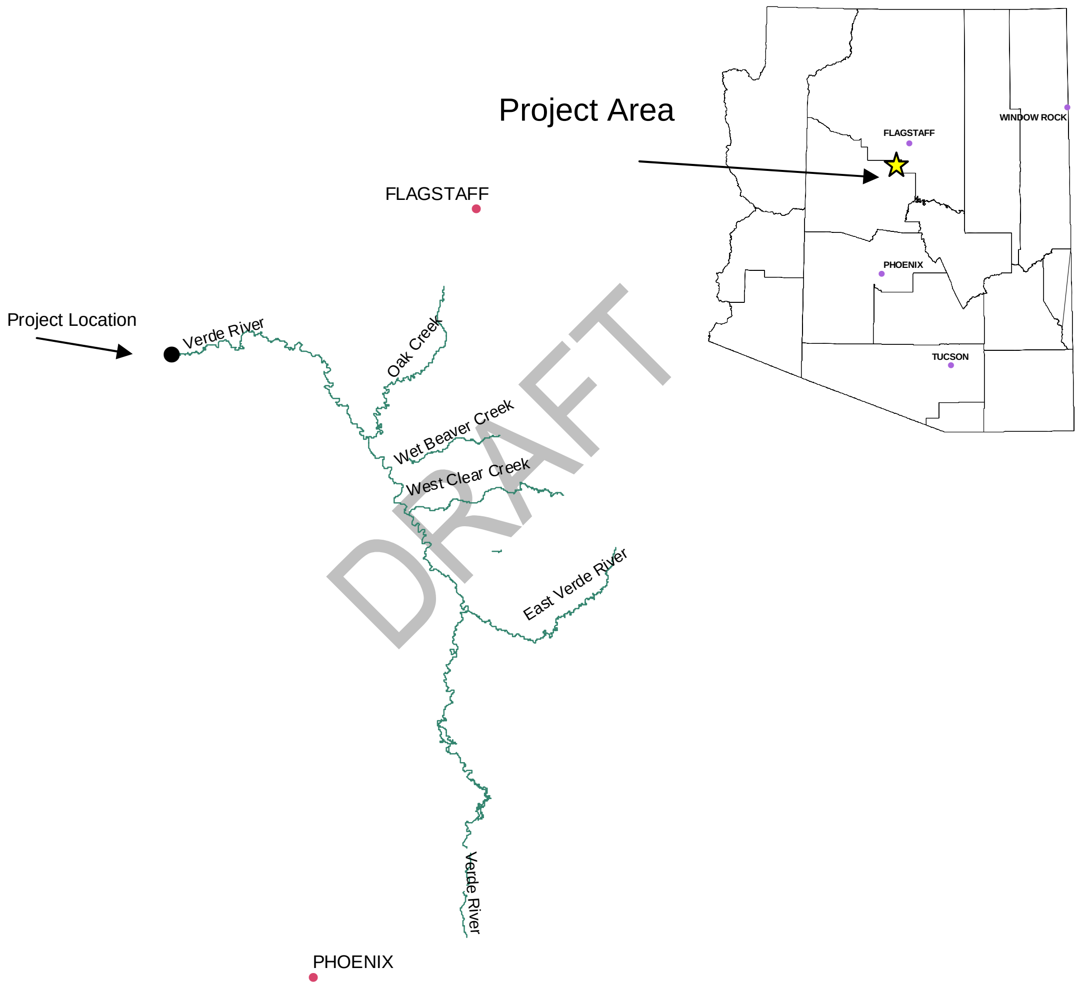

Figure 1. Verde River drainage and location of the Project Area

TABLE OF CONTENTS

CHAPTER 1: PURPOSE AND NEED

1.1 Introduction

The Service has prepared this Environmental Assessment (EA) to analyze potential effects to physical, biological and cultural resources that may result from native fish renovation efforts in the headwaters of the Upper Verde River.

This document is organized into six chapters:

- Chapter 1: *Purpose and Need*: Presents information on the history of the proposed action, the purpose of and need for the proposed action and the lead agencies' proposal for achieving that purpose and need. This section also details how the lead agency informed the public of the proposal and how the public responded.

- Chapter 2: *Comparison of Alternatives, including Preferred Alternative*: Provides a detailed description of the lead agency preferred alternative; alternative methods for satisfying the stated purpose and need; and, significant issues raised by the public, preferred alternative proponents, and other agencies.

- Chapter 3: *Affected Environment:* Describes the project environment.

- *Chapter 4: Environmental Consequences*: Describes the environmental consequences of implementing the preferred alternative and other alternatives. This section also includes a summary table of the environmental consequences associated with each alternative.

- Chapter 5: *Agencies and persons consulted*: Lists preparers and agencies consulted during development of the EA.

- Chapter 6: *Literature Cited*: Lists documents used in the preparation of this EA.

1.2 Purpose for the Proposed Action

The purpose of the proposed action is to restore and enhance the native fish community in Stillman Lake. A renovated Stillman Lake would provide a refuge for these fish due to reduced non-native predator loads and a source of native fish for downstream areas. Through recurring flood events, larval and young native species will disperse downstream into riverine and historical habitats. Also, the lentic nature of Stillman Lake would provide habitat for native lowland leopard frogs (*Rana yavapaiensis*) if non-native aquatic species are significantly reduced.

1.3 Need for Taking the Proposed Action

Renovation would benefit native fishes in the Upper Verde River by eliminating non-native predators and allowing native fishes in Stillman Lake the ability to grow to a larger size until they disperse downstream during flooding events. This action would also aid in determining how long it takes for downstream areas to re-colonize with stocked natives and provide much needed information regarding the long- term cost effectiveness of renovation projects. This proposed action may be an important first step in renovation of subsequent, downstream sections of the Verde River and Granite Creek which would be assessed at a later time. Renovation of Stillman Lake is necessary before restoration activities can begin in downstream areas. However, the proposed action addresses Stillman Lake only and does not address non-native fish populations downstream of the project area.

Conservation through re-establishment of native fishes in Arizona is consistent with the AGFD's Wildlife 2006 Nongame and Endangered Wildlife subprogram narrative, goals of which include restoration of native biological diversity and recovery of imperiled species. Furthermore, through a June 2002 Memorandum of Agreement, the Service and AGFD have mutually agreed to participate in actions to improve the status of wildlife species-at-risk, such as the roundtail chub and other native fish. Currently, AGFD's management goals for the Upper Verde River Wildlife Areas, which includes the Stillman Lake area, include protection of current and potential values for threatened, endangered, and sensitive (TES) stream and riparian habitats, fish, waterfowl, big game, small game, and non-game species with primary emphasis on TES species and their habitats.

1.4 Decision to be Made

The Service must decide whether to implement the preferred alternative, an alternative action, or no action. If the preferred alternative is implemented, the Service would renovate Stillman Lake, in cooperation with AGFD. AGFD would then internally evaluate the native species to be established in Stillman Lake through an internal environmental assessment process. In addition, Arizona Revised Statutes, Title 17-301, Section D4 states that the use of poisons or nets to take or manage aquatic wildlife will be determined and regulated by the Arizona Game and Fish Commission.

The Central Arizona Project (CAP) Fund Transfer Program, established under the 1994 and 2001 CAP biological opinions, may provide funding for renovation of Stillman Lake and repatriation of native fishes. Monitoring would occur in cooperation with the Bureau of Reclamation and the AGFD, under the "Native Fish Sanctuary Concept" under development by Gordon Mueller (USGS, Appendix A).

1.5 Public Involvement

A scoping letter dated November 2004 was distributed to 114 individuals, agencies, and interested parties. Four individuals responded with written comments. Several issues were identified within the written comments. These issues defined the range of actions, alternatives, and impacts that are addressed in this document, and served as the basis for refining the preferred alternative and developing mitigation measures.

The decision will occur after a 45-day public review of this draft environmental assessment, and after consideration of all public comments received during the comment period. If the alternative selected would cause significant adverse impacts on the human or natural environment an Environmental Impact Statement would be prepared prior to implementing the alternative. If no significant adverse impacts are anticipated, we will prepare a Finding of No Significant Impact and a final environmental assessment. These documents will be posted on our website (http://www.fws.gov/arizonaes/) and mailed to those who provided comments on this draft or who request copies.

Public comments can be summarized as follows:

- Use of piscicides to remove the non-native fishes in Stillman Lake
- Cost of preferred alternative
- Unclear as to the benefits of restoring Stillman Lake for native species
- Role of beaver dams and native fish distribution
- Effects of piscicides on other species such as birds and mammals and compliance with the Clean Water Act
- Sedimentation effects from berm removal
- Recommendation to address the entire Verde River
- Recommendation to address potential impacts to spikedace (*Meda fulgida*)

In a letter dated November 4, 2004, AGFD provided the following comments in response to the scoping letter:

- Recommendation to re-sample Stillman Lake following the September 2004 flood
- Continued close coordination between agencies due to treatment and stocking of fish
- Maximizing the use of mechanical removal methods
- Identification of funding sources to monitor the preferred alternative and include education to prevent illegal stocking
- Salvage of larger bodied sportfish prior to treatment
- Identification of trigger points for re-treatment need to be clearly defined
- Clarification of rationale for target removal goals

CHAPTER 2: DESCRIPTION OF ALTERNATIVES

2.1 No-Action Alternative

Under a No-Action alternative, neither renovation nor repatriation of native fish in Stillman Lake would occur. The enclosed, lotic nature of Stillman Lake provides prime habitat for spawning and recruitment of non-native aquatic species such as common carp (*Cyprinus carpio*) and flathead catfish (*Pylodictis olivaris*). Stillman Lake is a source population of these non-natives that disperse downstream when the Verde River periodically floods. Therefore, if renovation does not occur, non-natives will continue to dominate the area, and we will be unable to manage this or adjacent stream habitat for native fishes or other native aquatic species. There would be no cost for implementing the No-Action Alternative.

2.2 Alternative A, Preferred Alternative (Chemical Renovation and Restocking of Native Fish)

Use of Chemical Piscicide to Renovate Stillman Lake: The purpose of the proposed action is to restore and enhance the native fish community in Stillman Lake. In order to do this, the Service, in cooperation with AGFD, is proposing to remove all non-native fish (e.g. flathead catfish), and reduce crayfish and non-native amphibians. A fish toxicant effective in killing most species and life stages of gill-breathing animals will be used to remove non-native fishes from Stillman Lake. Sodium or potassium permanganate will be used as detoxifying agent at the downstream end of the treatment zone. During chemical application baited minnow traps would be deployed in order to expose crayfish to the piscicide and increase mortality. Stillman Lake is conducive for native fish restoration because of its isolation and the retention of the berm which hydrologically separates the area from the rest of the Verde River. Following the eradication of non-native fishes from Stillman Lake, it would be gradually restocked over a three-year period to restore the native fish community that was historically found in the area. Native fish that would be stocked into Stillman Lake include adult razorback sucker (*Xyrauchen texanus*), desert sucker (*Pantosteus clarkii*), Sonora sucker (*Catastomus insignis*), roundtail chub (*Gila robusta*), and speckled dace (*Rhinichthys osculus*). The razorback sucker is listed as endangered under the Endangered Species Act (Act); the other species are not listed.

The EPA-registered piscicide (antimycin or rotenone) would be applied under the supervision of a certified applicator, in accordance with a treatment plan approved by the Service and AGFD. If the treatment chemical is rotenone, the formulation used would be either Nusyn-Noxfish or CFT Legumine. Both formulations have rotenone as the primary active ingredient, but the older formulation of Nusyn-Noxfish has several hydrocarbon-based diluents and surfactants in low concentrations that impart a diesel-like odor to the product, which may allow fish to detect the chemical in water and thus avoid it. The recent formulation of CFT Legumine replaces most of those chemicals with fewer and better-performing diluents, thus decreasing and altering its smell, and potentially reducing its ability to be detected by fishes. Both formulations would be applied using backpack sprayers along shorelines and small boats with electric motors to cover deeper sections of Stillman Lake.

If antimycin is used, Stillman Lake would be treated with a combination of aqueous antimycin A (Fintrol-Concentrate) and possibly sand coated antimycin A (Fintrol-15). Fintrol-Concentrate is comprised of the active ingredient antimycin A and inert ingredients soy lipids, acetone (diluents), biethyl phthalate (a surfactant), and nonoxyl-9 (a detergent). Fintrol-concentrate would be applied either by backpack sprayer or mixed in buckets with water and dispersed by hand. Fintrol-15 is comprised of antimycin A coated over a grain of sand that is then coated with other inert materials that dissolve slowly when in water to allow the antimycin to be released over a depth of 15 feet when applied at the surface. Fintrol-15 is applied by hand or with a hand-held seed or fertilizer spreader.

Prior to treatment, Stillman Lake volume would be calculated using direct measurements. Appropriate calculations would then be made to determine the amounts of piscicide necessary to treat Stillman Lake. These calculations would be double-checked by a certified pesticide applicator.

Renovation activities would be coordinated among AGFD, the Service, and other adjacent landowners. Staff working along Stillman Lake would use an established game trail, so no new trails would be created. All activities would comply with applicable state and Federal rules and regulations. Sodium or potassium permanganate would be used to detoxify the fish toxicant, to ensure that downstream water quality and public safety concerns are met. A detoxification drip station would be established downstream of the Stillman Lake outflow, where perennial flow begins in the Verde River, to meter either aqueous potassium permanganate ($KMnO_4$) or sodium permanganate ($NaMnO_4$) into the stream during the course of each piscicide treatment to ensure detoxification. In addition, to ensure that no subsurface flow carrying piscicide enters into Granite Creek, an additional detoxification station would be established on Granite Creek. For each station, a cage with sentinel fish would be placed approximately 100 yards downstream of the detoxification area to ensure that the detoxification is occurring as intended.

Neither rotenone nor antimycin are effective at killing crayfish and non-native amphibians such as bullfrogs (*Rana catesbeiana*) due to these species' ability to avoid the chemical by leaving the water. Currently, there are no approved chemicals for eradication of these species; therefore, removal of non-native crayfish and bullfrogs would be conducted through mechanical methods such as trapping. However, manual trapping efforts concurrent with chemical application may temporarily reduce population densities of crayfish by preventing escapement of captured crayfish.

Rotenone: In addition to applicability as a piscicide, rotenone is registered as an insecticide for use on dogs, cattle, sheep, ornamental plants, trees, and turf; and for foliar preharvest application to vegetables, berries, tree fruit, nuts, forage crops, and sugar cane. Rotenone, a naturally occurring compound extracted from the roots of certain species of the bean family, has been used for centuries to capture fish (Finlayson et al. 2000). When introduced at a proper dosage into water, rotenone interrupts cellular respiration in gill-breathing animals by blocking the transfer of electrons in the mitochondria. Scientists believe that fish are more sensitive to rotenone because it is rapidly absorbed into the bloodstream from water flowing across the gill membrane. Both fish and aquatic insects are highly susceptible to rotenone (Skaar 2001), although aquatic insect populations usually rebuild to pre-treatment levels quite rapidly (Lennon 1971, Schnick 1974). Gill-breathing amphibians (i.e., frog and toad tadpoles and larval salamanders) are also adversely affected.

Rotenone is very unstable in the environment (half-life measured in days) and completely breaks down within one to four weeks depending on pH, alkalinity, temperature, dilution, and exposure to sunlight (Schnick 1974). Rapid neutralization (oxidation) occurs when rotenone is mixed with potassium permanganate (see Permanganate section below). Inert ingredients in the liquid formulation of rotenone as Nusyn-Noxfish consist of petroleum hydrocarbons as solvents and emulsifiers (primarily naphthaline, methylnaphthalenes, trichloroethylene, and xylenes), whereas those ingredients have been essentially replaced with n-methyl-2-pyrrolidone and diethylene glycol ethyl ether in the CFT Legumine formulation. There are no Federal or Arizona water quality standards for rotenone. When applied to surface waters according to label instructions for fish control, rotenone is not a pollutant as defined under the Clean Water Act.

Antimycin A: Antimycin A is an organic compound that was isolated from the bacterium *Streptomyces girseus* at University of Wisconsin in 1945 (Leben and Keitt 1948, Dunshee et al. 1949). Antimycin ($C_{28}H_{40}N_2O_9$) (Rinne and Turner 1991), which inhibits growth of some fungi but does not affect most bacteria, was later found to be toxic to fish and patented as a piscicide in 1964. The formulation proposed for use in this project is Fintrol-Concentrate produced by Aquabiotics Corp. of Bainbridge Island, Washington. Fintrol is registered with the Environmental Protection Agency under registration number 39096-2, and it is recognized by the Arizona Department of Environmental Quality as acceptable under the conditions of the Arizona Water Quality Standards for Surface Waters. It consists of 10% antimycin, a surfactant, and acetone.

The degradation compounds have very low toxicity for both fish and mammals (Herr et al. 1967). Detoxification of antimycin is accelerated by pH greater than 7.0 and exposure to sunlight (Lee et al. 1971, Marking and Dawson 1972). When exposed to sunlight or open shade, antimycin degrades completely in 1.0 hour and 1.5 hours, respectively (Lee et al. 1971). The above-neutral pH of Stillman Lake and exposure to sunlight would result in relatively rapid and total degradation of antimycin. For this reason, antimycin A application stations need to be established at 100-150 m intervals to maintain desired toxicity levels.

Antimycin acts at a cellular level to interrupt respiration (Schnick 1974:11) by inhibiting electron transport between cytochrome *b* and cytochrome *c* in Complex III of the cellular respiratory chain (Potter and Reif 1952, Rieske et al. 1967a, b). Antimycin does not repel fish (i.e. they are unable to detect it), and thus they do not attempt to avoid treated areas. Its action is rapid and irreversible (Aquabiotics Corp 1970). It is deactivated quickly and easily with approximately 1 mg/L potassium permanganate ($KMnO_4$) at the downstream end of the treatment area (Stefferud et al. 1991).

Permanganate: Although antimycin and rotenone rapidly degrade naturally, permanganate is the recommended neutralizer to ensure that fishes in Stillman Lake below the fish barrier are not affected by the piscicide treatment. Potassium permanganate (or sodium permanganate) is a strong oxidizer that breaks down into potassium (or sodium), manganese, and water very rapidly. These substances are common in nature and have no deleterious effects at concentrations normally used with neutralizing applications (Finlayson et al. 2000). Potassium permanganate reduces the half-life of antimycin from approximately 5 hours to 7 to 11 minutes in a laboratory setting (BSFW 1974). Neutralization is slowed by low temperatures and accelerated at high temperatures. Potassium permanganate itself can be toxic to some fish under certain hard water conditions at high concentrations (generally >4 parts per million) and long exposure periods (several hours) (Marking and Bills 1975).

Temporary signs would be placed at public access points along Stillman Lake prior to and during renovation activities that would explain the preferred alternative and list public precautions. Permanent signs would be placed near visited areas to inform the public about the value of native fish populations and the penalties associated with live transfer of non-native fishes under Arizona Revised Statutes.

Fish Salvage: AGFD has the authority to manage fish and wildlife resources of the State and would approve and oversee activities associated with fish salvage and renovation. Fish salvage operations would commence a week prior to rotenone treatment of Stillman Lake. Using a combination of electrofishing and nets, desirable sportfish such as flathead catfish, large/smallmouth bass, and channel catfishes would be captured and restocked into cleared waters of the state at the discretion of the AGFD. These fish will be re-located to areas where anglers may better utilize them. Since there is a possibility of also capturing native fishes such as Sonora suckers, any native species would be released downstream of the Stillman Lake outflow where the Verde River becomes perennial.

Repatriation: Fish would be hauled to Stillman Lake by vehicle on established roads. Biologists would carry fish in buckets the last 0.25 mile to Stillman Lake to avoid driving vehicles in Granite Creek and minimize floodplain disturbance. This preferred alternative includes repatriation of native fishes such as roundtail chub, and razorback, desert, and Sonora sucker. The intent of the proposed action is for native fishes to be able to reproduce successfully in a low-predator environment. When Stillman Lake re-connects to the Verde River during high-flow events, the expectation is that the native fishes would disperse downstream. In this scenario, Stillman Lake would serve as a source population for downstream areas. Due to Stillman Lake's occasional connection to the Verde River, it is likely that non-natives would re-establish themselves in Stillman Lake during extreme high-flow events. This is especially relevant until other restoration activities can begin downstream. Until downstream restoration projects are planned and implemented, re-invasion of Stillman Lake is possible and would be addressed through adaptive management. As stated previously, prior to stocking fish into Stillman Lake, the AGFD internal fish-stocking evaluation process would be completed. In addition, stocking efforts would be coordinated with other, on-going stocking efforts in the Verde River Watershed.

Monitoring and re-treatment: Following the initial chemical treatment, Stillman Lake would be intensively sampled by the Service and AGFD to determine if project objectives were met. If pisicivorous, non-native fish remain in Stillman Lake post-renovation, re-treatment would be necessary. The preferred alternative could include up to three piscicide treatments, within a three-month period, if necessary to completely remove non-native fishes. In addition, the preferred alternative would include the option of conducting up to two complete re-treatments of Stillman Lake within the ten-year period covered by this document. We expect that additional treatment may be necessary due to non-natives invading Stillman Lake during high-flow events or through illegal introductions. However, the need for additional chemical treatments would be assessed based upon the extent of the reinvasion. We expect to work cooperatively with AGFD in implementation of the Native Fish Sanctuary Management Plan for Stillman Lake (Sanctuary Plan, Appendix A) to determine when and if additional application of fish toxicant is necessary.

Following successful treatment, monitoring Stillman Lake would be conducted through a collaborative, cooperative effort that is identified in the Sanctuary Plan. The Sanctuary Plan is a working document intended to identify and describe management goals, resources, and methods required to effectively manage native fishes at Stillman Lake. The Sanctuary Plan also identifies research opportunities. Through the active management of these native species in small sanctuary habitats, scientists and resource managers would gain the knowledge and experience that would be important for the species to be recovered on a larger scale.

The proposed action is related to other native fish improvement efforts on-going downstream. As part of an on-going, experimental research project examining the effectiveness of mechanical removal on non-native and native fish populations in the Verde River, the U.S. Forest Service has been removing non-native fish approximately three miles downstream of Stillman Lake for four years. The AGFD has received a grant from the Arizona Department of Environmental Quality (ADEQ) that addresses turbidity downstream of Stillman Lake. The AGFD would institute four restoration measures with post-project monitoring to enhance water quality for the citizens of Arizona by reducing non-point pollution sources in the Verde River. Turbidity (the primary impairment) would be reduced in the river through restoration efforts and include outreach/education efforts on site and in the local community. The restoration measures proposed include 1) fencing to exclude livestock from the riparian area, 2) road obliteration and barriers to control vehicle and off-highway vehicle (OHV) travel; 3) stream-bank slope adjustment, and 4) re-vegetation of native plants on impacted floodplain terraces, exposed and barren stream banks, and areas closed to vehicle traffic. These four measures would improve water quality by improving vegetation ground cover, thereby reducing excessive storm runoff and soil erosion. In addition, AGFD has purchased property both upstream and downstream of Stillman Lake with the primary intent of managing these areas for native species (AGFD 1996).

The proposed action is also consistent with on-going recovery actions for razorback sucker and roundtail chub, as identified in the Razorback Sucker Recovery Plan (USFWS 1998), the Razorback Sucker Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Plan (USFWS 2002), and the draft AGFD statewide conservation agreement for six native fishes that includes recommendations to improve the status of the roundtail chub.

Costs for the preferred alternative would include personnel time, monitoring, and equipment. In addition, depending on type of fish toxicant used, the costs for chemical purchase may be low due to existing stock. Project costs for this alternative are expected to be less than Alternative B due to the availability of Service and AGFD expertise to implement this alternative.

2.3 Mitigation Measures for Preferred Alternative

Mitigation measures are prescribed to avoid, reduce, or compensate for potential adverse effects of an action. The following measures would be implemented for the preferred alternative:

- Public information and education materials describing project effects and benefits would be prepared and distributed to local residents and through the media.
- Vehicular access (with landowner permission) through private property would be limited to the floodplain and already disturbed areas. No vehicles would be permitted to drive on abandoned terraces adjacent to Stillman Lake.
- Crews working on Stillman Lake during salvage, renovation and monitoring activities would practice "leave no trace" camping techniques.
- Strict adherence to the piscicide label would be required for transportation, storage, mixing, and personal protective equipment.
- Daily use records would be kept to document the use of the piscicide, as required.
- Fish removed, whether by mechanical or chemical means, would be collected and buried on site.

2.4 Alternative B (Removal of Sediment Berm)

Breaching the sediment berm and draining Stillman Lake: During a January 2004 meeting to discuss potential alternatives, removal of the sediment berm that impounds Stillman Lake was suggested as a possible alternative to other renovation methods. Even if all the water could not be drained by berm removal, reducing overall volume in the lake would potentially make other renovation alternatives (e.g., mechanical removal of fish) more cost effective.

In this alternative, the berm would be removed to approximately 3.28 feet (1 meter) below the current water level to provide enough elevation for drainage to occur. A channel would be constructed that would follow the historical channel to convey the flows downstream. Erosion controls would be incorporated along each side of the channel to minimize sedimentation. Channel dimension and profile would be based on landscape slope and distance to where flows become perennial in the Verde River. This effort would likely be contracted to an engineering firm with experience in channel restoration and design. During a field trip in August 2004, several engineers visually surveyed the area and agreed that this alternative was feasible given the hydrology and geomorphology of the area. However, the overall cost of the proposed action would increase significantly if earth moving and channel restoration become components of the project.

Once water is qravity drained, a pump would be used to pump water levels as low as feasible. Once draining and pumping are complete, the berm would be repaired and the conveyance channel obliterated and returned to its preconstruction state. Native willow seedlings from below the Stillman Lake outfall would be planted to restore the area to its pre-construction state. Additional information and analysis on this alternative is included in Appendix B.

Mechanical removal techniques would be used under this alternative to control non-native fish populations and would be an on-going management action into the foreseeable future. Mechanical removal would entail the use of electrofishing and nets to actively remove target fish species.

This alternative would be more costly to implement and maintain. Due to the need to hire a contractor to design and implement the channel construction and deconstruction, costs are expected to substantially more expensive than Alternative A or the No-Action Alternative. In addition to the cost of channel construction, mechanical removal of target species would need to be conducted on a yearly basis.

2.5 Mitigation Measures for Alternative B (Removal of Sediment Berm)

Mitigation measures are prescribed to avoid, reduce or compensate for potential adverse effects of an action. The following measures would be implemented for this action alternative:

- Public information and education materials describing project effects and benefits would be prepared and distributed to local residents and through the media.

- Vehicular access (with landowner permission) through private property would be limited to the floodplain and already disturbed areas. No vehicles would be permitted to drive on abandoned terraces adjacent to Stillman Lake.

- Crews working on Stillman Lake during salvage, renovation and monitoring activities would practice "leave no trace" camping techniques.

- Fish removed would be collected and buried on site.

2.6 Alternatives Considered but Not Analyzed

During the early planning phases, several alternative actions for meeting the purpose and need were considered but eliminated from further analysis as described below. These alternatives included consideration of different treatment methods.

- *Treatment of Stillman Lake using detonation cord (Primacord)*: Detonation cord explosives have been used in some cases instead of piscicides due to its cost effectiveness under certain conditions, elimination of chemical residues associated with emulsifiers, carriers, and detoxicants and the absence of piscicide escapement from the target area (Bass and Hilt 1979, Metzger and Shafland 1986, Platts 1974). More recent evaluation (Bayley and Austen 1988) concluded that in shallow impoundments, use of detonation cord was inferior to rotenone (chemical piscicide) with respect to efficiency of fish removal, cost, personnel, and convenience. In addition, the potential effects to aquatic habitat are unknown. Due to the lack of information on how explosives may impact the complex system of springs that create Stillman Lake, this alternative was eliminated from further analysis.

- *Mechanical Removal*: To date, nearly $4.4 million has been spent in the upper Colorado River basin (USFWS 1988-2003) to mechanically remove >1.5 million fish from open systems (Mueller 2005). Most of these fish were small cyprinids and removal costs ranged from $2 to $86 per fish. Increasing pressure from angler groups, land owners, and state resource agencies has restricted or limited removal of some recreational species; this has increased logistics and program costs (Swanson 2001). Recreational species salvaged from removal programs cost 2.5 to 10 times more than hatchery produced fish (Brooks et al. 2000) and are sometimes placed where they can re-invade treatment areas. Benefits to native fish populations from mechanical removal efforts are still uncertain. In a review of the Upper Colorado River basin effort, seven of the nine independent investigators concluded that were no tangible benefits to the native community. The one positive response was based solely on the presence of natives (Modde 1997). Six recommended removal efforts be intensified or expanded. Six studies reported no significant change while three reported a decline in large non-native predators

(McAda 1997; Brooks et. al. 2000; Modde and Fuller 2002). Northern pike (*Exox lucius*) were substantially reduced because these fish originated as escapees from an upstream reservoir (McAda 1997). Channel catfish, on the other hand, do reproduce in the river and present a different dilemma. Biologists have successfully reduced the abundance of large channel catfish in the San Juan River (Davis 2003) through mechanical removal. However, because channel catfish actively reproduce in the river and mechanical removal tends to target larger life-history stages, juveniles have become more plentiful, suggesting that distribution has simply shifted toward smaller fish. In the San Juan, razorback suckers are being lost when they are only a few days old; this implies they are being lost to small or intermediate, not large, predators (Begon et al. 1996). If so, a shift toward more numerous smaller predators could actually worsen predation pressure for early life stages of native species.

In Stillman Lake, mechanical removal via electroshocking and intensive netting occurred in 2001, 2004, 2005 and 2006 (Table 1). These efforts to remove non-native fishes have included a minimum of 5,677 electroshocking seconds and 58 Net Night units (1 unit defined as a 24 hour set). In addition, data indicate that overall size (mean length) of carp ($P \leq 0.001$) and flathead catfish ($P \leq 0.001$) have not decreased over time. This implies that mechanical removal efforts in Stillman Lake have been unsuccessful in reducing biomass or affecting a reduction in fish length. Small sample sizes of the other captured species preclude statistical analysis. In addition, the capture efforts in 2004 and 2005 were the most extensive to date. However, there is no noticeable reduction in population size for most species. If we were to continue with mechanical removal, we would expect our results to closely approximate Modde and Fuller (2002) results where reduction of catfishes was ineffective in relation to the cost of the project.

While mechanical removal by itself would not achieve the project goals, mechanical removal could be used as a tool in the ongoing management of Stillman Lake.

Table 1. Results from mechanical removal efforts in Stillman Lake, Verde River, Arizona in 2001, 2004-2006. Data reflect mean length (mm) and sample total for each species captured.

	2001		2004		2005		2006	
SPECIES	Mean Length	Number	Mean Length	Number	Mean Length	Number	Mean Length	Number
Common carp	450	3	436	152	359	111	437	65
Channel catfish	260	2	308	3	378	2	0	0
Green sunfish	70	1	90	12	82	559	78	80
Flathead catfish	599	5	373	24	433	8	553	4
Yellow bullhead	0	0	196	12	177	21	183	23
Smallmouth bass	0	0	190	1	193	1	0	0
Largemouth bass	0	0	430	1	148	2	0	0
Sonora sucker	0	0	0	0	233	28	292	2

*channel catfish (*Ictalurus punctatus*); common carp (*Cyprinus carpio*); green sunfish (*Lepomis cyanellus*), flathead catfish (*Pylodictis olivaris*); yellow bullhead (*Amerius natalis)*; smallmouth bass (*Micropterus dolomuieu)*; largemouth bass (*Micropterus salmoides*); Sonora sucker (*Catastomus insignis*).

- *Use of pumping to reduce water volume or to "dry" Stillman Lake*: Stillman Lake is thought to be at "steady state", where two cfs of inflow via the springs is balanced by two cfs of subsurface flow under the berm (Wirt et. al. 2004). Therefore, any pumping would need to exceed the two cfs of inflow to make progress at significantly reducing the water level in Stillman Lake. Based upon the size and number of the pumps that we could realistically transport to the area, it is unlikely that pumping would exceed two cfs of inflow and we would not be able to reduce water levels. In addition, there is 10 feet (3 meters) of elevation head that a pump would need to overcome to disperse the water downstream. A pump with a pumping capacity of 54,000 gallons/hour would be required to stay ahead of the two cfs of inflow.

  Pumping Stillman Lake to a lower level or trying to dry Stillman Lake was eliminated from further analysis due to the inefficiency and low cost-effectiveness of pumping to exceed the two cfs of inflow entering Stillman Lake, channel instability below Stillman Lake, close proximity of Granite Creek, and the potential high sediment load mobilized by moving high volumes of water downstream.

2.7 Comparison of Alternatives

Table 2. Summary of actions under each alternative.

No Action	Alternative A (Preferred Alternative)	Alternative B (Removal of Sediment Berm)
• No Action would be taken	• Fish toxicant used to remove non-native fish • Effectiveness monitoring • Potential re-treatment • Stocking with native fishes • Monitoring	• Sediment berm removed and overflow channel constructed • Water drained and pumped • Non-native fish removed through mechanical methods • Effectiveness monitoring • Continued mechanical removal of non-native fish • Stocking with native fishes • Monitoring

CHAPTER 3: AFFECTED ENVIRONMENT

This chapter presents relevant resource components of the existing project environment. Below is a discussion of physical and biological factors including location, water resources, vegetation, soils, terrestrial wildlife and human health, fish and aquatic wildlife, threatened and endangered species, recreation and visual aesthetics, and cultural resources.

3.1 Location

The project area is located at the headwaters of the Verde River, south of Paulden and north of Chino Valley in Yavapai County (Township 17 North, Range 2 West, southern portion of section 11 and north portion of section 14, Figure 2). Perennial flow of the Verde River begins upstream of its confluence with Granite Creek in an area called Stillman Lake. Stillman Lake is a relatively secluded area that has limited access because it is surrounded by private lands. The area is not a true "lake," but is a long, narrow body of water (approximately 20 surface acres) that originates from a spring complex approximately 0.25 miles downstream of Sullivan Dam. Stillman Lake is a semi-impoundment of the Verde River formed by an alluvial fan that originates from Granite Creek. Although Stillman Lake does have hydrologic connection to the Verde River during runoff events, normally all the flow to downstream areas is subsurface.

Stillman Lake lies within part of AGFD's Upper Verde River Wildlife Area (UVRWA) which was purchased in 1996 using Heritage Fund monies. UVRWA consists of four parcels of land owned by the AGFD Commission and managed by AGFD. Stillman Lake is within the Granite Creek parcel. Upstream of Stillman Lake, land ownership is a mix of private and state lands, including another parcel of the UVRWA (Sullivan Lake property, Figure 3). Downstream of Stillman Lake are private lands for approximately 3.5 miles, and then the

Prescott National Forest begins. The AGFD has also applied for a Special Land Use Permit (SLUP) from the ASLD for approximately 240 acres of State Trust lands located adjacent to two of the deeded parcels. The primary management emphasis for the Upper Verde River property is to manage riparian habitat and maintain native fish diversity (AGFD 2001). Secondary management emphases are environmental education and compatible wildlife-oriented recreation. The Granite Creek parcel was formerly used for livestock grazing and adjacent state and private lands are still used for this purpose. In addition, an increasing number of residences are being built in the area.

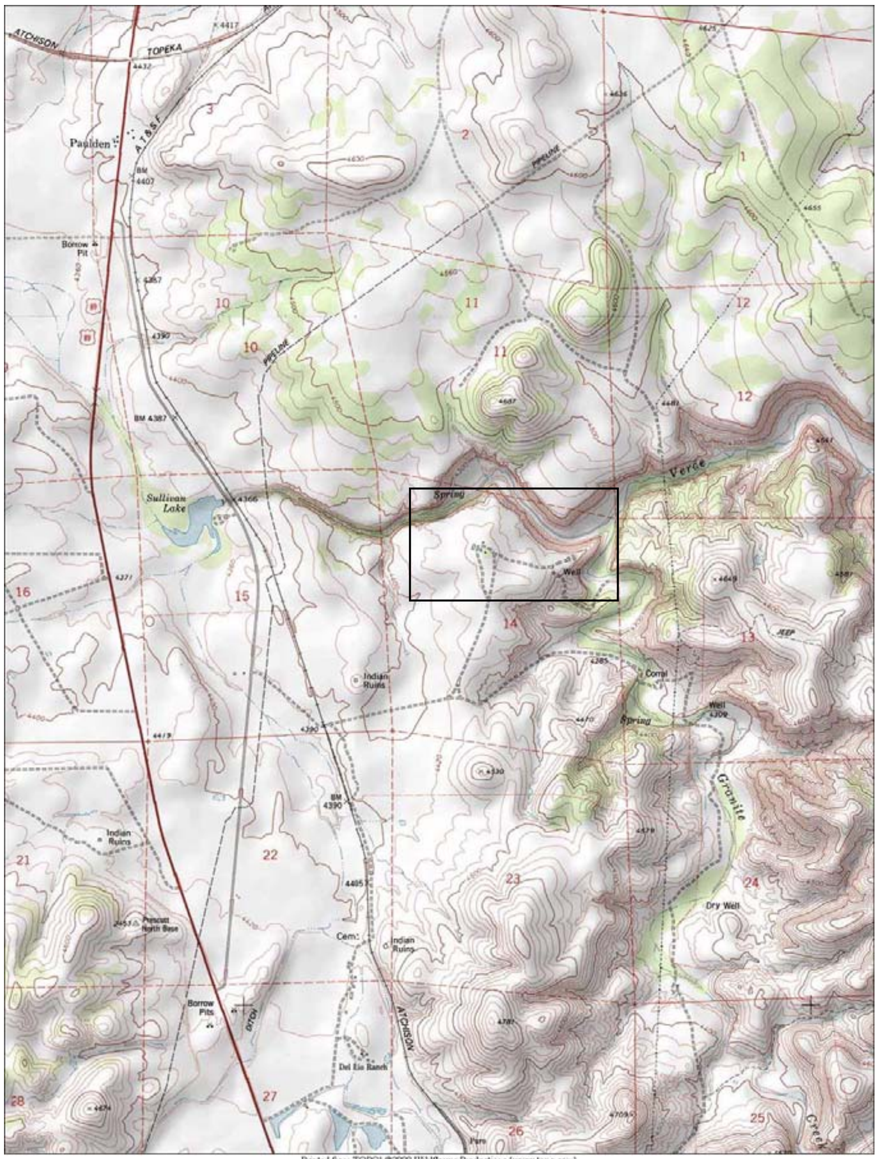

Figure 2. Location of Stillman Lake, in the headwaters of the Verde River. Black box indicates project area. Note that Sullivan Lake is an ephemeral wetland and not open water as map indicates.

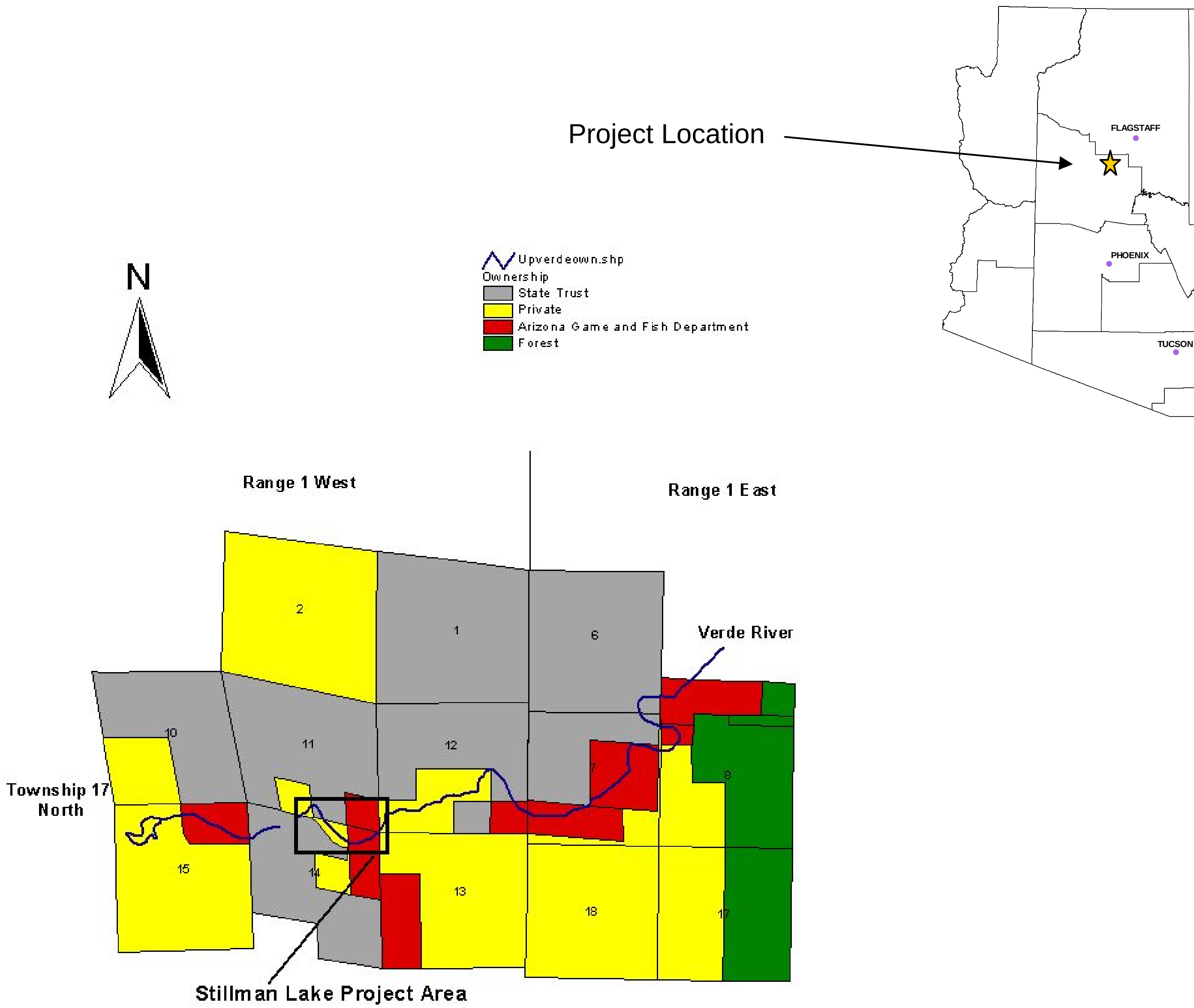

Figure 3. Land ownership in the Stillman Lake Project Area

3.2 Water Resources

Stillman Lake is approximately 20 surface acres and originates from a spring complex approximately 0.25 miles downstream of Sullivan Dam. Stillman Lake is currently impounded by a sediment wedge created and maintained by high flow events in Granite Creek (Figure 4.) Granite Creek is a first order, intermittent tributary that courses over 37 miles (60 km) through Yavapai County, southwest of Prescott. It begins at 6,234 feet (1900 meters) in elevation along the northeast slopes of the Sierra Prieta range.

Figure 4. Aerial photo of the Upper Verde River, including Stillman Lake and Granite Creek. Arrow indicates where Granite Creek enters the Upper Verde River from the south, creating the sediment wedge that backs up the water in Stillman Lake.

Stillman Lake is unique among Southwestern aquatic habitats. Water levels do not vary over seasons and appear stable historically (Wirt et. al. 2004); they range from 0.5 meter in depth near the inflow area to a maximum depth of 3.0 meters near the berm. Water levels are thought to be regulated by a series of springs located near the upper end that maintain the volume. Based on isotope studies, infiltration occurs under the berm near Granite

Creek, which leaks water into the Verde River. The flow is thought to be at steady state where springs flow at two cubic feet per second (cfs) but two cfs seeps underneath the berm (Wirt et. al 2004). During baseflow conditions, there is no upstream connectivity to Williamson Valley Wash or Big Chino Wash. The water level in Stillman Lake varies little (Wirt et. al. 2004), but during high flow events (e.g. fall 2004, spring 2005), water from Williamson Valley Wash and Big Chino Wash overtops the berm and creates continuous flow to the Verde River downstream. Although Stillman Lake does have hydrologic connection to the Verde River during runoff events, normally all of the flow to downstream areas is subsurface.

According to local residents, the sediment wedge impounding Stillman Lake has been in place since at least the 1930's (personal communication, Anne Harrington, May 14, 2003). However, during some high flow events, water does go over the top of the berm (or sediment wedge) as it did most recently in September 2004 and spring 2005 (Figures 5 and 6).

Water-quality parameters are summarized in Table 3 and are assumed to be representative of lake conditions. However, the USGS National Water-Quality Assessment Program conducted a water-quality assessment within the Central Highlands Province of Arizona (which contains Stillman Lake) and found that water quality in most streams is generally reflective of natural conditions (Anning 2004). However, in some stream reaches within the province, bed-sediment and tissue samples had detectable concentrations of organochlorine pesticides, including a chemical breakdown product of the insecticide DDT (Anning 2004). This pesticide was detected in two stream reaches of the Verde River; one of the reaches was within Granite Creek. In addition to this pollutant, two other insecticides were detected in Granite Creek. The USGS attributed the chemicals found in Granite Creek to urban land use in the Granite Creek drainage. The Environmental Protection Agency and ADEQ have listed Granite Creek and Watson Lake as “impaired waters.” Currently, Prescott Creeks, a locally based, non-profit organization, has received a Water Quality Improvement Grant for ADEQ to address sediment, contamination, and bacteriological issues contributing to the degradation of these water bodies.

Table 3. Summary of water quality parameters from Stillman Lake, Verde River, AZ. Distance in Stillman Lake measured from the inflow area opposite the berm. All water quality parameters represent mean values integrated through the water column (surface, midpoint and bottom).

Distance (Feet)	Max Depth (meters)	Temp (ºC)	Conductivity (µS)	pH	DO (mg/L)	Turbidity (NTU)
0	0.9	18.1	488.4	7.8	5.9	59.3
500	0.9	17.9	525.2	7.8	5.9	76.3
1000	1.1	18.1	520.9	7.9	6.5	73.4
1500	1.4	19.1	487.9	7.7	7.2	83.7

2000	1.6	18.1	488.4	7.8	5.9	67.0
2500	1.2	18.2	514.0	7.8	7.5	62.1
3000	1.0	19.9	518.6	7.7	6.5	48.4
3500	0.5	19.1	519.0	7.7	6.7	50.0

Most run-off into Stillman Lake comes from Williamson Valley Wash and Big Chino Wash, so the lake does not drain the same area that Granite Creek does. However, land uses above Stillman Lake include agricultural use, so some of the same water quality factors as those in Granite Creek may apply.

Figure 5. Stillman Lake during non-flooding conditions

Figure 6. Stillman Lake during flooding events and water overtopping the berm

3.3 Vegetation

The area includes associated riparian areas, floodplains, cliffs, and adjacent uplands. The diverse topography is dissected, ranging in elevation from 4,200 to 4,600 feet. The width of the river channel and floodplain varies from less than 0.1 to greater than 0.5 mile. Prominent cliffs rise 100 to 300 feet above the river. Lower Granite Creek supports a well-developed narrowleaf cottonwood (*Populus acuminata*) riparian forest.

3.4 Soils

Soils in the project area consist of sandy loam intermixed with some heavier clays that extend past the riparian area into the uplands. Soils near the riparian area are generally compacted due to historical livestock management. The berm that forms when Granite Creek flows is comprised of sand with heavier bedload (30-40cm) at the base.

3.5 Terrestrial Wildlife and Human Occurrence

Terrestrial Wildlife: Comprehensive avian, mammalian, and herpetofaunal surveys have not been conducted on the UVRWA; however, riparian vegetation communities typically support diverse and abundant native faunal populations, especially in the arid Southwest.

Based upon a limited amount of small mammal trapping, surveys, or casual observations, the AGFD has created a list of species that occur or potentially occur on the UVRWAs. Big game species include mule deer *(Odocoileus hemionus*) and javelina (*Tayassu tajacu*). Elk (*Cervus canadensis*) and black bear (*Ursus Americana*) use is infrequent, but they have been seen in the area. Pronghorn (*Antilocapra americana*), in low numbers, use the pinyon-juniper uplands that adjoin the Verde River. Mountain lion (*Felis concolor*) occupy the riparian corridor and rugged side drainages.

Common predators and furbearers that inhabit the area include striped skunk (*Mephitis mephitis*), badger (*Taxidea taxus*), beaver (*Castor canadensis*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), and bobcat (*Felis rufus*).

River otter (*Lutra canadensis*), desert cottontail (*Sylvilagus floridanus*), rock squirrel (*Spermophilus variegates*), raccoon (*Procyon lotor*), cliff chipmunk (*Eutamias dorsalis*), white throated woodrat (*Neotoma albigula*), Steven's woodrat (*Neotoma stephensi*), deer mouse (*Peromyscus maniculatus*), and brush mouse (*Peromyscus boylii*) have also been observed in the area.

The Verde River is a significant perennial waterway in northern Arizona and aside from supporting rare or priority management riparian breeding bird species, it also serves as an important stopover and/or wintering ground for a host of migratory birds. The headwaters of the Verde River provide breeding habitat for western yellow-billed cuckoos (*Coccyzus americanus*) and Lucy's warblers (*Vermivora luciae*) and potential breeding habitat for Bell's vireos (*Vireo bellii*), common black hawks (*Buteogallus anthracinus*), and other riparian-obligate species. Wintering and fall migrants detected in the Upper Verde River area include bald eagles (*Haliaeetus leucocephalus*), ferruginous hawks (*Buteo regalis*), red-tailed hawks (*Buteo jamaicensis*), sage thrashers (*Oreoscoptes montanus*), and Brewer's sparrows (*Spizella breweri*).

Human Occurrence: Stillman Lake receives very little human recreational use due to limited access. Vehicular access to Stillman Lake is obtained through adjacent private property. Permission from the property owner would be required to access Stillman Lake prior to project implementation.

3.5 Fish and Aquatic Wildlife

AGFD and the Service fish surveys have located the following species within the project area: common carp, channel catfish, green sunfish, flathead catfish, yellow bullhead, smallmouth bass, largemouth bass, mosquitofish, Sonora sucker, and bullfrogs. Recent flooding events have not eroded away the berm despite flows in the Upper Verde River exceeding 12,000 cfs in spring 2005. During periods of high flow, fish are likely to invade Stillman Lake from adjacent Granite Creek and may potentially come upstream from the Verde River. Evidence to support this includes the absence of native species such as Sonora suckers during surveys in 2000 and 2004, yet Sonora suckers were found in Stillman Lake following high spring flows in 2005. The suckers likely were washed into Stillman Lake from Granite Creek. Potential sources of non-native fish upstream from Stillman Lake are minimal and include several small, privately owned stockponds.

Downstream from the project area, recent surveys have found similar fish species in the mainstem Verde River. Nonnative species such as carp, green sunfish, and smallmouth bass are prolific in areas below Stillman Lake. However, additional native species including desert sucker, roundtail chub, and speckled dace are found regularly, especially in spring following winter high flow events (Fong 2004).

During sampling in September 2001, the AGFD found several species of non-native fishes, including flathead catfish in Stillman Lake. Other fish that were found during this sampling effort include common carp, channel catfish, red shiner (*Notropis lutrensis*), green sunfish, largemouth bass and smallmouth bass (Region III Fisheries Survey of the Verde River, 2001, 2004, 2005). In the late 1980s and early 1990s, AGFD stocked razorback suckers into the Verde River, near Stillman Lake. Stocking occurred from 1986-1994 (AGFD files). Hendrickson (1993) documents that following these stocking efforts, razorback suckers were captured in the Verde River, in a pool 100 meters upstream of Granite Creek. Based upon this description, we infer that these fish were captured in Stillman Lake. These fish may have dispersed out of Stillman Lake based upon river-wide surveys conducted by the U.S. Forest Service Rocky Mountain Research Station (Rinne et al. 1998).

Non-native fish dominate significant portions of Arizona's streams and if natives exist, in most areas they do so without noticeable recruitment (Minckley 1991). Following a long history of habitat loss and degradation (Minckley 1991, Rosen and Schwalbe 1995, Pacey and Marsh 1998, Marsh and Pacey 2005), the spread and establishment of non-indigenous aquatic organisms, especially fish, is increasingly viewed as one of the most serious long-term threats to the status and recovery of native aquatic vertebrates. Direct impacts of non-native fishes to native forms include predation, competition, hybridization, and parasite and pathogen transmission. Predation on early life stages (eggs, larvae, juveniles) is considered the primary avenue by which non-native fishes depress and often eliminate what are considered "predator naïve" native species (Minckley 1991). Evidence suggests that to survive and persist, even in physically degraded habitats, native species need habitats free of and protected from established populations of non-native species.

3.6 Threatened and Endangered Species

Table 4 presents the federally listed, proposed, and candidate species that occur in the project area. Listed species are afforded protection under ESA. Candidate species are those for which the Service has sufficient information to propose them as endangered or threatened, but for which listing is precluded due to other higher priority listings. Proposed species have been formally proposed to be listed.

Table 4. Federally-listed and candidate species in Yavapai County (May 2006).

Common Name	Scientific Name	Status
Bald Eagle	*Haliaeetus leucocephalus*	Threatened
Spikedace	*Meda fulgida*	Threatened, proposed

		Critical Habitat
Colorado pikeminnow	*Ptychocheilus lucius*	Experimental, non-essential in Verde River
Razorback sucker	*Xyrauchen texanus*	Endangered with critical habitat
Yellow-billed Cuckoo	*Coccyzu americanus*	Candidate

The following listed, proposed, and candidate species would not be affected by the project due to lack of suitable habitat and/or because the current range for the species is outside the project area: Arizona cliffrose (*Purshia subintegra*), California brown pelican (*Pelecanus occidentalis californicus*), Chiricahua leopard frog (*Rana chiricahuensis*), desert pupfish (*Cyprinidon macularius*), Gila chub (*Gila intermedia*), Gila topminnow (*Poeciliopsis occidentalis*), Mexican spotted owl (*Strix occidentalis lucida*), southwestern willow flycatcher (*Empidonax traillii extimus*), headwater chub (*Gila nigra*), and Page springsnail (*Pyrgulopsis morrisoni*).

Bald Eagle: The bald eagle south of the 40th parallel was listed on March 11, 1967 as endangered under the Endangered Species Preservation Act of 1966 (USDI 1967), and was reclassified to threatened status under the ESA on July 12, 1995 (USDI 1995). No critical habitat has been designated for this species. The bald eagle was proposed for delisting on July 6, 1999 (USDI 1999). On February 16, 2006, the proposed delisting rule was re-opened for public comment (USDI 2006).

The bald eagle is a large bird of prey that historically ranged and nested throughout North America except extreme northern Alaska and Canada, and central and southern Mexico. A recovery plan (USDI 1982) was established to delineate specific research and management objectives for the population in the Southwest. Since DDT was banned from use in the United States in 1972, there has been a steady increase in both the number of breeding pairs and the number of young reared per breeding attempt in most North American populations (Gerrard and Bortolotti 1988). In Arizona, the number of known bald eagle Breeding Areas has steadily increased from 1 or 2 in 1970, to 47 in 2005 (Jacobsen et al. 2005).

Wintering bald eagle populations tend to be scattered and highly mobile, usually foraging and roosting in small groups. Wintering eagles prefer areas of plentiful food resources, usually near water. Individual or small groups of eagles often occur in terrestrial habitats when open bodies of water freeze over. Eagles are consistently detected on the Verde River between the East Verde and West Clear Creek (Beatty 1992, Beatty et. al 1995a, Beatty et. al 1995b, Beatty and Driscoll 1999).

Stillman Lake is not included in any midwinter survey routes, and there is no information available regarding winter foraging use. However, potential roosting habitat (large trees, protected from the wind by adjacent slopes) is not present in the action area. The existing fishery in Stillman Lake provides limited foraging habitat for eagles. AGFD has detected bald eagles in the UVRWA during the fall. The nearest bald eagle nest is 21 miles downstream near Perkinsville.

Spikedace: The spikedace was listed as threatened on July 1, 1986 (USDI 1986). The spikedace is a small-bodied, short-lived fish endemic to the Gila River Basin that has been extirpated from most of its historical range. In Arizona, spikedace remain only in Aravaipa Creek, a portion of the Upper Verde River, and Eagle Creek (USDI 1990). The species is extremely rare in the Verde River, Eagle Creek, and portions of the upper Gila River watershed in New Mexico. Spikedace occupy flowing pools generally less than 3 feet deep over sand, gravel, or mud bottoms below riffles or in eddies (Minckley 1981, Rinne 1992). Although spikedace have never been recorded from Stillman Lake, the Verde River below the project area does provide suitable habitat for this species.

The Verde River from Sullivan Dam to the mouth of Fossil Creek is proposed critical habitat for the spikedace (USDI 2005). The last year the fish was confirmed in this stretch of the Verde River was 1999. Threats to the species in this area include non-native fish species, livestock grazing, and water diversions (USDI 2005). The recovery plan for the spikedace recommends protection of existing populations, enhancement and restoration of habitats, and reestablishment of spikedace.

Colorado pikeminnow: The Colorado pikeminnow was listed as endangered on March 11, 1967 (USDI 1967). The pikeminnow was once common throughout the Colorado River system, including the Gila River basin, but natural populations are now found only in scattered areas of the upper Colorado River system in Utah, Colorado, and New Mexico (USDI 1991a). On July 24, 1985, the Salt River from Roosevelt Dam upstream to the U.S. Highway 60 bridge, and the Verde River from Horseshoe Dam upstream to Perkinsville were designated as locations for experimental, non-essential populations of Colorado pikeminnow (USDI 1985). Those areas were subsequently stocked with the species and now Colorado pikeminnow are stocked annually in the Verde River near Childs.

Razorback sucker: The razorback sucker was listed as endangered on October 23, 1991 (USDI 1991b). Critical habitat was designated on March 21, 1994 (USDI 1994) and includes portions of the Verde, Gila, and Salt Rivers. This species was once common throughout the Colorado River basin, but now exists sporadically in only about 750 miles of river in the Upper Colorado River basin. In the lower basin, a substantial population exists only in Lake Mohave with occasional individuals occurring both upstream in Lake Mead and the Grand Canyon and downstream in the mainstem and associated impoundments (USDI 1991b). Razorback suckers have been stocked in numerous locations in the Gila, Salt, and Verde River basins in an attempt to recover the species. As stated above, AGFD stocked razorback sucker into the Verde River in the late 1980s through the mid-1990s. Hendrickson (1993) documents that following these stocking efforts, razorback suckers were captured in the Verde River, in a pool 100 meters upstream of Granite Creek. Based upon this description, we infer that these fish were captured in Stillman Lake.

Yellow-billed Cuckoo: On July 25, 2001, the Service published a notice in the Federal Register (USDI 2001) that a petition to list the western yellow-billed cuckoo (yellow-billed cuckoo) presented substantial information that ESA listing was warranted, but precluded by higher-priority listing actions. The yellow-billed cuckoo remains a candidate species. The yellow-billed cuckoo is a late migrant associated with large tracts of undisturbed riparian deciduous forest where willow, cottonwood, sycamore, and/or alder is present. Yellow-billed cuckoos require fairly large tracts (minimum of 25 acres and at least 300 feet wide) of habitat for nesting (Latta et al. 1999). However, recent research (personal communication, Murrelet Halterman, January 29, 2003) indicates that yellow-billed cuckoos can successfully reproduce in smaller habitat patches consisting of narrow stringers of trees. Preliminary information on the San Pedro River indicates that cuckoos used patches between 10 and 50 acres in size. In all sites, cottonwood/willow patches were surrounded by mesquite and hackberry. Cuckoos on the Bill Williams River appear to use larger patches. Yellow-billed cuckoos in higher elevations may be found in mesquite and tamarisk. The yellow-billed cuckoo feeds almost entirely on large insects, and if food-stressed, may also feed on berries and fruit. Yellow-billed cuckoos were detected in the Granite Creek UVRWA Parcel by AGFD.

Immediately surrounding Stillman Lake (above the berm) there is no yellow-billed cuckoo breeding habitat. However, below Stillman Lake, along Granite Creek, and farther downstream along the Verde River, breeding habitat exists.

3.7 Recreation and Visual Aesthetics

Scenic condition: The project area is defined by a broad floodplain at the confluence of the Granite and Verde Rivers. While native vegetation proliferates near the adjacent perennial streams, visual quality is disrupted by continued use by livestock within the riparian corridor.

Recreation: While recreation demand is high in some parts of the Verde River due to the presence of public access and perennial water, Stillman Lake receives little recreational use because it is surrounded by private property. Above Stillman Lake, The Little Thumb Butte Bed and Breakfast operates a horseback boarding facility. The owner frequently conducts trail rides along Stillman Lake. There are no developed or managed recreation sites in the area.

There are opportunities for sportfishing along the Upper Verde River. Pringle (2004) identified 191 total non-trout angler user days (AUD) in the Upper Verde River, from Sullivan Dam to Perkinsville. These are AUD's attributed to warm-water sportfishing, primarily on non-native species. Stillman Lake is located in this section of the upper Verde River. The Department has not conducted an assessment of AUD on Stillman Lake specifically. However, the Department estimates that angler use in the Stillman area is minimal due to limited access.

3.8 Cultural Resources

The latest listing of the National Register for Historic Places was consulted; no sites listed or formally determined eligible for inclusion on the Registers are known within the project area. The closest listed site is the Verde River Bridge located 2.7 miles south of Paulden, Arizona on Sullivan Lake Road. Stillman Lake is approximately 2.5 miles downstream of the Verde River Bridge.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Effects of the No-Action and action alternatives are summarized in Table 6. The No-Action alternative would likely continue current conditions under which non-native fish community dominance increases resulting in continued negative impacts to native fish. The following elements have been analyzed and will not be affected: Air Quality, Areas of Critical Environmental Concern, Farm Lands, Native American Religious Concerns, Wastes (hazardous or solid), Wild and Scenic Rivers, and Wilderness.

4.1 Water Resources

<u>No-Action Alternative</u>

No environmental consequences to water resources, including water quality and quantity, would occur under this alternative.

<u>Alternative A, Preferred Alternative (Chemical Renovation and Repatriation of Native Fish)</u>

Chemical renovation (piscicide application) would impact the length of Stillman Lake (approximately 1 mile). The effects from the use of fish toxicant at recommended concentrations would be restricted to fish and aquatic macroinvertebrates and would be short-term.

Rotenone: Rotenone is a large, heavy molecule that is not soluble, and tends to attach to organic matter (e.g. algae, sediment). Sunlight and the natural physical and chemical characteristics of Stillman Lake would quickly break down the rotenone into inert byproducts. The only flow connection Stillman Lake has to the Verde River and Granite Creek during baseflows is sub-surface. Any rotenone applied to Stillman Lake that went sub-surface would be inundated with organic material that would aid in detoxifying the chemical. The byproducts of neutralized rotenone are not harmful to fish or other organisms (Finlayson et al. 2000).

Antimycin: Antimycin A is an organic compound that was isolated from the bacterium *Streptomyces girseus* at University of Wisconsin in 1945 (Leben and Keitt 1948, Dunshee, et al. 1949). The formulation proposed for use in this project is Fintrol-Concentrate. Fintrol is registered with the Environmental Protection Agency under registration number 39096-2, and it is recognized by the Arizona Department of Environmental Quality as acceptable under the conditions of the Arizona Water Quality Standards for Surface Waters. It consists of 10% antimycin, a surfactant, and acetone.

Permanganate: Permanganate detoxification stations would be placed below Stillman Lake and just upstream of the berm in Granite Creek to ensure no chemical piscicide goes into Granite Creek or the Verde River. Permanganate is quickly broken down as it reacts to organic material and either rotenone or antimycin. Breakdown components of sodium permanganate (sodium, manganese, and water) are common in nature and have no deleterious environmental effects at concentrations used for neutralization of rotenone and antimycin (Finlayson et al. 2000). Therefore, water chemistry within Stillman Lake would return to pretreatment conditions within a few hours and no measurable effect on water quality would be anticipated downstream of the project area during piscicide application.

<u>Alternative B, (Removal of Sediment Berm)</u>

Excavation of channel substrates and other construction-related activity would contribute to elevated levels of suspended solids. Disturbances in the stream would temporarily increase turbidity for a short distance downstream of the construction area. We expect short-term adverse effects resulting from increased sediment load during active construction, but over the long-term this impact would be minor. However, because we have not measured sedimentation with scour chains or attempted to model the rate of downstream movement of channel substrates, the exact impact is unquantified. We predict that bank disturbances would be confined to solid rock and boulders, preventing soil erosion and sediment discharge into the stream. Project implementation activities (channel construction) would create localized soil disturbances that should have a short-term effect on stream conditions within the project area. These effects would be minor and would attenuate as vegetation recovers on project-impacted soils. The project would not affect long-term changes in water quality or stream dynamics.

4.2 Vegetation

<u>No-Action Alternative</u>

No environmental consequences to aquatic or riparian vegetation would occur under this alternative.

<u>Alternative A, Preferred Alternative (Chemical Renovation and Repatriation of Native Fish)</u>

Chemical Renovation: Very little vegetated habitat would be impacted by project implementation activities. There would be a minor impact to vegetation along the edge of

Stillman Lake from personnel working along Stillman Lake during project implementation. There is an established game trail that runs the length of Stillman Lake, so no new trails would be created to access the area. No vegetation clearing would occur as a part of this alternative and aquatic or riparian vegetation would not be harmed by the application of either chemical piscicide or the permangate neutralizing agent.

Repatriation of Native Fish: Aquatic or riparian vegetation would not be harmed by the addition of native fish to Stillman Lake.

<u>Alternative B, Alternative Action (Removal of Sediment Berm)</u>

Berm Removal: This alternative would remove all of the vegetation along the berm that forms Stillman Lake. Heavy equipment used to dig the channel below the berm would remove additional riparian vegetation. In addition, with recent flooding events that eliminated beaver dams, active headcutting is occurring just downstream of Stillman Lake. Granite Creek is only 16 feet (5 meters) away from the downstream channel and the combination of constructing a channel, breaching the berm, and draining the lake would remove much of the willow and other vegetation immediately below the berm and for approximately 300 yards downstream. The most significant effect would likely occur during a high-flow event when exposed banks may collapse resulting in lateral and vertical channel instability. The end result of this would be an increase in sediment input into the Upper Verde River.

Repatriation of Native Fish: Aquatic or riparian vegetation would not be harmed by the addition of native fish to Stillman Lake.

4.3 Soils

<u>No-Action Alternative</u>

No environmental consequences to soil resources would occur under this alternative.

<u>Alternative A, Preferred Alternative (Chemical Renovation and Repatriation of Native Fish)</u>

No environmental consequences to soil resources would occur under this alternative.

<u>Alternative B, (Removal of Sediment Berm)</u>

There would be disturbance to deposited soils associated with the berm and we estimate potential disturbance to approximately 300 yards of downstream active floodplain.

4.4 Terrestrial Wildlife and Human Health

No-Action Alternative

No environmental consequences to terrestrial wildlife and human resources would occur under this alternative.

Alternative A, Preferred Alternative (Chemical Renovation and Repatriation of Native Fish)

Chemical Renovation: The potential effects to Terrestrial Wildlife and Human Health for the fish toxicants rotenone and antimycin, and the permanganate neutralizing agent are described below.

Rotenone: Humans and wildlife could be exposed to concentrations of rotenone in surface waters of the project area for a minimal time period due to the presence of high organic material in Stillman Lake. Rotenone applied in a piscicide formulation is non-toxic to humans and non-aquatic vertebrates.

The active ingredient of Nusyn-Noxfish and CFT legumine is rotenone (5%). The Pesticide Action Network (PAN) Pesticides Database (http://www.pesticideinfo.org) lists information regarding the pesticide identification, toxicity, ecotoxicity, registered uses in the United States, product registration history, company and agent information, and links to literature regarding its use and toxicity. Rotenone is a certified organic botanical compound that has been used as an insecticide on crops and livestock for many years. The EPA has stated that "rotenone use in fish control does not present a risk of unreasonable adverse effect to humans or the environment." Rotenone is not listed as a PAN Bad Actor Chemical (chemicals that are either highly acutely toxic, cholinesterase inhibitors, known/probably carcinogens, known ground water pollutant, or known reproductive or developmental toxicant). Rotenone has acute aquatic toxicity and the PAN Pesticide Database lists the pure active ingredient as having "moderate" acute toxicity.

Antimycin: Antimycin A is an organic compound that was isolated from the bacterium *Streptomyces girseus* at University of Wisconsin in 1945 (Leben and Keitt 1948, Dunshee, et al. 1949). Antimycin ($C_{28}H_{40}N_2O_{9}$) (Rinne and Turner 1991) which inhibits growth of some fungi but does not affect most bacteria, was later found to be toxic to fish and patented as a piscicide in 1964. It consists of 10% antimycin, a surfactant, and acetone.

The degradation compounds of antimycin have very low toxicity for both fish and mammals (Herr et al. 1967). Detoxification of antimycin is accelerated by pH greater than 7.0 and exposure to sunlight (Lee et al. 1971, Marking and Dawson 1972). When exposed to sunlight or open shade, antimycin degrades completely in 1.0 hour and 1.5 hours, respectively (Lee et al. 1971). The above-neutral pH of Stillman Lake and exposure to sunlight would result in relatively rapid and total degradation of antimycin.

The effects of consuming fish killed by chemical renovation are poorly studied, but there have never been any reports of negative effects to humans or wildlife from eating fish killed by rotenone. Both rotenone and antimycin degrade rapidly under natural stream conditions, and when exposed to sodium or potassium permanganate, the remaining byproducts after neutralization are not harmful to humans or other organisms. During active treatment, human consumption of stream water or fish killed by piscicide would be discouraged and signs would be posted in the area noting this prohibition. Although the EPA (1981) has stated that there is no need to restrict livestock consumption of treated waters, if livestock are present in pastures with access to Stillman Lake or the area immediately below, we would work with adjacent landowners to move livestock to other areas during the treatment.

Permanganate: Although antimycin and rotenone rapidly degrade naturally, permanganate is the recommended neutralizer to ensure that fishes in Stillman Lake below the sediment berm are not affected by the piscicide treatment. Potassium permanganate (or sodium permanganate) is a strong oxidizer that breaks down into potassium (or sodium), manganese, and water very rapidly. These substances are common in nature and have no deleterious effects at concentrations normally used with neutralizing applications (Finlayson et al. 2000). Potassium permanganate reduces the half-life of antimycin from approximately 5 hours to 7 to 11 minutes in a laboratory setting (BSFW 1974). Neutralization is slowed by low temperatures and accelerated at high temperatures.

<u>Alternative B, (Removal of Sediment Berm)</u>

The effects of berm removal on terrestrial wildlife at Stillman Lake would be minimal and temporary in nature. There would be major, localized disturbance and loss of habitat for small mammals, birds, and herptefauna due to construction of the channel through the berm, and removal of aquatic and riparian vegetation at the site. The use of heavy equipment may preclude some terrestrial wildlife from accessing the site during implementation due to noise and disturbance.

We do not expect any impacts to human health and safety resulting from this alternative.

4.5 Fish and Aquatic Wildlife

<u>No-Action Alternative</u>

In the absence of action to protect and reestablish the native fish community, the trend of increasing non-native populations and decline of native populations would continue, and Stillman Lake would remain dominated by common carp, catfish, and green sunfish. This would continue to impact native fish downstream as Stillman Lake would continue to serve as a source of non-native fish. Maintaining the non-native fish assemblage may also adversely affect native amphibians and reptiles associated with Stillman Lake and the Upper Verde River.

Alternative A, Preferred Alternative (Chemical Renovation and Repatriation of Native Fish)

Chemical Renovation: Piscicide treatment would impact the one mile length of Stillman Lake. Detoxification at the outflow would prevent the rotenone and antimycin from affecting any areas downstream. Chemical renovation would eliminate all fishes within the treated area. Any native fishes, such as the suckers detected in 2005 and 2006, would be salvaged and placed downstream prior to treatment. Although we do not expect that salvage operations would recover all native fish, this action would minimize loss of these fish.

Effects of piscicides on aquatic invertebrates are variable. Any effects on aquatic insect populations are usually short-term, as kills are incomplete and recolonization is rapid (Whelan 2002). The ability to recolonize is dependent upon up- and downstream sources, and with the Verde River and Granite Creek adjacent to the project area, we would expect recolonization to occur relatively quickly. Potassium permanganate itself can be toxic to some fish under certain hard water conditions at high concentrations (generally >4 parts per million) and long exposure periods (several hours) (Marking and Bills 1975).

Neither rotenone nor antimycin would permanently or entirely remove crayfish populations. However, manual trapping efforts are expected to temporarily reduce crayfish densities by limiting the number of crayfish that can escape the chemical piscicide. Although it is desirable to eliminate crayfish from Stillman Lake to reduce predation on repatriated native fishes, their continued presence of crayfish is not expected to jeopardize the goals and objectives of the project. Crayfish have not been shown to interfere with native fishes to the point where fishes cannot successfully complete their life cycles and sustain populations. However, investigations are ongoing to develop methods to eliminate crayfish.

Re-establishment of native fishes: The re-establishment of native fishes to Stillman Lake would have beneficial environmental consequences. Stocking native fishes such as razorback sucker and roundtail chub would aid in restoring the native fish community in the Verde River and aid in the recovery process for the imperiled warm water native fish fauna of the Gila River Basin. This action, in conjunction with other projects, could eventually lead to downlisting and delisting of some fishes from the ESA.

Alternative B, (Removal of Sediment Berm)

The removal of the sediment berm and removal of a majority of the water from Stillman Lake would result in minimal effects to aquatic invertebrates. Most impacts to aquatic invertebrates would occur with the removal of aquatic and riparian vegetation during channel construction. The removal of this vegetation may impact larval stages of invertebrates and result in limited mortality. Draining most of the water in the lake and mechanically removing fish would also ultimately result in the death of most fish remaining within Stillman Lake. Although decreasing the amount and depth of water remaining in the lake would increase our ability to remove non-native fish mechanically, we would be unable to remove all fishes.

The effect of re-establishing native fishes would be the same as the preferred alternative except that under this alternative it is not expected that crayfish would be negatively affected by the removal of the sediment berm since there would be no manual trapping efforts conducted. Therefore, crayfish numbers would not be temporarily reduced as described in the preferred alternative.

4.6 Threatened and Endangered Species

No-Action Alternative

Repatriation of listed and sensitive fishes would not occur. No improvement to the recovery status of listed species would occur.

Alternative A, Preferred Alternative (Chemical Renovation and Repatriation of Native Fish)

Bald eagle: No suitable nesting and only limited foraging habitat occurs in Stillman Lake. Consumption of rotenone-killed fish would not be expected to harm foraging bald eagles. However, by removing exposed carcasses that may be available for foraging, we would further reduce the potential for any effects.

Spikedace: The preferred alternative would result in a net positive effect on the spikedace. Currently, Stillman Lake is an upstream source of non-natives into habitats downstream. By removing non-native fishes, the proposed alternative would aid in decreasing the population of predatory and competitive non-native fish above some historical spikedace locations in the Verde River. The removal of non-native fish may aid successful reproduction and survival of downstream spikedace populations. However, due to habitat degradation and the presence of non-native fish below Stillman Lake, the beneficial effect would dissipate downstream. The proposed spikedace critical habitat rule (USDI 2005) lists “habitats devoid of non-native fish species detrimental to spikedace, or habitat in which detrimental non-native fish are at levels which allow persistence of spikedace” as a primary constituent element of critical habitat. This alternative would assist in moving proposed designated critical habitat towards this end.

Colorado pikeminnow: The preferred alternative would indirectly benefit Colorado pikeminnow by reducing non-native fish populations upstream of Perkinsville. However, since the project does not propose to stock pikeminnow in Stillman Lake, effects to this fish would be minimal.

Razorback sucker: The preferred alternative would result in a net positive effect on the razorback sucker. Following removal of non-native fish from Stillman Lake, the preferred action would stock razorback suckers in Stillman Lake which would provide a source population that could disperse downstream in high-flow events. In addition, Stillman Lake is currently an upstream source of non-natives into habitats downstream. By removing non-native fishes, the proposed alternative would aid in decreasing the population of predatory and competitive non-native fish above known razorback sucker locations in the Verde River. The removal of non-native fish may aid successful reproduction and survival of downstream razorback sucker populations. However, due to habitat degradation and the presence of non-native fish below Stillman Lake, the beneficial effect would dissipate downstream.

Yellow-billed cuckoo: We do not expect any impacts to yellow-billed cuckoo or their habitat from this alternative.

Alternative B, (Removal of Sediment Berm)

Bald eagle: During channel construction we would expect potential disturbance to occur to bald eagles that may be foraging in the area. The operation of heavy equipment may temporarily discourage wintering bald eagles from foraging in the immediate vicinity. However, this would not preclude eagles from using the Verde River below Stillman Lake or Granite Creek above Stillman Lake. We would expect that eagles may temporarily avoid a 0.5 mile radius around the project area when heavy machinery is in use.

Spikedace: As stated above, removal of the sediment berm would result in short-term, but significant sediment inputs into the Verde River. This may result in adverse effects to proposed critical habitat if the suspended sediment load results in increased turbidity and poor water quality. Data do not currently exist to estimate the amount and composition of sediment that may be mobilized downstream following berm removal. However, due to low water velocities below Stillman Lake, we expect that sediment deposition would likely occur within the first 300 yards of the mainstem Verde River. If this action contributes to headcutting that is already occurring downstream of the berm, there may be slightly increased sedimentation that occurs longer term.

Currently, Stillman Lake is an upstream source of non-natives into habitats downstream. By removing non-native fishes, the proposed alternative would aid in decreasing the population of predatory and competitive non-native fish above spikedace locations in the Verde River. The removal of non-native fish may aid successful reproduction and survival of downstream spikedace populations. However, due to habitat degradation and the presence of non-native fish below Stillman Lake, the beneficial effect would dissipate downstream, as described above under the preferred alternative.

Colorado pikeminnow: This alternative would indirectly benefit Colorado pikeminnow by reducing non-native fish populations in Stillman Lake. However, since the project does not propose to stock pikeminnow in Stillman Lake, effects to this fish would be minimal.

Razorback sucker: Effects to razorback sucker from this alternative would be similar to those described above for spikedace. However, in addition to potential impacts to the habitat, this alternative would also include stocking razorback suckers in Stillman Lake. The reduction of non-native fish in Stillman Lake following draining and mechanical removal would provide a refuge for suckers to grow-out and disperse following flow events in Stillman Lake and the Upper Verde River.

Yellow-billed cuckoo: Willows and streamside vegetation would be removed with the berm and from channel construction. The project would be conducted outside the cuckoo breeding season. However, there is no nesting habitat along or immediately below Stillman Lake. There may be temporary disturbance within a 0.5-acre area resulting from some loss of foraging habitat below the berm. This should not result in adverse effects to yellow-billed cuckoos.

4.7 Recreation and Visual Aesthetics

No-Action Alternative

No environmental consequences to recreation would occur under this alternative. There would be no effect to scenic condition. We would also not expect any change in fishing pressure in the area. Stillman Lake receives little angler visitation.

Alternative A, Preferred Alternative (Chemical Renovation and Repatriation of Native Fish)

Angler use in the Stillman area is minimal due to limited access and management goals that are focused on native fish recovery as opposed to sportfishing opportunities (personal communication, Andy Clark, Region III Fishery Program Manager, April 13, 2006). There may eventually be native angling opportunities, such as roundtail chub, in Stillman Lake that would provide a greater angling experience than what is currently available. While access would still be limited under the current landownership, post-renovation management goals would focus on native sportfishing opportunities and encourage angler visitation and harvest.

There would be a temporary visual impact from the presence of dead fish following piscicide application. However, fish would be removed quickly and the visual impact would be minimal.

Alternative B, (Removal of Sediment Berm)

There would be a temporary reduction in recreational use of Stillman Lake and the surrounding area during berm removal and channel construction. However, this would not result in long-term impacts to recreation. During the course of implementation, construction activities would modify the scenic condition of the area for some until soils stabilize and vegetation is re-established. This is most likely to be an issue with equestrians that use the area for trail rides. Horseback riding is locally popular at Stillman Lake and at least one local business does use the area for clients staying at the bed and breakfast.

There would be a temporary impact to visual quality under this alternative. The Stillman Lake area is a popular place for horseback riding for locals and visitors. During channel construction and draining the lake, vegetation and ground disturbance would occur. This would result in a temporary visual disturbance to local riders looking for relatively undisturbed landscapes to ride. Visual disturbance would continue for at least one year until soils stabilize and vegetation begins to re-establish in the disturbed area.

In addition to the ground disturbance, there would be a temporary visual impact due to the presence of dead fish following mechanical removal. However, as stated under the preferred alternative, this impact would be minimal and short-term.

4.8 Cultural Resources

No-Action Alternative

No environmental consequences to cultural resources would occur under this alternative.

Alternative A, Preferred Alternative (Chemical Renovation and Repatriation of Native Fish)

No environmental consequences to cultural resources would occur under this alternative.

Alternative B, (Removal of Sediment Berm)

The removal of the sediment berm would require an archaeological survey to confirm that no impacts to cultural resources would occur. However, because of the nature of the berm and how it was created during disturbance events, it is likely that berm removal and channel construction would have no impact to cultural resources.

4.9 Cumulative Impacts

The Council on Environmental Quality defines cumulative impacts as the incremental impact of multiple and future actions with individually minor, but collectively significant, effects. Cumulative impacts can be concisely defined as the total effects of the multiple land uses and development, including their interrelationships, on the environment.

Most of the current land uses were described in the “Affected Environment” herein. In the Stillman Lake area, these include dispersed recreation and livestock grazing. However, both of these activities are limited within the project area. An additional action that is difficult to quantify is continued groundwater pumping in the watershed above Stillman Lake. The population of Yavapai County is growing at a very high rate, and as such, development is also increasing. As the demand for water increases, it is unclear how this would affect spring flow in Stillman Lake, although we would surmise that it would result in negative impacts to groundwater connections. It is possible in the near future that the water resources in Stillman Lake, and the Upper Verde, may be reduced by current and future groundwater pumping. However, at this time, the springs in Stillman Lake continue to put out a continuous flow of 2 cfs and do not appear to be drying. None of the resources in Stillman Lake are expected to incur significant cumulative impacts from the alternatives described herein.

4.10 Comparison of Alternatives

Table 5. Summary of impacts to environmental Resources by alternative.

Resource Issue	Alternative		
	No Action	**Alternative A, Preferred Alternative- Chemical Renovation and Restocking of Native Fish**	**Alternative B – Removal of Sediment Berm**
Water Resources	No effect	Short-term impact to Upper Verde headwaters from application of chemical piscicide and permanganate neutralizing agent.	Potential high sediment load resulting from channel modification resulting in impacts to the Verde River. However, we do not have the data to determine how much sediment may result from this action.
Vegetation	No effect	No effect	Some disturbance of native willows and other vegetation on and below berm.
Soils	No effect	No effect	Disturbance to 300 yards of downstream active floodplain
Terrestrial wildlife and Human Health	No effect	Temporary, minor disturbance to small mammals and herpetofauna due to biologists presence in the area	Major, localized, temporary disturbance to small mammals, birds and herpetofauna due to ground moving activities
Fish and Aquatic Wildlife	Non-native fish community dominance increases and	Elimination of non-native fish community from approximately one mile of the headwaters of the Verde River; short-term reduction	Temporary reduction in non-native fish community from one mile of the headwaters

	continuing negative impacts to native fish, frogs.	in macroinvertebrates; and, prevents continued source of non-native fish in the Upper Verde watershed.	of the Verde River; temporarily reduces source of non-native fish in the Upper Verde watershed. Yearly mechanical removal of fish
Threatened and Endangered Species	No effect	The preferred alternative would have beneficial effects to proposed spikedace critical habitat and native fish habitat in Stillman Lake. Benefit to native species that would be reintroduced into Stillman Lake, including the endangered razorback sucker.	Potential temporary adverse effects from high sediment load resulting from channel modification/berm removal. Beneficial effects from temporary reduction in non-native fishes. Benefit to native species that will be reintroduced into Stillman Lake
Recreation and Visual Aesthetics	Non-native fish would continue to negatively impact native sportfish such as roundtail chub.	Shift in angling opportunities from non-native to native species in Stillman Lake. Potential negative impact to current sportfishing opportunities in Stillman Lake. Very brief short-term impact to visual quality due to temporary presence of dead fish following application of fish toxicant.	Shift in angling opportunities from non-native to native species in Stillman Lake. Potential negative impact to current sportfishing opportunities in Stillman Lake. Berm removal and channel modification would temporarily be visually disturbing. Very brief short-term impact to visual quality due to temporary presence dead fish following mechanical removal.
Cultural resources	No effect	No effect	No effect with mitigation

CHAPTER 5: AGENICES AND PERSONS CONSULTED

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The public scoping letter was sent to 105 local landowners, interested parties, local governments, and agencies for review and comment.

CHAPTER 6: LITERATURE CITED

Anning, D.W. 2004. Effects of natural and human factors on stream and water quality in central Arizona. Arizona Water Resources Supplement, January – February 2004.

Arizona Game and Fish Department (AGFD). 1996. Upper Verde River Wildlife Area Management Plan. Phoenix, Arizona.

AGFD. 2001. Wildlife 2006. Arizona Game and Fish Deparment, Phoenix, Arizona.

AGFD. 2006. Comprehensive Wildlife Conservation Strategy for 2005-2015. Arizona Game and Fish Department, Phoenix, Arizona.

Aquabiotics Corp. 1970. Fintrol fish toxicant. Application pamphlet included with Antimycin-A containers.

Bass, D.G. and V.G. Hitt. 1979. Quantitative sampling of warmwater stream fish with detonating cord. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies. 31:519-521.

Bayley, P.B. and D.J Austen. 1988. Comparison of detonating cord and rotenone for sampling fish in warmwater impoundments. North American Journal of Fisheries Management. 8:310-316.

Beatty, G. 1992. Arizona bald eagle winter count: 1992. Nongame and Endangered Wildlife Program. Arizona Game and Fish Department, Phoenix, Arizona.

Beatty, G., J. Driscoll, and M. Siemens. 1995a. Arizona Bald Eagle Winter Count: 1994. Nongame and Endangered Wildlife Program Technical Report 68. Arizona Game and Fish Department, Phoenix, Arizona.

Beatty, G., J. Driscoll, and J. Koloszar. 1995b. Arizona Bald Eagle Winter Count: 1995. Nongame and Endangered Wildlife Program Technical Report 82. Arizona Game and Fish Department, Phoenix, Arizona.

Beatty G. and J. Driscoll. 1999. Arizona Bald Eagle Winter Count: 1997-1998. Nongame and Endangered Wildlife Program Technical Report 137. Arizona Game and Fish Department, Phoenix, Arizona.

Begon, M., J. L. Harper, and C. R. Townsend. 1996. Ecology: individuals, populations, and communities. 3rd edition. Blackwell Science Ltd., London.

Brooks, J. E., M. J. Buntjer, and J. R. Smith. 2000. Non-native species interactions: management implications to aid in recovery of the Colorado pikeminnow *Ptychocheilus lucius* and razorback sucker *Xyrauchen texanus* in the San Juan River, CO-NM-UT. San Juan River Basin Recovery Implementation Program, U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

BSFW (Bureau of Sport Fisheries and Wildlife). 1974. A review of literature on the use of antimycin in fisheries. Report PB-235-440, Washington, D.C.

California Department of Fish and Game. 1994. Pesticide investigations unit, aquatic toxicology laboratory 1990 annual progress report. CDFG, Environmental Services Division, Sacramento.

Davis, J. E. 2003. Non-native species monitoring and control, San Juan River 1999-2001. Progress report for the San Juan River Recovery Implementation Program. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Dunne, T., and L. B. Leopold. 1978. Water in environmental planning. W. H. Freeman and Company.

Dunshee, B.R., C. Leben, G.W. Keitt, and F.M. Strong. 1949. The isolation and properties of antimycin A. Journal of the American Chemical Society 71:2436-2437.

U.S. Environmental Protection Agency (EPA). 1981. Completion of a pre-RPAR review of rotenone. USEPA, Office of Toxic Substances (June 22, 1981), Washington, D.C.

Finlayson, B.J., R.A. Schnick, R.L. Cailteux, L. DeMong, W.D. Horton, W. McClay, C.W. Thompson, and G.J. Tichacek. 2000. Rotenone use in fisheries management: administrative and technical guidelines manual. American Fisheries Society, Bethesda, Maryland.

Fong, S. 2004. Verde River Trip Report, August 2-4, 2004. Arizona Game and Fish Department. Region III Fisheries Program. 8pp.

Gerrard, J. and G. Bortolotti. 1988. The bald eagle: haunts and habits of a wilderness monarch. Smithsonian Press, Washington. 178pp.

Hendrickson, D.A. 1993. Evaluation of the razorback sucker (*Xyrauchen texanus*) and Colorado squawfish (*Ptychocheilus lucius*) reintroduction programs in Central Arizona based on surveys of fish populations in the Salt and Verde Rivers from 1986 to 1990. Final Report, Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona. 182 pp.

Herr, F., E. Greselin and C. Chappel. 1967. Toxicology studies of antimycin, a fish eradicant. Transactions of the American Fisheries Society 96:320-326.

Jacobsen, K.V., J.S. Canaca, and J.T. Driscoll. 2005. Arizona bald eagle management program 2005 summary report. Nongame and Endangered Wildlife Program Technical Report 237. Arizona Game and Fish Department, Phoenix, Arizona.

Johnson, T.B. and R.L. Glinski. 1989. Procedures for nongame wildlife and endangered species re-establishment projects in Arizona. Nongame and Endangered Wildlife Program Technical Report 13. Arizona Game and Fish Department, Phoenix, AZ.

Latta, M. C. Beardmore, and T. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan. Version 1.0. Nongame and Endangered Wildlife Program Technical Report 142. Arizona Game and Fish Department, Phoenix, Arizona.

Leben, C. and G.W. Keitt. 1948. An antibiotic substance active against certain phytopathogens. Phyopathology 38:899-906.

Lee, T.H., P.H. Derse, and S.D. Morton. 1971. Effects of physical and chemical conditions on the detoxification of antimycin. Transactions of the American Fisheries Society 100:13-17.

Lennon, R.E. 1971. The use of toxicants in fisheries management. Department of Interior, U.S. Fish & Wildlife Service, Fish Control Laboratory, La Crosse, Wisconsin.

Leopold, L. B. 1994. A view of the river. Harvard University Press.

Marking, L.L. and V.K. Dawson. 1972. The half-life of biological activity of antimycin determined by fish bioassay. Transactions of the American Fisheries Society 101:100-105.

Marking, L. and T. Bills. 1975. Toxicity of potassium permanganate to fish and its effectiveness for detoxifying antimycin. Transactions of the American Fisheries Society 104:579-583.

Marsh, P.C and C.A. Pacey. 2005. Immiscibility of native and non-native species. In: Proceedings: restoring native fish to the lower Colorado River, interactions of native and non-native fishes. U.S. Fish and Wildlife Service, Albuquerque, NM, and U.S. Bureau of Reclamation, Boulder City, NV.

McAda, C. W. 1997. Mechanical removal of northern pike from the Gunnison River, 1995-1996. Colorado River Recovery Implementation Program, Project 58. U.S. Fish and Wildlife Service, Grand Junction, Colorado.

Metzger, R.J. and P.L. Shafland. 1986. Use of detonation cord for sampling fish. North American Journal of Fisheries Management. 6:113-118.

Minckley, W.L. 1981. Ecological studies of Aravaipa Creek, central Arizona, relative to past, present, and future uses. Final Report to the U.S. Bureau of Land Management, Safford District Office, Arizona, Contract No. YA-512-CT6-98. 362 pp.

Minckley, W.L. 1991. Native Fishes of the Grand Canyon region: an Obituary? Pages 127-177 in Proceedings of a symposium May 24-25, 1990, Sante Fe, NM. National Academy Press, Washington, D.C.

Minckley, W.L, P.C. Marsh, J.E. Deacon, T.E. Dowling, P.W. Hedrick, W.J. Matthews, and G. Mueller. 2003. A Conservation Plan for Native Fishes of the Colorado River. BioScience: 53 219-234.

Modde, T. 1997. Fish use of Old Charley Wash: an assessment of floodplain wetland importance to razorback sucker management and recovery. Recovery Program Project CAP-6. U.S. Fish and Wildlife Service, Vernal, Utah.

Modde, T., and M. Fuller. 2002. Feasibility of channel catfish reduction in the lower Yampa River. Upper Colorado River Basin Recovery Implementation Program Project 88. Colorado River Fish Project, Vernal, Utah.

Moody, T., M. Wirtanen, and S.N. Yard. 2003. Regional relationships for bankfull stage in natural channels of the arid Southwest. Natural Channel Design, Inc. Flagstaff, AZ.

Mueller, G.A. 2005. Predatory fish removal and native fish recovery in the Colorado River. Fisheries, 30: 10-21.

Oberg, K. 1967a. On the principal way of attack of rotenone in fish. Archives for zoology 18:217-220.

Oberg, K. 1967b. The reversibility of the respiration inhibition in gills and the ultrastructural changes in chloride cells from rotenone-poisoned marine teleost, *Gaduscallarius*. Experimental Cellular Research 45:590-602.

Pacey, C.A. and P.C. Marsh. 1998. Resource use by native and non-native fishes of the lower Colorado River: literature review, summary and assessment of relative roles of biotic and abiotic factors in management of an imperiled indigenous ichthyofauna. Final report to U.S. Bureau of Reclamation, Agreement No. 7-MT-30-R0012. Arizona State University, Tempe.

Platts, W.S. 1974. Geomorphic and aquatic conditions influencing salmonids and stream classification- with application to ecosystem management. U.S. Department of Agriculture, Surface Environment and Mining Program, Billings Montana.

Ponce, V.M. 1989. Engineering hydrology, principles and practices. Prentice Hall, Inc.

Potter, V.R. and A.E. Reiff. 1952. Inhibition of an electron transfer component by Antimycin A. The Journal of Biological Chemistry 194:287-297.

Rieske, J.S., H. Baum, C.D. Stoner, and S.H. Lipton. 1967a. On the antimycin-sensitive cleavage of complex III of the mitochondrial respiratory chain. The Journal of Biological Chemistry 242:4854-4866.

Rieske, J.S., H. Baum, C.D. Stoner, and S.H. Lipton. 1967b. Factors affecting the binding of antimycin A to complex III of the mitochondrial respiratory chain. The Journal of Biological Chemistry 242:4888-4896.

Rinne, J. N., J. A. Stefferud, P.J. Sponholtz and D.A. Clark. 1998. Fish community structure in the Verde River, Arizona 1974-1997. Hydrology and water resources in Arizona and the Southwest: 6.

Rinne, J. 1992. Physical habitat utilization of fish in a Sonoran desert stream, Arizona, southwestern United States. Ecology of Freshwater Fish 1:35-41.

Rinne, J.N. and P.R. Turner. 1991. Reclamation and alteration as management techniques, and a review of methodology in stream renovation. Pages 219-244 in W.L. Minckley and J.E. Deacon, editors. Battle against extinction: native fish management in the American West. The University of Arizona Press, Tucson, Arizona.

Rosen P.C. and C.R. Schwalbe. 1995. Bullfrogs: introduced predators in southwestern wetlands. Pages 452-454 in E.T. LaRoe, G.S. Farris, C.E. Puckett, P.D. Doran and M.J. Mac, *editors*. Our Living Resources. U.S. Department of the Interior, National Biological Service, Washington, D.C.

Rosgen, D.L. 1994. A classification of natural rivers. Catena 22: 169-199.

Schnick, R.A. 1974. A review of the literature on the use of antimycin in fisheries. U.S. Department of Interior, Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, Fish Control Laboratory, La Crosse, Wisconsin.

Shen, H. W. 1971. Stability of alluvial channels. River Mechanics. Ft. Collins, CO.

Skaar, D. 2001. Brief summary of persistence and toxic effects of rotenone. Status Report. Montana Fish, Wildlife, & Parks, Helena, Montana.

Stefferud, J.A., D.L. Propst, and G.L. Burton. 1991. Use of antimycin to remove rainbow trout from White Creek, New Mexico. Proceedings of the Desert Fishes Council 23:55-66.
Swanson, J. 2001. Resident shocked about fish tales (newspaper article). Craig Daily Press, 15 May 2001, Craig, Colorado.

Whelan, J.E. 2002. Aquatic macroinvertebrate monitoring results of the 1995 and 1996 rotenone treatments of Manning Creek. Publication Number 02-04, Utah Division of Wildlife Resources, Salt Lake City, Utah.

U.S. Department of Interior (USDI), Fish and Wildlife Service. 1967. Native fish and wildlife. Endangered species. Federal Register 32(48):4001.

U.S. Department of Interior (USDI), Fish and Wildlife Service. 1982. Bald eagle recovery plan (southwestern population). U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Department of Interior (USDI), Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants; Determination of experimental population status for certain introduced populations of Colorado squawfish and woundfin. Federal Register 50(142):30188-30194.

U.S. Department of Interior (USDI), Fish and Wildlife Service. 1986. Endangered and threatened wildlife and plants; determination of threatened status for the spikedace. Federal Register 51(126):23769-23781.

U.S. Department of Interior (USDI), Fish and Wildlife Service. 1991a. Colorado Pikeminnow revised recovery plan. U.S. Fish and Wildlife Service, Denver, Colorado. 56 pp.

U.S. Department of Interior (USDI), Fish and Wildlife Service. 1991b. Endangered and threatened wildlife; the razorback sucker determined to be an endangered species. Federal Register 56(205):54957-54967.

U.S. Department of the Interior (USDI), Fish and Wildlife Service. 1994. Endangered and threatened wildlife and Plants: Determination of critical habitat for four Colorado River Endangered Fishes; Final Rule. Federal Register 59(54):13374-13400.

U.S. Department of the Interior (USDI), Fish and Wildlife Service. 1995. Endangered and threatened species; bald eagle reclassification; final rule. Federal Register 50(17):35999-36010.

U.S. Department of the Interior (USDI), Fish and Wildlife Service. 1999. Endangered and threatened wildlife and plants; proposed rule to remove the bald eagle in the lower

48 states from the list of endangered and threatened wildlife. Federal Register 64(128):36454-36464.

U.S. Department of the Interior (USDI), Fish and Wildlife Service. 2001. Endanged and threatened wildlife and plants; 12-month finding for a petition to list the yellow-billed cuckoo (*Coccyzus americanus*) in the western continental United States. Federal Register 66(143):38611-38626.

U.S. Department of the Interior (USDI), Fish and Wildlife Service. 2005. Endanged and threatened wildlife and plants; proposed rule to designate critical habitat for the spikedace (*Meda fulgida*) and the loach minnow (*Tiaroga cobitis*); proposed rule. Federal Register 70(243):75546-75588.

U.S. Department of the Interior (USDI), Fish and Wildlife Service. 2006. Endangered and threatened wildlife and plants; removing the bald eagle in the lower 48 states from the list of endangered and threatened wildlife. Federal Register 71(32):8238-8251.

U.S. Fish and Wildlife Service (USFWS). 1998. Razorback Sucker (*Xyrauchen texanus*) Recovery Plan. Denver, Colorado. 81pp.

U.S. Fish and Wildlife Service (USFWS). 2002. Razorback sucker (*Xyrauchen texanus*) Recovery Goals: amendment and supplement to the Razorback Sucker Recovery Plan. U.S. Fish and Wildlife Service, Mountain –Prairie Region (6), Denver, Colorado. 113pp.

Weedman, D.A. P.J. Sponholtz and S.J. Hedwall. 2005. Fossil Creek Native Fish Restoration Project. Arizona Game and Fish Department, Phoenix, Arizona. 53pp.

Wirt, L. E. DeWitt and V.E. Langenheim. 2004. Geologic Framework of Aquifer Units and Ground-water flowpaths, Verde River headwaters, North-Central Arizona. U.S Department of the Interior, U.S. Geologic Survey. Open File Report: 2004-1044.

APPENDIX A: NATIVE FISH SANCTUARY PLAN FOR STILLMAN LAKE

Location: Stillman Lake, Verde River, Arizona
Managing Agencies: Arizona Game and Fish Department, U.S. Fish and Wildlife Service

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Goal: To provide habitat conditions that promote native fish recruitment at levels that sustain a natural community while providing management and research opportunities to promote advances in conservation and recovery.

Purpose of this document: This Management Plan is a working document intended to identify and describe management goals, resources and methods required to effectively manage native fishes at Stillman Lake and research opportunities. Through the active management of these species in small sanctuary habitats, scientists and resource managers would gain the knowledge and experience that would be critical for the species to be recovered on a larger scale. This document describes those steps, resources and opportunities.

Last Modified: November 6, 2006

INTRODUCTION

The purpose of the proposed action is to restore and enhance the native fish community in Stillman Lake. Perennial flow of the Verde River begins upstream of its confluence with Granite Creek in an area called Stillman Lake. Stillman Lake is approximately 20 surface acres and originates from a spring complex approximately 0.25 miles downstream of Sullivan Dam. Stillman Lake is formed by an alluvial fan that originates from Granite Creek. Although it does have hydrologic connection to the Verde River during runoff events, normally all the flow to downstream areas is subsurface.

Stillman Lake is a locally popular hiking and bird watching location but vehicular access is limited due to surrounding private lands. Following reduction of non-native fishes and amphibians from the lake, it would be gradually restocked over a three-year period to restore a native fish community. It is hoped that recurring flood events would disperse larval and young native species downstream into riverine and historical habitats.

During sampling in September 2001, the Arizona Game and Fish Department (AGFD) found several species of non-native fishes, including flathead catfish. Other fish that were found during this sample effort include common carp, channel catfish, red shiner, green sunfish, largemouth and smallmouth bass (Region III Fisheries Survey of the Verde River, 2001).

Non-native fishes dominate significant portions of Arizona’s streams and if natives exist, they do so without noticeable recruitment (Minckley 1991). Following a long history of habitat loss and degradation (Minckley 1991, Rosen et al. 1995, Pacey and Marsh 1998, Marsh and Pacey in press), the spread and establishment of non-indigenous aquatic organisms, especially fish, is increasingly viewed as one of the most serious long-term threats to the status and recovery of native aquatic vertebrates. Impacts of non-natives to the native community are not only ecological, but also economic (Benson 1999, GAO 2001). Direct impacts of non-native fishes to native forms include predation, competition, hybridization, and parasite and pathogen transmission. Predation on early life stages (eggs, larvae, juveniles) is considered the primary avenue by which non-native fishes depress and often eliminate what are considered “predator naïve" native species (Minckley 1991). Evidence suggests that to survive and persist, even in physically degraded habitats, native species need habitats free of and protected from established populations of non-native species.

This proposed action would benefit native fishes in the Upper Verde River by allowing us to keep natives in Stillman Lake until they grow larger and can disperse downstream during flooding events. In addition, the proposed action would aid in determining how long it takes for downstream areas to re-colonize with stocked natives, and provide much needed information regarding the long- term cost effectiveness of renovation projects. We hope that this action is an important first step in renovation of subsequent, downstream sections of the Verde River, including Granite Creek. Renovation of the Verde springs area and Stillman Lake is necessary before restoration activities can begin in downstream areas.

As a result, steps are being taken for the salvage, chemical renovation and restocking of Stillman Lake with native fishes. W.L. Minckley's (et al. 2003) Conservation Plan for Native Fishes was based on this phenomenon as are key components of C.O. Minckley's Lower River Management Plan. As outlined in the BioScience paper, these communities are temporary and require long-term management. This management plan outlines the goals, resources and steps necessary for the maintenance of Stillman Lake.

MANAGEMENT PLAN ISSUES

Habitat Quality: The conditions at Stillman Lake are unique in terms of habitat and water quality. The lake represents a historical portion of the river channel which contains a wide variety of substrate types. Groundwater hydraulics is unique in terms of water circulation and flow gradient. Stillman Lake is approximately 20 surface acres and originates from a spring complex approximately 0.25 miles downstream of Sullivan Dam. During low flow conditions, there is no upstream connectivity to Williamson Valley Wash or Big Chino Wash. In general, depths range from 0.5 meters near the inflow area to a max depth of 3.0 meters near the berm. During baseflow conditions, the water level in Stillman Lake varies little (Wirt 2004), but during high flow events (Fall 2004, Spring 2005), water from Williamson Valley Wash and Big Chino Wash overtop the berm and create continuous flow to the Verde River downstream. It is currently unclear what volume of flow is sufficient to overtop the berm and how often this may occur. It is also poorly understood how readily exchange of fishes occurs between Stillman Lake, the Verde River, and Granite Creek. The substrate within Stillman Lake varies greatly from highly cohesive clays to gravel deposits near the berm. Aquatic vegetation is typically minimal and shoreline vegetation is limited to cattails near the outflow. This combination maintains optimal water quality, especially temperature and dissolved oxygen which are critical parameters for desert aquatic habitats.

Available Resources: The purpose of the management plan is to determine if the native fish sanctuary approach is practical on a small and possibly larger scale. Currently, no one single agency has the expertise or the resources to implement such a program. However, by pooling various resources from several sources we feel such a test would be more economic and practical and results could be better controlled and measured. Even then, uncertainty pertaining to available resources, staff and funding makes it necessary to prioritize needs. This plan presents and prioritizes those management, monitoring and research needs. Available resources would be directed at the highest priority items. The priority order, addition or deletion of these lists would be an ongoing process as information is collected, processed and analyzed.

Environmental Compliance: The U.S. Fish and Wildlife Service (Service) in cooperation with AGFD is currently funded to complete the NEPA compliance on renovation of Stillman

Lake. Throughout this study, both the Service and AGFD would work to meet appropriate compliance of federal and state environmental laws and regulations.

Management Options in Order of Priority (1 highest):

1. Natural Recruitment
    a. Establish, improve or maintain habitat conditions that support natural recruitment for both introduced native fishes at rates that sustain their population and produce surplus fish.
    b. Establish, improve or maintain habitat conditions that support natural recruitment for one introduced native fish at rates that sustain their population.
    c. Establish, improve or maintain habitat conditions that support limited natural recruitment for both introduced native fishes. Supplemental stocking is necessary to sustain one or both population.
2. Repository for adult razorback suckers, roundtail chub, desert, and Sonora suckers
    a. Maintain an adult population that would successfully spawn
    b. During high flow events when Stillman is connected to the Verde, disperse small life history stages downstream
3. Grow-Out Facility
    a. Establish conditions that allow for grow-out of native fishes.
4. Abandon Project

Management Actions:

1. Physical Habitat Improvements
    a. Reduce the spread of cattails and encourage replacement by native sedge species
    b. Investigate feasibility of modifying the berm to minimize connection with downstream portions of the Verde River and Granite Creek.
2. Biological Actions
    a. Remove large surplus fish and stock in appropriate places.
    b. Stock natives to augment or replace losses due to natural causes (predators/habitat conditions).
    c. Maintain non-native crayfish and bullfrog reduction efforts
3. Interpretive Actions
    a. Develop signs describing project and penalties for introducing non-native fish
    b. Develop an interpretative field talk in cooperation with local landowners (Thumb Butte Bed and Breakfast)

Management Triggering Actions

Due to its occasional connection to Granite Creek and the Verde River during high flow events, Stillman Lake would require management activities necessary to sustain the native fish community. This community is temporary, being subject to common or unique threats. These include invasion by non-native fishes, storm events that result in fish kills, and existing habitats conditions that may not support spawning, natural recruitment or optimal productivity. In anticipation of these, the following 'triggering' conditions are specifically set in order to trigger appropriate management actions to mitigate or remedy the problem in a timely manner.

Problem	Management Action
Non-native fish	Re-evaluate feasibility/consider management options
Poor recruitment	Initiate bullfrog and crayfish control
Natural fish die-off	Restock w/multiple year classes
Poor body condition (stunting)	Harvest and remove >20%

PROPOSED MONITORING

The conceptual plan for developing fish sanctuaries in the Colorado River (Minckley et al. 2003; BioScience 53:219-234) suggests that stabilizing native fish populations requires developing and/or creating habitats of sufficient physical, chemical, and biological quality. Thus the purpose of our monitoring plan is to evaluate these factors with regards to enhancing survival of all life stages of native fish. Our goal is to provide land managers with essential information for maintaining and improving the quality of Stillman Lake as a native fish sanctuary.

Physical Habitat Monitoring

1): Instantaneous in-situ measurements would be taken using a Hydrolab to measure DO, temperature, pH, conductivity, and salinity measured at 0.5-m intervals at the deepest areas of Stillman Lake. We would continue to take these measurements on all semi-annual sampling trips.

2): Water quality sampling. We would collect initial samples for major ion analysis by BOR; chlorophyll, total suspended solids; and elemental and contaminant analysis (Hg, Se, As, ClO_4). Future sampling frequency would depend on initial levels of elements of concern.

3): 24-hr sampling of DO and water temperature. We expect DO to be lowest and temperatures highest in July and August. During this time we would use three MiniSondes (at bottom, middle, and upper sections of the water column along an installed post) to continually measure these variables over a 24-hr period.

4): Long-term temperature data. We would install a water temperature recorder (e.g., Hobos) to record hourly temperatures over a 1-yr period.

Zooplankton and Macroinvertebrates

1): Zooplankton. Three vertical tows would be taken in the deepest portion of the lake during each trip. Biomass would be measured by filtering through a plastic graduated cylinder. All samples would be preserved for later analysis. Phytoplankton and chlorophyll would be sampled both trips.

2): Macroinvertebrates: Concurrent with zooplankton samples, we would collect aquatic insects caught in the larval light traps. In addition, we would collect macroinvertebrates using a variety of sample techniques at 6 locations at varying depths to determine average number of organisms/m^2. Our purpose is to measure the abundance of invertebrates, not to provide a detailed description of aquatic insect diversity.

Fish Populations

1): Are the stocked native fishes surviving or have they disappeared? Are they free of disease? Are non-natives present? We would collect population data via electrofishing and/or trammel-netting in the fall. Each fish would be measured, weighed, and spawning condition evaluated. Crayfish and bullfrog presence and abundance would be estimated with minnow traps baited with canned food, set overnight.

2) If there are non-native fish, what is their relative abundance? Are the non-natives reproducing? This question can be answered from data collected above.

3): Are native fishes growing? This question can be answered by comparing data between samples by subsampling fish using PIT tags.

4): Are native fishes spawning? We would set four larval light traps for 2-hr periods to determine presence of fish larvae. Larvae collected would be preserved to identify species.

5): Is there evidence of recruitment? We would look for young-of year fish during spring surveys; and by setting minnow traps and ½ -inch trammel nets in the fall.

Data Handling and Reporting

Annual reports would be written and provided to all interested persons and agencies. The monitoring program would be reviewed on an annual basis to determine if changes to the protocol need to be made. If a significant event occurs, such as an unusual climatological, hydrological, or biological event, we may need to revise our methods and consider additional or alternative monitoring techniques or sampling dates.

IDENTIFIED RESEARCH NEEDS:

Stillman Lake presents unique research opportunities that would advance the refinement of native fish sanctuaries. While outside the resources of this study, these research needs should be identified and promoted.

1. Identify the most efficient means of salvaging native fish. Can broadcast feeders and pop nets make salvage efforts more effective and less stressful on fish?
2. Measure the hydraulic exchange that is occurring and develop natural ‘recharge’ techniques to maintain water quality at other sites.
3. Examine rearing and growth parameters for roundtail chubs.
4. Identify flows that compromise Stillman Lake and re-establish non-native fishes.

PROPOSED SCHEDULE AND ACTIVITIES

Timing	Action	Crew#	Lead Agency	Contact

Under development

APPENDIX B: UPPER VERDE RIVER HYDROLOGY INFORMATION

To further develop Alternative B, the Service and the AGFD measured cross-sections across Stillman Lake and for 1.5 miles (2.4 km) downstream of the outflow (Figure 1). Efforts were made to measure depths through bottom silt to firm substrate. Cross-sectional areas and distances between cross-sections were used to estimate the water volume of Stillman Lake as well as provide information on the contours and depth profile within the lake. The water volume calculated was approximately 1,010,821 ft^3 (28,606 m^3, Table 1).

Table 1. Cross sectional area of Stillman Lake, Verde River

Stillman Lake XS	**Area (ft^2)**	**Distance between XS s**
XS#1	**82**	
2	**266**	**384**
3	**187**	**324**
4	**392**	**1224**
5	**402**	**600**
6	**347**	**322**
7	**421**	**216**
8	**488**	**164**

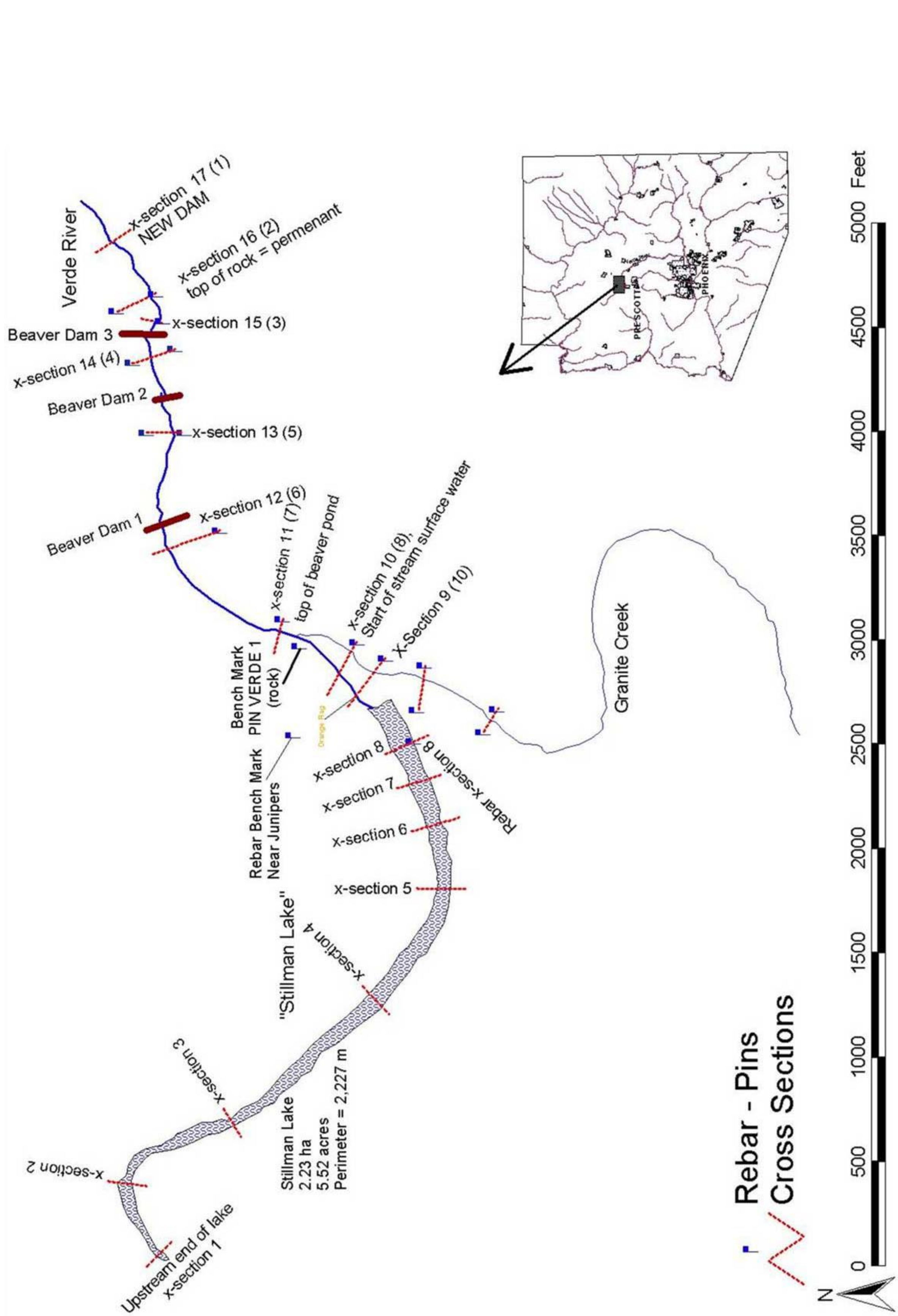

Figure 1. Topographical view of Stillman Lake and locations of cross sections

Stream flow data from the Verde River was obtained from the U.S. Geological Survey (USGS) stream gage located at Paulden, 8 miles downstream of Stillman Lake. Since 1963, the USGS has operated the Paulden gage which covers a drainage area of 2,150 mi^2. Preliminary observations indicate that there is not a significant increase in watershed size between Stillman Lake and the Paulden gage. Therefore, this information is relevant to our analysis of this alternative and measurements from the Paulden gage should closely approximate those taken at Stillman Lake and below.

Flood flow frequency analysis refers to the use of frequency analysis to study the occurrence of particular flows or discharges (Ponce 1989). The flood flow that determines the location or elevation of the flood plain surface is the bankfull flow or discharge. The discharge that fills the river channel and begins to flow over the floodplain is the bankfull discharge. This discharge, on average, has a return interval of 1.5 years, or occurs 2 out of 3 years (Dunne and Leopold 1978, Leopold 1994). Bankfull flows closely approximate the effective discharge, which over time moves the greatest amount of sediment (Leopold 1994). Flood flow frequency on the Verde River at Paulden was determined with annual peak flow data for years 1963-2002. The frequencies were calculated with two methods: log Pearson III and normal frequency distribution.

Determination of the bankfull or channel forming flow is relevant to Stillman Lake and the channel downstream of the berm. Besides providing a valuable reference point when measuring cross sectional area, it is also important when calculating the channel dimension and profile if the berm was removed. Different methods are available to approximate bankfull channel dimensions in an unregulated river. Regional curves can predict cross-sectional area, mean depth and width of the bankfull channel from watershed size. Many regional curves have been developed in the United States. Moody et. al (2003) developed regional curves for the Verde River watershed. However, data from the regional curves developed in the Verde River watershed would not likely be accurate for the large (2,150 mi^2) watershed above Stillman Lake (T. Moody pers. comm. 01/16/04). This is due to the likelihood that precipitation would not occur over the entire watershed in sufficient amounts to produce the same intensity of runoff that would form the bankfull channel in a smaller watershed. Regional curves are usually developed from bankfull channel dimensions from smaller watersheds. Precipitation over a 20 mi^2 area is more likely to produce in a consistent bankfull channel through time than a much larger watershed.

Measurements of the active channel during different discharges are collected at gage sites by the USGS. They are recorded on 9-207 forms which are available on the USGS website for each gage. When 100 cfs or greater discharges are plotted against channel measurements at the Paulden gage channel cross-sectional area can be predicted for various discharges (Figure 8). For the Paulden gage, the bankfull cross sectional area was calculated to be 171.3 ft^2 (15.9 m^2) with a channel width of 92.4 feet (28.1 meters). Using these figures, we would expect a mean bankfull channel depth of 1.8 feet (0.54 meters), during a 947cfs discharge event. Cross-sectional areas calculated from discharges of 633, 685, and 705 cfs are 159, 169, and 170 ft^2 respectively (15.8 m^2) using formula in Figure 2).

Moody et al. (2003) reports a return interval of 1.7 years for bankfull discharge at the Paulden gage based on bankfull indicators measured at that site.

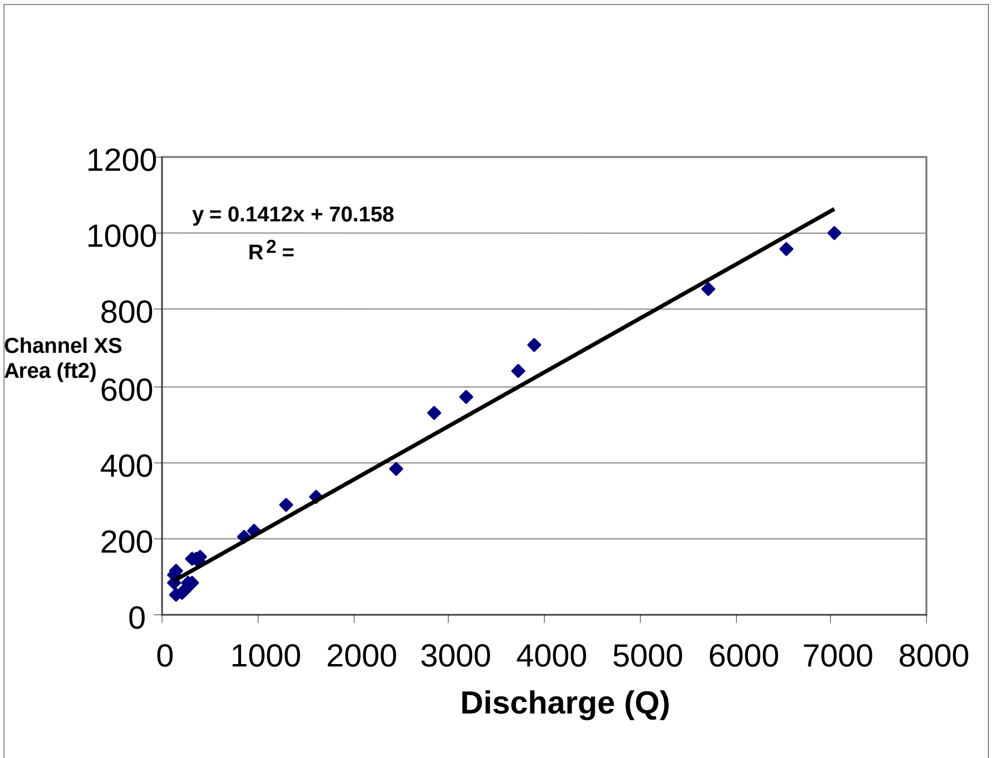

Figure 2. Verde River below Paulden gage and channel cross sectional area versus discharge

This information would be used in the field to approximate the bankfull channel dimensions and allow for the proper identification of the floodplain. This is important when determining the site potential for riparian vegetation and assessing the riparian condition prior to channel disturbing events such as berm removal and draining Stillman Lake. Rivers that produce high levels of discharge, such as the Verde River, need floodplains in order to dissipate the energy generated by these flows. If the river is naturally entrenched, with no floodplain and confined between canyon walls, then the downstream reaches have developed over time to accept this high flow. Very little vegetation can be supported in such an area. If the channel is entrenched from down cutting as a result of poor land management, then damage results. Water is confined within the abandoned flood plain or terrace. Rivers without a floodplain for energy dissipation, water table recharge, trapping sediment, etc are often non-functioning (Shen 1971, Rosgen 1994).

Longitudinal Profile: A longitudinal profile was measured 6,225 ft from station 1 on the upstream side of Stillman Lake to lower beaver dam (#3). The thalweg (maximum depth) slope across this distance was 0.00056 ft/ft or 0.056% (Figure 3). This preliminary analysis indicates that there is less than 0.1% slope difference between the elevational profile of Stillman Lake with downstream sections. While a channel could be created to drain some volume of Stillman Lake, the channel would have to be over a 3.5 feet (1 meter) deep at the start to get enough elevation head to carry the water downstream (Engineering Field Trip 8/25/2004). In addition, with recent flooding events that eliminated the beaver dams, active headcutting is occurring just downstream of Stillman Lake. Granite Creek is only 16 feet (5 meters) away from the downstream channel and any construction and draining of Stillman Lake by breaching the berm has the chance of negatively impacting adjacent Granite Creek.

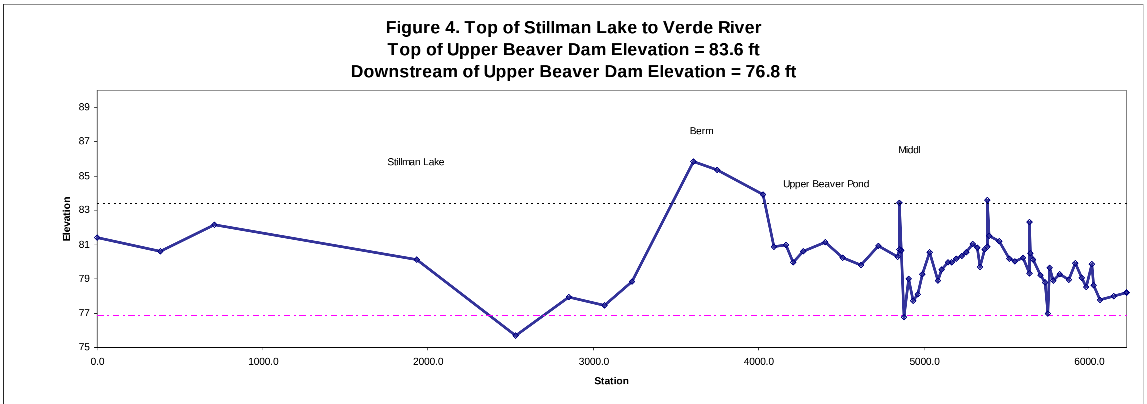

Figure 3. Longitudal profile of Stillman Lake

CROSS-SECTION DATA FOR STILLMAN LAKE

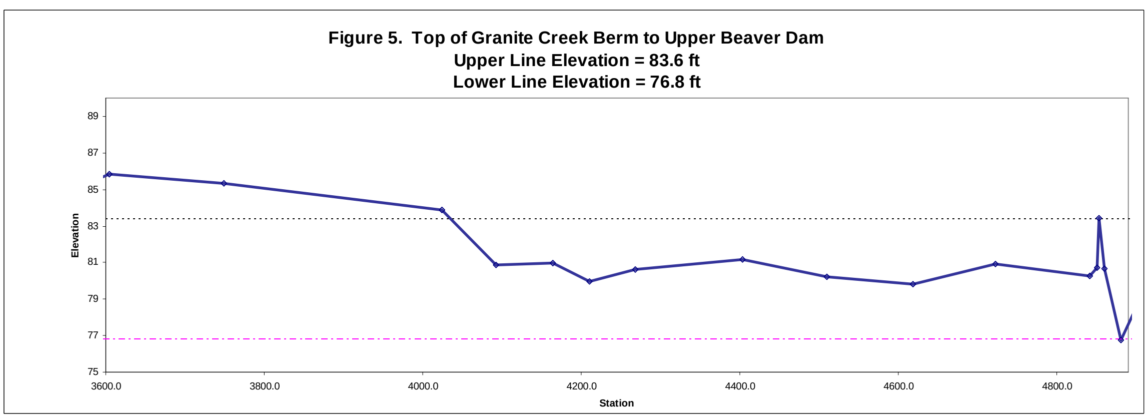

Figure 6. Upper Beaver Dam
Upper Line Elevation = 83.6 ft
Lower Line Elevation = 76.8 ft

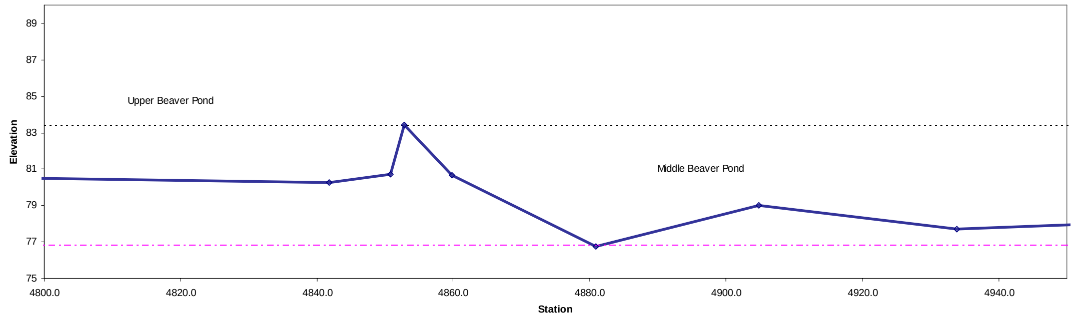

Figure 7. Upper Beaver Dam to Lower Beaver Dam
Upper Line Elevation = 83.6 ft
Lower Line Elevation = 76.8 ft

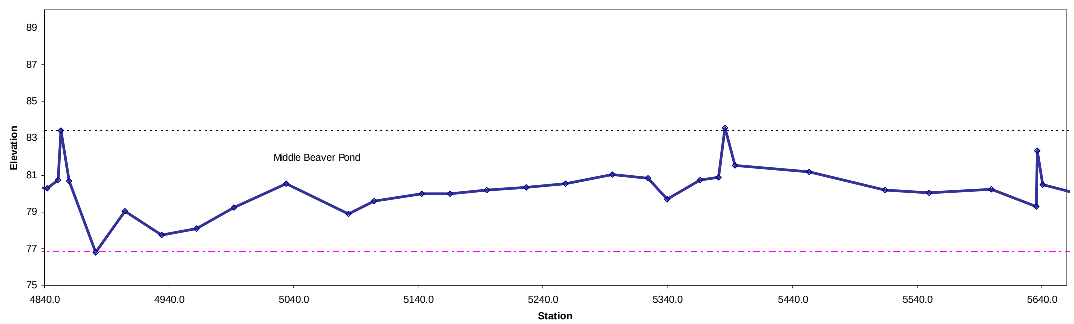

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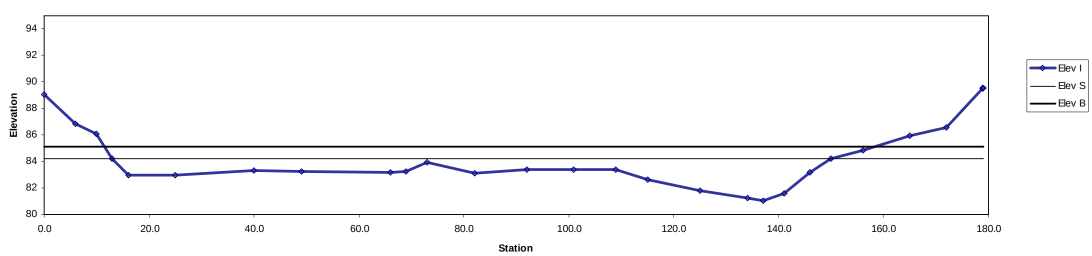
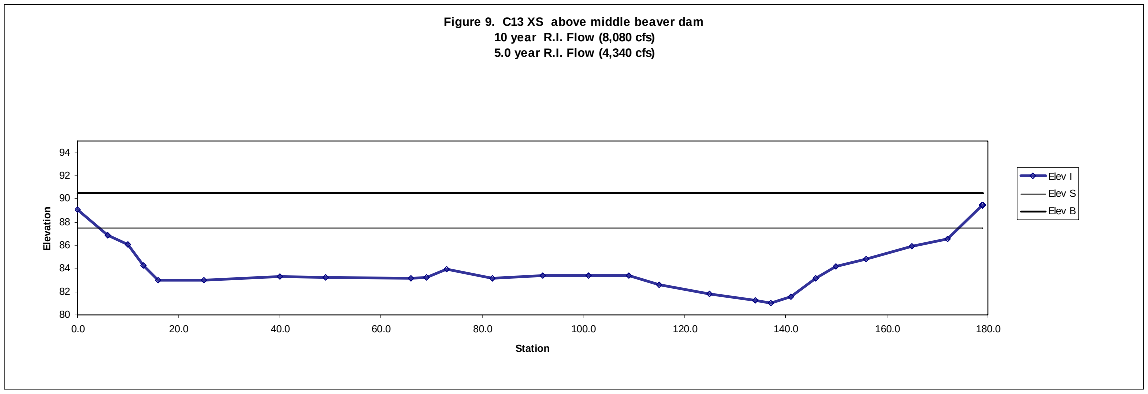
Figure 8. C13 XS above middle beaver dam
2.5 R.I. Flow (1,590 cfs)
1.5 R.I. Flow (633 cfs)

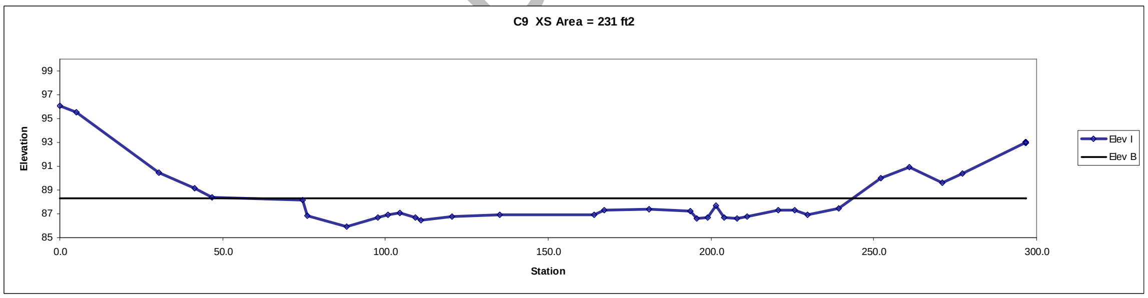




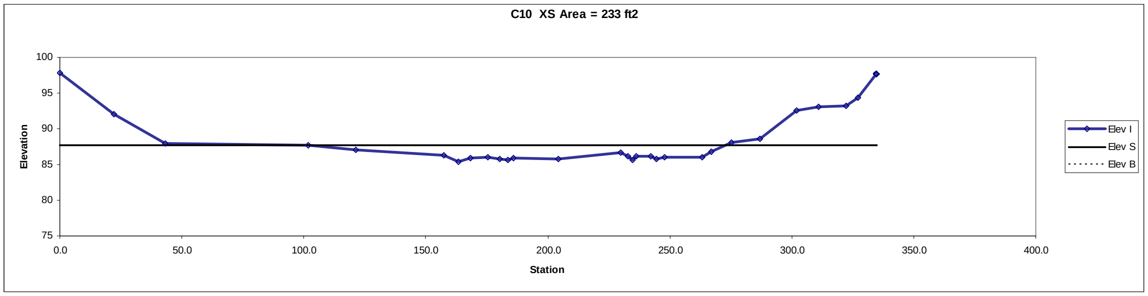
Beaver Pond and Verde River Cross-Sections

Nine permanent cross-sections were established and measured in the three beaver ponds and the Verde River downstream of the lower dam. These would be used to determine whether breaching individual or all beaver dams would impact existing channel morphology. Riparian vegetation is well established in all three beaver ponds and the downstream reach of the Verde River. Increased discharge resulting from breaching the dams needs to be determined. It is anticipated that channel changes can then be predicted and measured from these cross-sections. Cross-sectional diagrams follow:

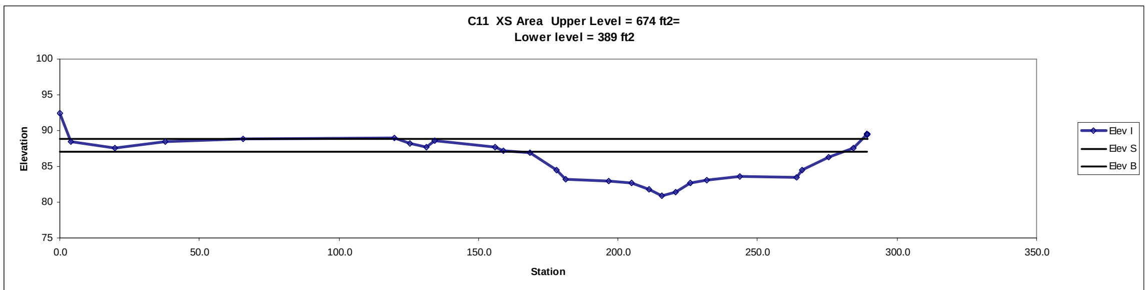
Cross-section 9 – Upper Beaver Pond at Orange Flag



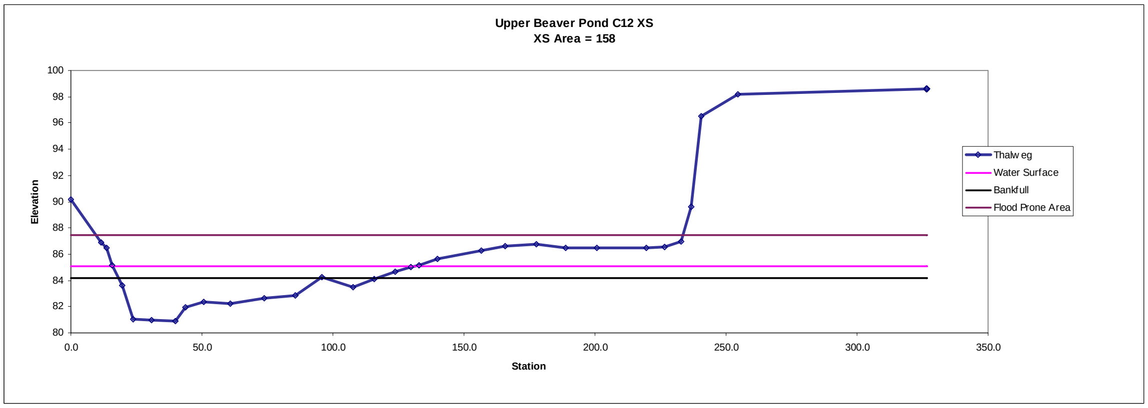
Cross-section 10 – Top of Upper Beaver Pond



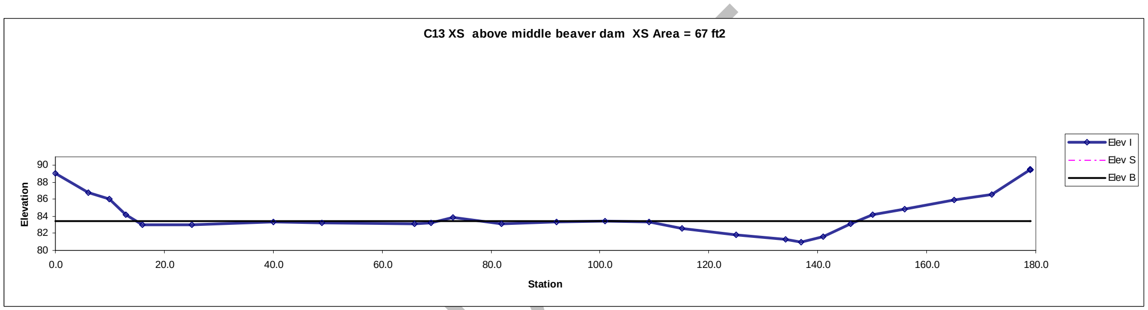
Cross-section 11 – Upper Beaver Pond



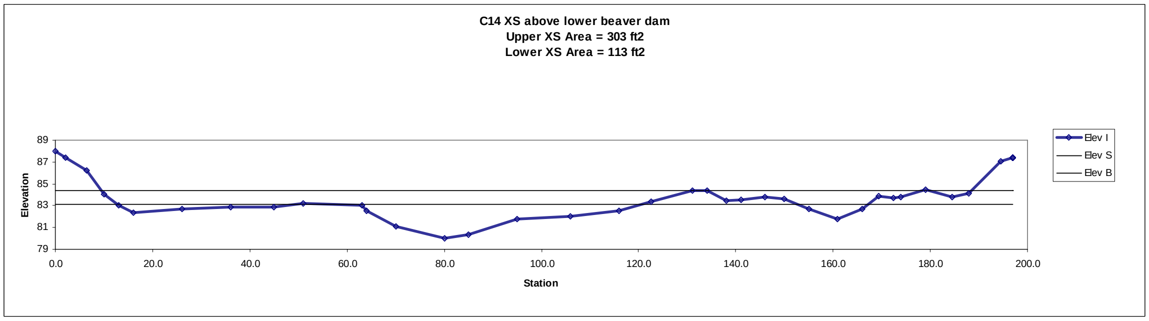
Cross-section 12 – Upper Beaver Pond, just above Upper Dam



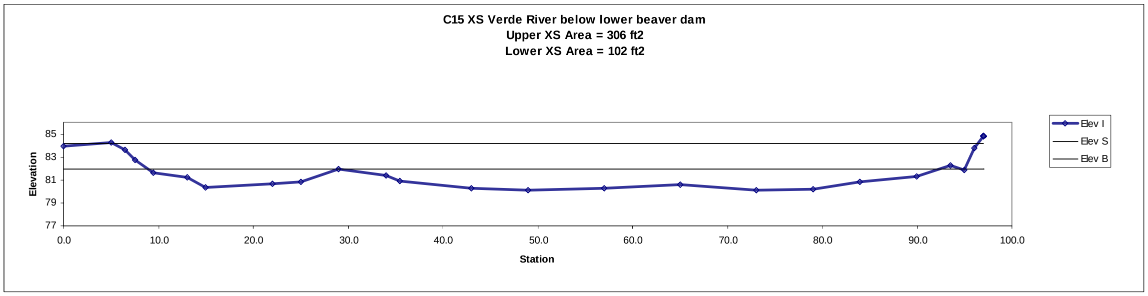
Cross-section 13 – Middle Beaver Pond



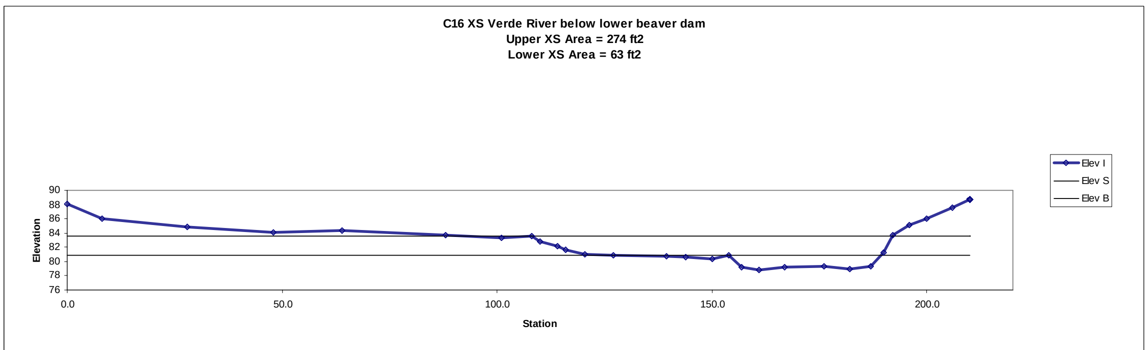
Cross-section 14 – Lower Beaver Pond



Cross-section 15 – Verde River below Lower Beaver Dam



Cross-section 16 – Verde River below Lower Beaver Dam



Cross-section 17 – Verde River below Lower Beaver Dam