United States Department of the Interior

Fish and Wildlife Service
Arizona Ecological Services Office
9828 North 31st Avenue, Suite C3
Phoenix, Arizona 85051
Telephone: (602) 242-0210 Fax: (602) 242-2513

In reply refer to:
AESO/SE
2022-0048502-S7-001

March 7, 2024

Memorandum

To: Regional Director, U.S. Fish and Wildlife Service, Albuquerque, New Mexico

Through: Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service Region 2, Albuquerque, New Mexico

HEATHER WHITLAW
Digitally signed by HEATHER WHITLAW
Date: 2024.03.07 08:27:49 -07'00'

From: Field Supervisor, Arizona Ecological Services Field Office, Phoenix, Arizona

Subject: A Combined Endangered Species Act Section 10(a)(1)(B) (Intra-Service) and Section 7 (Army Corps of Engineers) Biological Opinion for Salt River Project's Roosevelt Habitat Conservation Plan Amendment

This Intra-Service biological opinion on Salt River Project's (SRP) Roosevelt Habitat Conservation Plan (RHCP) Addendum (amendment) (SWCA 2023a) is a combined section 10(a)(1)(B) and section 7 approach to compliance under the Endangered Species Act (Act) for implementation of covered activities for non-Federal (section 10) and Federal (section 7) participants.

This Intra-Service biological opinion responds to the request for Section 7 consultation with the U.S. Fish and Wildlife Service's (FWS) Arizona Ecological Services Office pursuant to the Act of 1973 (16 U.S.C. §§ 1531-1544), as amended. This consultation addresses effects that may result from amending our incidental take permit in accordance with section 10(a)(1)(B) of the Act for SRP's Modified Roosevelt Dam and Lake operations in Gila and Maricopa counties, Arizona.

This biological opinion also addresses the Army Corps of Engineers (Corps) requirements under section 7 of the Act for authorizing SRP's request for a temporary planned deviation (planned deviation) to the Corps 1997 Water Control Manual (WCM) regulating Modified Roosevelt Dam's flood control operations.

SRP's RHCP amendment (SWCA 2023a) addresses ongoing conservation storage operations and adds flood control space (FCS) operations. SRP's RHCP amendment includes and addresses the effects of the Corps decision to review and potentially approve a proposed planned deviation to

the 1997 WCM for Modified Roosevelt Dam flood control operations. A planned deviation is a provision in the existing 1997 WCM. The Corps' review and decision associated with a WCM deviation is a Federal action.

The proposed actions may affect the following: threatened northern Mexican gartersnake (*Thamnophis eques megalops*: gartersnake) and its designated critical habitat; endangered southwestern willow flycatcher (*Empidonax traillii extimus*: flycatcher) and its designated critical habitat; and threatened yellow-billed cuckoo (*Coccyzus americanus*: cuckoo) and its designated critical habitat. The RHCP amendment also may affect the endangered spikedace's (*Meda fuldgida*) designated critical habitat.

The RHCP amendment may affect but is not likely to adversely affect the narrow-headed gartersnake (*Thamnophis rufipunctatus*) and its designated critical habitat. Our concurrence is included in Appendix A. Appendix B contains various tables and figures.

Since permit issuance for SRP's original RHCP (ERO 2002), we removed the bald eagle (*Haliaeetus leucocephalus*) from the list of threatened and endangered species under the Act. Separate from listing under the Act, bald eagles are also protected under the Bald and Golden Eagle Protection Act (16 U.S.C. §§ 668-668d), as amended (Eagle Act). Following delisting, we further defined "disturb" as set forth in the Eagle Act, 50 C.F.R. 22.6, and developed incidental take permits and criteria to comply with the Eagle Act. Our Eagle Act compliance is included in the National Environmental Policy Act (NEPA) Environmental Assessment (EA) for these proposed actions. However, for purposes of this biological opinion, we are addressing effects to the delisted bald eagle under the Act should it ever become listed as threatened or endangered in the future.

We anticipate the proposed actions will not cause effects to the Yuma Ridgway's rail (*Rallus obsoletus yumanensis*: rail) (previously named Yuma clapper rail) different in location or extent to those addressed in the original 2003 RHCP (ERO 2002) and accompanying biological opinion (USFWS 2003).

We anticipate SRP's proposed actions will have no effect to individual spikedace, because we do not think any spikedace occur in Tonto Creek, the Salt River, or Roosevelt Lake. Biologists have not reintroduced spikedace in Tonto Creek or the Salt River, or its immediately adjacent tributaries, nor are there existing plans due to the abundance of nonnative predatory aquatic species. We have described that large areas of the Salt River Sub-basin and Tonto Creek Unit are unsuitable for spikedace, either because of topography or because of reservoirs and other stream-channel alterations (USFWS 2012).

We are not addressing "No effect" determinations any further in this biological opinion.

We base our biological opinion on SRP's RHCP amendment (SWCA 2023a) and original RHCP (ERO 2002), our RHCP addendum (amendment) EA (SWCA 2023b) and original Environmental Impact Statement (EIS) (USFWS 2002b), the Corps biological assessment for the planned deviation (ACOE 2023), telephone conversations, field investigations, and other sources of information. Literature cited in this biological opinion is not a complete bibliography of all literature available on the species of concern, effects from dam operations, or on other subjects

considered in this opinion. Where appropriate, we will reference effects already addressed in the original RHCP, and the associated biological opinion (USFWS 2003) and incidental take permit (TE-060125) (ERO 2002). A complete record of this consultation is on file at this office.

Consultation History

- 1983-1996: FWS completes numerous biological opinions with U.S Bureau of Reclamation (USBR), Corps, and U.S. Forest Service (USFS) on Roosevelt Dam modifications and operations (see compiled lists in the RHCP [ERO 2002, USFWS 2003] and RHCP amendment [SWCA 2023a]).
- February 21, 2003: FWS completes RHCP EIS, biological opinion, and 10(a)(1)(B) permit issuance for 50 years (2003-2053).
- 2003 to present: SRP implements RHCP, holds annual meetings, and completes annual reports.
- May 20, 2019: FWS and SRP discuss 10(a)(1)(A) and 10(a)(1)(B) RHCP amendment processes, project, and schedule.
- December 3, 2019: FWS completes consultation on the issuance SRP's Section 10(a)(1)(A) recovery permit for proposed scientific and/or enhancement of propagation or survival activities for the gartersnake at Roosevelt Lake (USFWS 2019a).
- January 17, 2020: RHCP amendment kick-off meeting.
- August 30, 2021: FWS completes consultation reinitiation for SRP's Section 10(a)(1)(A) recovery permit for proposed scientific and/or enhancement of propagation or survival activities for the gartersnake at Roosevelt Lake (USFWS 2021a).
- January 2020-2023: SRP, FWS, Corps, USBR, SWCA, Inc., and stakeholders regularly meet to develop the RHCP amendment.
- July 17, 2023: FWS receives SRP's RHCP Amendment (SWCA 2023a) and application.
- August 4, 2023: FWS receives the Corps biological assessment for SRP's request for a planned deviation (ACOE 2023).
- August 4, 2023: FWS announces availability of RHCP Amendment, 10(a)(1)(B) Incidental Take Permit application, and draft EA for 30-day public review.
- January 29, 2024: FWS sends SRP and Corps draft biological opinion.
- February 6, 2024: FWS received SRP and Corps comments on the draft biological opinion.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Regulations implementing the Act (50 CFR 402.02) define "action" as "all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies of the United States or upon the high seas."

The original 2002 RHCP (ERO 2002) and our incidental take permit (ITP or permit) (USFWS 2003) addressed SRP's Modified Roosevelt Dam and Lake (Modified Roosevelt) conservation storage operations. The Roosevelt Lake conservation space (CS) is the area up to the 2,150.78-foot elevation contour (2,151 feet above mean sea level [amsl]) where SRP stores water from the Salt River and Tonto Creek drainages and is the original RHCP's geographical extent of covered activities (Figures 1 and 2). Our permit authorized incidental take of four bird species from SRP's CS operations: flycatcher, cuckoo, rail, and the bald eagle.

This RHCP amendment (SWCA 2023a) addresses SRP's ongoing conservation storage operations effects to the recently listed gartersnake, and adds FCS operations, including a request for a proposed three in five-year planned deviation to the Corps 1997 WCM, beginning in 2024 (ACOE 2023). By including FCS operations, the RHCP amendment permit area expands from Roosevelt Lake's 2,151 feet CS to the 2,174.87-foot FCS contour (2,175 feet amsl) (Figures 1 and 2). Due to CS activities effects to the gartersnake, SRP's permit area also includes the lower 14.1 miles of Tonto Creek from the furthest edge of the FCS to East Del Chi Drive (Figures 3 and 4).

The RHCP's existing permit duration remains the same, expiring in 2053.

SRP is responsible for the "safety of dams" space (2,175 to 2,218 feet amsl) and is not including those operations for that area in the RHCP amendment (Figure 1).

Further detailed description of the proposed action and other components of RHCP implementation are in SRP's RHCP amendment (SWCA 2023a), the Corps' planned deviation biological assessment (ACOE 2023), and the associated NEPA EA (SWCA 2023b). For example, SRP describes details about the RHCP's "Changed Circumstances" and financial and budget information in the document, but we do not describe them in this document. The original RHCP (ERO 2002) includes detailed Roosevelt Dam history; information about operations and regulatory compliance; and strategies to mitigate effects to birds from conservation storage operations.

Modified Roosevelt Conservation Storage Operations

SRP described in detail Modified Roosevelt's conservation storage operations in their original RHCP (ERO 2002) and RHCP amendment (SWCA 2023a), and we also described those operations in our biological opinion (USFWS 2003). We summarize SRP's essential Modified Roosevelt Dam operations up to 2,151 feet amsl below and describe how water moves within the CS in the Environmental Baseline (Figures 1 and 2).

SRP implements water conservation storage operations in accordance with the Modified Roosevelt Dam Operating Agreement, which specifies the following, in order of priority.

1. Maintain the safety and integrity of the dam.
2. Maintain sufficient SRP storage to meet SRP water delivery obligations.
3. Optimize reservoir storage for SRP use within the SRP reservoir system.
4. Maintain adequate SRP carryover storage for following years in case of low runoff.
5. Conjunctively manage groundwater pumping given reservoir storage and projected runoff and demand.
6. Maximize hydrogeneration.
7. Operate to permit necessary facility maintenance.

Modified Roosevelt Normal Flood Control Space Operations

The 1996 Roosevelt Dam modifications created, for the first time, designated Roosevelt Reservoir FCS. SRP is responsible for Modified Roosevelt's FCS (2,151 to 2,175-feet amsl) and safety of dams (2,175 to 2,218 feet amsl) operations in accordance with the 1996 Water Control Agreement (between the Corps, USBR, and SRP), and the WCM (Figure 1).

SRP implements WCM prescriptions for releasing water from Modified Roosevelt's FCS when the lake elevation exceeds CS limits. Normal WCM operations require that SRP manage releases and return the lake to the CS limits (2,151 feet amsl) within 20 days of water first entering the FCS. The purpose of FCS operations is to minimize downstream flood damage by reducing peak discharges during large flood events. The WCM schedules minimum Modified Roosevelt water releases based on lake elevation and whether the lake is rising or falling.

Modified Roosevelt Planned Deviation to Flood Control Space Operations

The Corps, in coordination with USBR (as owner of Modified Roosevelt Dam), will determine whether to approve the planned deviation from the WCM for Modified Roosevelt Dam (ACOE 2023). Planned deviations are an option in the existing WCM that require Corps authorization. The Corps is not changing or amending the WCM, rather they are considering authorizing an existing WCM provision for implementing planned deviations. If approved by the Corps, the planned deviation would allow SRP to extend water's duration in the FCS from 20 days to 120 days for a single flood control event in a year, before they must return water to 2,151 feet amsl (Figures 5, 6, and 7).

This planned deviation would only apply to FCS's lowest 5 vertical feet, which occurs between 2,151 feet and 2,156 feet amsl (Figures 5, 6, and 7), and only in up to 3 years within a given 5-year period (beginning in the 2024 water year). Flood control operations would return to the WCM's current operating criteria when the lake is above the 2,156-foot amsl elevation contour, when the deviation period has expired, or when SRP has implemented these alternate flood control measures in 3 of the 5 years. SRP estimates that the lower 5 feet of the FCS can store approximately 108,000 acre-feet of water.

SRP's request for a planned deviation would extend the evacuation period from 20 to 120 days for a single runoff event in a year. Additional months of FCS operations beyond a single 120-day event can occur from a new runoff/flood control (storms or snowmelt) event. If an additional

runoff event occurs within the 120-day planned deviation, SRP would evacuate the FCS above the 2,156 feet amsl elevation within 20 days. SRP would then continue FCS operations under the release rates as allowed by the planned deviation.

Conservation Measures

Gartersnake Conservation and Mitigation Program along Lower Tonto Creek

SRP will implement the following Gartersnake Conservation and Mitigation Program tasks, intended to fully offset the impacts of Modified Roosevelt's CS and FCS operations (including the planned deviation), by reducing the primary threats to the gartersnake from nonnative predatory fish (Table 1).

SRP's gartersnake conservation and mitigation actions in two specific areas of Tonto Creek address effects from CS and FCS operations (including the planned deviation) (Figures 16 and 17). SRP's conservation actions in lower Tonto Creek and mitigation along the Gisela Reach address effects from Modified Roosevelt Dam's CS and normal FCS operations. SRP's conservation actions in the FCS address effects from the proposed planned deviation. SRP discusses implementation details about these conservation and mitigation measures in the RHCP amendment (SWCA 2023a).

1. Suppress nonnative predatory fish by electrofishing in two separate sections of lower Tonto Creek (the immediate 14.1 miles above the Roosevelt Lake FCS and a 3-mile section between the Town of Gisela and Rye Creek).
2. Stock native fish in both lower Tonto Creek sections and the FCS.
3. Stock lowland leopard frog (*Lithobates [Rana] yavapaiensis*) in the Gisela section of lower Tonto Creek and possibly the FCS.
4. Fund a lowland leopard frog breeding facility.

Following nonnative predatory fish suppression by electrofishing, SRP will stock gartersnake prey species native to the Tonto Basin in lower Tonto Creek, such as: longfin dace (*Agosia chrysogaster*), speckled dace (*Rhinichthys osculus*), sucker species (*Catostomus* spp.), chub species (*Gila* spp.) and Gila topminnow (*Poeciliopsis occidentalis occidentalis*). SRP may stock other aquatic gartersnake prey species in coordination with FWS and Arizona Game and Fish Department (AGFD). SRP will stock captive-raised fish in pools where nonnative predatory fish suppression occurs. Stocking would occur at rates commensurate with the size of the pool treated and fish availability.

Lowland leopard frogs are a native prey species for gartersnakes in lower Tonto Creek and the Tonto Creek Basin. Coupled with predatory nonnative fish suppression, stocking frogs near Gisela could increase gartersnake prey availability and diversity. SRP is not currently planning to stock frogs in FCS pools. If SRP, FWS, and stakeholders decide to stock frogs in the FCS in the future, this conservation action is eligible to generate credit.

SRP will implement the following conservation/mitigation measures in gartersnake habitat along two separate lower Tonto Creek sections and the FCS (Figures 16 and 17):

1. Lower Tonto Creek, from the Roosevelt Lake FCS upstream to East del Chi Drive, nonnative predatory fish suppression and native fish stocking (Figure 16):
    a. This 14.1-mile reach of lower Tonto Creek terminates at East del Chi Drive where three 9-foot-diameter culverts are perched more than 1 foot above the downstream plunge pool elevation, creating a barrier to fish passage.
    b. SRP has separated this lower Tonto Creek reach into four segments—Reach 1: A-Cross Road to Bar X Crossing (3 river miles); Reach 2: Bar X Crossing to East Greenback Valley Road (3.5 river miles); Reach 3: East Greenback Valley Road to Haufer Wash (3.5 river miles); and Reach 4: Haufer Wash to East del Chi Drive (5 river miles).
    c. SRP will monitor daily mean flows at the Tonto Creek stream gage at Gun Creek during the spring runoff period of February 1 through May 31. In years when Tonto Creek daily mean flows at the gage are greater than 200 cfs but not more than 1,100 cfs for a period of 5 or more consecutive days, SRP will minimize take of gartersnakes through nonnative predatory fish suppression in persisting pools.
    d. SRP will mobilize nonnative predatory fish suppression once spring runoff diminishes, and the maximum daily stream gage reading reaches 20 cfs daily mean flow or less (typically during May). The objective is to remove as many nonnative predatory fish as possible by using electroshocking techniques or other practicable and appropriate methods.
    e. Because Tonto Creek is intermittent, and pools and nonnative predatory fish persist closest to Roosevelt Lake, SRP's nonnative predatory fish suppression effort will be greatest closer to Roosevelt Lake. SRP will treat 100% of remaining pools in Reach 1, 50% in Reach 2, 25% in Reach 3, and 12% in Reach 4. SRP will only treat pools on Federal lands and would not treat pools on private property.
    f. SRP will provide AGFD (or another suitable partner with FWS approval) with sufficient funds to rear and stock native fish, such as longfin dace, speckled dace, suckers, and chubs in lower Tonto Creek above the FCS. SRP anticipates that its funding to support stocking activities will result in the release of native fish into at least one lower Tonto Creek pool above the FCS in years when nonnative fish suppression triggers occur.
2. Lower Tonto Creek–Gisela Reach nonnative predatory fish suppression and native fish stocking (Figure 17):
    a. The Gisela Reach is a 3-mile reach of Tonto Creek, outside the permit area, between the town of Gisela and the 76 Ranch at Rye Creek confluence. SRP has divided the Gisela Reach into three approximately 1-mile-long segments (Segments A, B, and C).
    b. To the extent practicable (*e.g.*, subject to weather conditions), SRP will conduct nonnative predatory fish suppression in each of the first 5 years after approval of the amended permit and in 2 out of every 3 years, on average, thereafter through the remaining permit term.
3. Roosevelt Lake FCS native fish stocking:
    a. Following nonnative fish suppression in the lower Tonto Creek Reach 1 in the FCS, SRP will stock native fish prey into the treated pools that offsets the impacts of take from conservation and flood control operations, including those impacts from the planned deviation. To the extent practicable, SRP will implement

stocking within the same year and as soon as practicable following the suppression activities. Stocking will occur, in coordination with FWS, at rates commensurate with the size of the pool treated and the availability of fish for stocking.

4. Lowland leopard frog breeding facility:
    a. There are currently no breeding facilities available to produce lowland leopard frogs for stocking, although captive propagation methods exist and are feasible. If SRP can find a qualified and FWS-approved organization interested in breeding lowland leopard frogs suitable for stocking in the Tonto Basin, SRP would commit up to $625,000 (subject to further investigation) toward establishing, operating, and maintaining a breeding facility over the remaining permit term.

SRP's Gartersnake Conservation/Mitigation Crediting Strategy

SRP measures the benefit of gartersnake conservation and mitigation fish suppression and stocking actions in units of acre-years, representing both the relative value and duration of the conservation/mitigation benefit (Table 2). SRP will conduct mitigation actions at the Gisela portion of Tonto Creek because water movement and storage prevents effective conservation actions in the CS and FCS. Since SRP will retain some discretion about when and which measures to implement in any given year, SRP will estimate and account for conservation/mitigation benefits with credit metrics described below.

SRP's predatory nonnative fish suppression and native fish stocking gartersnake conservation measures performed in lower Tonto Creek immediately above the FCS are to offset SRP's impact of nonnative fish on the gartersnake and its habitat from long-term conservation storage operations. SRP's trigger for implementing these conservation activities are the magnitude, duration, and timing of Tonto Creek flows measured at the Gun Creek gauging station.

SRP's predatory nonnative fish suppression gartersnake mitigation measures in the Gisela portion of Tonto Creek generate credit to offset the impact to gartersnakes and its habitat from long-term conservation storage and current/normal FCS operations.

SRP's predatory nonnative fish suppression and stocking conservation actions in the FCS generate credit for effects to the gartersnake and its habitat from the planned deviation.

SRP calculates gartersnake conservation/mitigation credits as the product of three variables:

1. Acres benefited by the conservation/mitigation measure;
2. Relative conservation/mitigation value (factor ranging from 0.5 to 1.0); and
3. Duration of the conservation/mitigation measure in years.

SRP measures the benefit of conservation/mitigation efforts as acres of gartersnake habitat where SRP offsets the effects of the action. SRP expects fish suppression treatments will benefit the gartersnake beyond the specific treated pools and benefit will extend to the lateral boundaries of gartersnake habitat.

1. SRP assumes the mitigation measures in the Gisela section of Tonto Creek will benefit the acres of gartersnake habitat and critical habitat associated with a treated segment. SRP will choose which segment and how many segments (*i.e.*, one, multiple, or none) it

wants to treat in a year. The actual credit generated by a conservation measure depends on the segment(s) to which it is applied.

   a. Gisela River Mile Segment A: 53.8 acres of critical habitat.
   b. Gisela River Mile Segment B: 91.6 acres of critical habitat.
   c. Gisela River Mile Segment C: 76.1 acres of critical habitat.

2. Conservation measures completed in the FCS benefit the gartersnake to the boundaries of the modeled habitat in the FCS (estimated 192.2 acres of habitat).

Relative conservation value is a factor that reflects the relative efficacy of the action in supporting gartersnake recovery based on professional opinion. For the conservation/mitigation measures proposed, the relative efficacy depends on the Tonto Creek location.

1. Gisela Reach (1.0×)
   a. Stocking actions benefit a larger proportion of the gartersnake population because there is room for downstream dispersal of these prey species.
   b. AGFD's management objective for this reach of Tonto Creek is a native fishery (AGFD 2022). Given this context, SRP predicts these mitigation measures are more durable.
2. Roosevelt Lake FCS (0.5×)
   a. AGFD's management objective for Roosevelt Lake is a sport fishery. Given this context, SRP predicts the conservation measures performed in the Roosevelt FCS are less durable.

SRP measures the conservation/mitigation measure duration of the conservation uplift resulting from the action, in years. Given that there is considerable uncertainty regarding the durability of the conservation/mitigation measures, and considering seasonal connectivity with habitats containing nonnative predatory fish and survival rates of stocked fish with endemic diseases and predators, credit will only be granted for one year, each year the measure is applied. SRP anticipates these conservation/mitigation measures will produce durable landscape-level gartersnake benefits. However, SRP does not assume the benefits, thereby taking a conservative approach to crediting.

In rare circumstances, SRP may propose other conservation/mitigation measures for credit. These actions are subject to case-by-case approval by the FWS. One of these circumstances is SRP's commitment of up to $625,000 (subject to further investigation) toward establishing, operating, and maintaining a breeding facility for lowland leopard frogs over the remaining permit term, provided an interested and qualified organization can be identified. SRP proposes that this would be worth acre-years of credit equal to gartersnake habitat in the FCS (192.2 acres) and in the Gisela Reach (221.4 acres) for 4 years. This equals 1,654.4 acre-years.

SRP demonstrates how it can generate enough credit to fully offset the impacts of gartersnake incidental take in the CS and FCS within the permit term with a combination of the proposed conservation/mitigation measures, although SRP may vary the location, number of reaches, and frequency of treatment (Table 2). The actual number and frequency will depend on current conditions, ongoing coordination with the FWS and other partners, and credit generation needs.

The credit generated by the conservation/mitigation measures over 30 years (up to 8,071 acre-years) exceeds the 5,187 acre-year estimated impact of take (Tables 2 and 4). SRP is responsible for generating only 5,187 acre-years of gartersnake conservation credit, in addition to implementing the actions required to fully offset the impacts of nonnative fish on gartersnakes in lower Tonto Creek above the FCS, over the remaining permit term.

Gartersnake and Conservation/Mitigation Action Monitoring, Adaptive Management, and Reporting

SRP provides greater detail in the RHCP amendment (SWCA 2023a) on gartersnake and conservation/mitigation action monitoring, adaptive management, and reporting. We summarize SRP's proposed efforts below.

SRP estimates gartersnake incidental take as habitat surrogate by the cumulative amount of habitat modification (*i.e.*, changes in habitat availability) and the cumulative number of migration days anticipated to occur over the remainder of the permit term.

SRP will ensure it does not exceed authorized gartersnake incidental take by:

1. monitoring the actual changes in available habitat acres and the actual number of migration days that occur each year of the permit;
2. debiting these amounts from the authorized cumulative totals on an annual basis in a running ledger of authorized, actual, and remaining incidental take;
3. reporting the ledger to the FWS each year with the RHCP annual report; and
4. establishing triggers for reengaging with the FWS on another amendment if the remaining amount of take reaches a certain level (*i.e.*, Changed Circumstances).

Monitoring Changes in Gartersnake Habitat Availability in the CS and FCS

Estimates of gartersnake incidental take in the CS and FCS rely on two key field conditions: the Roosevelt Lake elevation and the location and extent of visible surface water along the Tonto Creek channel above the lake below the 2,175-foot amsl elevation contour. Together, these field conditions generate estimates of available gartersnake habitat for a given year. SRP will perform the following monitoring tasks to track changes in gartersnake habitat availability each year of the remaining permit term.

1. Document the Roosevelt Lake elevation on June 30 of each year.
2. Document the maximum Roosevelt Lake elevation in each month with flood control operations.
3. Delineate the extent of visible surface water in the Tonto Arm above Roosevelt Lake each year between June 1 and June 30.
4. Estimate gartersnake habitat in the CS and FCS each year.
5. Determine the year-to-year change in gartersnake habitat availability in the CS.
6. Determine the monthly reductions in gartersnake habitat availability in the FCS.
7. Update the incidental take ledger and check for changed circumstances.
8. Include the updated incidental take ledger in the RHCP annual report.

Monitoring Fish Migration Days for Lower Tonto Creek

1. Calculate the average daily flow rate for each day between February 1 and May 31.
2. Determine the number of migration days contributing to incidental take that occur each year.
3. Update the incidental take ledger and check for changed circumstances.
4. Include the updated incidental take ledger in the RHCP annual report.

Monitoring and Reporting Conservation/Mitigation Measure Implementation

SRP will report to the FWS annually its completed conservation measures, and report to FWS data or analysis that may inform discussions and decisions about how to apply conservation measures in future years.

1. SRP will report the number and locations of pools in each mitigation reach or segment it treated to remove fish and the level of effort applied. For treatments occurring in lower Tonto Creek, SRP will also report if the treated pools are within the FCS or within lower Tonto Creek above the FCS.
2. SRP will report the number and disposition, by species and size class, of fish removed (Ictalurids and Centrarchids) or returned (all other taxa) to each treated pool.
3. SRP will report the locations and number of pools in each mitigation reach or segment where they stocked native fish or, separately, lowland leopard frogs.
4. SRP will report the number, by species and size class, of native fish species or the amount (*e.g.*, size of egg masses, number of tadpoles) of lowland leopard frogs released into each treated pool.
5. SRP will document financial support provided to a FWS-approved entity and dedicated to the establishment or operation of a captive-breeding facility for lowland leopard frogs. SRP will report to FWS how it applied the funds for this purpose.
6. SRP will report length frequency histograms to assess the population age structure of the nonnative fish in mitigation areas over time.
7. SRP will report the number of fish removed and effort per pass. SRP will standardize the catch bypass or by electrofishing seconds to assess changes in relative abundance over time.
8. SRP will report electrofishing catches of native fish species stocked into mitigation areas. Biologists will not catch stocked small-bodied fish as easily using electrofishing gear as the targeted larger nonnative fish. However, SRP will report the species observed and notes on their general abundance. SRP may use this information to generally assess whether stocked fish are surviving and retained in the pools over time.
9. SRP will report incidental detections of amphibians at mitigation areas. SRP will record, whenever encountered observations of amphibians, especially lowland leopard frog, during implementation of conservation measures. The locations and timing of these observations may be described and compared to locations and timing of lowland leopard frog stocking.

Tracking Conservation/Mitigation Credits

To fully offset the impact of the authorized gartersnake incidental take in the CS or FCS, SRP

commits to generating at least 5,187.0 acre-years of credit during the remaining permit term. SRP will track and report the generation of credit as follows:

1. SRP will calculate annually the number of gartersnake credits, in acre-years, generated by implementation of conservation/mitigation measures.
2. SRP will track the cumulative generation of gartersnake credits in a ledger and compare the cumulative sum to 5-year interim benchmarks that assume an even generation of conservation credit over the 30 years of the remaining permit term. SRP will include the ledger in the RHCP annual report to FWS.
3. SRP's interim benchmarks are to ensure that they complete conservation/mitigation actions in a timely manner and avoid a lag in realized benefits.
    a. Year 5: 864.5 acre-years of credit
    b. Year 10: 1,729.0 acre-years of credit
    c. Year 15: 2,593.5 acre-years of credit
    d. Year 20: 3,458.0 acre-years of credit
    e. Year 25: 4,322.5 acre-years of credit
    f. Year 30: 5,187.0 acre-years of credit
4. If the cumulative amount of credit SRP generates does not meet or exceed the amount specified by an interim benchmark for two consecutive 5-year periods, then a Changed Circumstance will have occurred. SRP will notify FWS in the RHCP annual report of the Changed Circumstance.

Documenting Achievement of Biological Objectives

SRP designed the conservation/mitigation measures to achieve gartersnake habitat improvement by suppressing nonnative fish predators and increasing the availability of native prey. SRP will analyze data collected during nonnative fish suppression and native fish stocking efforts to determine whether they have achieved these objectives.

During nonnative fish removal efforts, SRP will record data such as location, fish species, and fish total length. Over time, SRP anticipates that should nonnative fish removal and native fish stocking efforts be successful, the numbers of nonnative fish will decline and the ratio of nonnative to native fish species will shift. Changes in size classes of nonnative fish may also indicate changes in spawning success and recruitment rates. Documenting these changes over the permit term will serve as the metric for determining whether these mitigation measures are successful. After five treatment years, SRP will analyze data to determine if treatments are successful and discuss them with FWS.

Monitoring Conservation/Mitigation Measures Addressing Impacts of Incidental Take in the CS and FCS

SRP will implement conservation/mitigation measures to generate credit that offsets the impacts of authorized incidental take. The amount of credit generated by each action depends on the type of action, the area benefited by the action, and the duration of that benefit. To fully offset the impact of the authorized incidental take, SRP commits to generating at least 5,187.0 acre-years of credit during the remaining permit term. SRP will establish the amount of credit generated by each conservation/mitigation measure in coordination with the FWS.

SRP will monitor credit generation as follows:

1. Confirm that the number of anticipated credits from approved conservation/mitigation measures totals at least 5,187.0 acre-years by the end of the remaining permit term.
    a. SRP will track the anticipated total number of credits generated by each approved conservation/mitigation measure over the remaining permit term. SRP will compare the anticipated total number of credits against the commitment to generate at least 5,187.0 acre-years of credit by the end of the remaining permit term.
    b. SRP will report to the FWS annually the total acre-years of anticipated credit for approved conservation/mitigation measures to-date as an indicator of overall progress toward meeting the biological goals and objectives.
    c. If the total anticipated acre-years of credit from approved conservation/mitigation measures to-date meets or exceeds 5,187.0, then SRP will continue to implement those approved actions contributing to this total but will not be expected to identify or seek approval for new conservation/mitigation measures for the remainder of the permit term unless Changed Circumstances apply.
2. Identify whether the delivery of credits is occurring on schedule, or whether SRP needs additional conservation/mitigation measures.
    a. Every 5 years, SRP will calculate the number of acre-years of credit realized by its completed conservation/mitigation measures to-date and compare it to the amount that would be generated if the target 5,187.0 acre-years were generated at an even pace over 30 years (*i.e.*, 5,187.0 acre-years/30 years = 172.9 acre-years per year). This will serve as an indicator of whether conservation/mitigation delivery is on schedule.
    b. In calculating realized conservation/mitigation benefits, SRP will only include the acre-years of credit for years in which it implements a conservation/mitigation measure. For example, if in the previous 5-year period, nonnative fish removal occurred in 3 years, native fish stocking happened in 3 years, and lowland leopard frog stocking happened in 0 years (*e.g.*, no frogs were available for stocking this period), then only credit for the years of nonnative fish removal and native fish stocking would be included in the realized credit total.
    c. SRP will calculate the benchmark amount of actual credit needed to keep pace with estimated take as the number of years that have elapsed as of the time of the review (*i.e.*, 5, 10, 15, 20, 25 years) multiplied by the average annual amount of conservation/mitigation benefit needed to reach 5,187.0 acre-years over 30 years (*i.e.*, 172.9 acre-years). These benchmark values are:
        i. Year 5: 864.5 acre-years of conservation credit
        ii. Year 10: 1,729.0 acre-years of conservation credit
        iii. Year 15: 2,593.5 acre-years of conservation credit
        iv. Year 20: 3,458.0 acre-years of conservation credit
        v. Year 25: 4,322.5 acre-years of conservation credit
    d. If the realized conservation/mitigation benefits fall short of the benchmarks for credit earned, additional conservation/mitigation measures will be added or current measures will be expanded (*e.g.*, fish suppression and stocking in additional river mile segments of the Gisela Reach) to address any deficit before the end of the next 5-year check-in. SRP and FWS will approve these actions

through regular coordination process. If SRP does not address the deficit by the end of the next 5-year period, then a Changed Circumstance will have occurred. SRP will implement the measures of this Changed Circumstance to maintain its regulatory assurances.

3. SRP will ensure they apply conservation/mitigation measures in a manner that supports the RHCP amendment's biological goals and objectives.
    a. SRP will report to the FWS annually its completed conservation/mitigation measures. Completed conservation/mitigation measures are the basis for the award of credit.
        i. SRP will report the number of pools they treated to remove nonnative fish. SRP will record treated pools by river mile segment. SRP will also report the number and disposition, by species and size class, of fish removed (Ictalurids and Centrarchids) or returned (all other taxa) to each treated pool.
        ii. SRP will report the number and locations of pools where they stock native species. SRP will record locations by river mile segment. SRP will also report the number, by species and size class, of native species released into each treated pool.
    b. SRP will collect information during implementation of conservation/mitigation measures, which may inform discussions and decisions about how to apply measures in future years. For example:
        i. SRP will record species and total length measurements for nonnative fish removed in the Gisela Reach of lower Tonto Creek. SRP will use length frequency histograms to assess the population age structure of the nonnative fish over time.
        ii. SRP will record the number of fish removed and effort per pass. SRP can standardize catch bypass or by electrofishing seconds to assess changes in relative abundance over time.
        iii. SRP will not capture stocked small-bodied fish stocked as easily using electrofishing gear as the targeted larger nonnative fish. However, SRP will record the species observed and notes on their general abundance. SRP may use this information to assess whether stocked fish are surviving and occur in the pools over time.
        iv. SRP will record observations of amphibians, especially lowland leopard frogs, during conservation/mitigation work. The locations and timing of these observations may be described and compared to locations and timing of lowland leopard frog stocking.

Monitoring Conservation Measures Addressing Impacts of Incidental Take Along Lower Tonto Creek

SRP will report on applied conservation measures and the outcome (*e.g.*, number and percentage of pools treated and number and percentage of pools stocked by reach).

1. SRP will calculate the number and percentage of pools treated to remove nonnative fish, and the number, disposition, species, and size class of nonnative fish encountered in each treated pool.

2. SRP will calculate number of pools where they stocked native species, and the number, by species and size class, of native species released into each treated pool.

Adaptive Management

SRP's adaptive management will apply to its approved conservation/mitigation measures so that they achieve effective and efficient benefit. SRP's RHCP amendment provides gartersnake conservation/mitigation measure implementation flexibility through the remaining life of the permit. Adaptive management increases the potential for conservation success by providing early detection of problems and the opportunity to implement remedial actions.

SRP identified adaptive management alternatives for the following situations, which would require revisions to the conservation/mitigation measures.

1. SRP has not yet identified a qualified and FWS-approved organization to propagate lowland leopard frogs for stocking.

   SRP will make a good-faith effort to implement the conservation/mitigation measures for propagation and stocking of lowland leopard frogs. However, if SRP cannot accomplish this measure, SRP will remove it from the conservation program. SRP will select additional conservation measures or an expansion of current conservation measures (*e.g.*, fish suppression and stocking in additional river mile segments of the Gisela Reach). SRP will scale the number and size of the actions to offset the loss of planned credits from breeding and stocking frogs.

2. Sustained flooding or perennial flows make the pools dangerous or unsuitable for treatment in a planned conservation/mitigation measure year.

   Should this occur, SRP will apply the conservation/mitigation measures in the next year with safe access and discrete pool formation. If SRP does not apply conservation/mitigation measures in 2 of 3 years, the frequency or number of measures planned over the next several years may need to increase to keep the credit generated on schedule with the credit benchmarks.

3. The electrofishing gear is not effective for fish removal.

   If the fish species targeted for removal (*i.e.*, Centrarchidae and Ictaluridae families) are not readily captured using electrofishing, other gear types may be considered. Alternative gear types may include, but are not limited to, seine nets or baited hoop nets.

4. The pools to be treated are not practicably or legally accessible.

   SRP and FWS identified two alternative locations in southeastern Arizona along the Santa Cruz, San Pedro, and Babocomari rivers where SRP can enhance gartersnake habitat for credit using the existing proposed conservation/mitigation measures. SRP will scale the number, size, and timing of the actions to meet the credit generation benchmarks.

Effectiveness Monitoring at Gisela Reach

SRP proposes to evaluate the effectiveness of its mitigation activities in a two-step approach that they will implement in the reach of Tonto Creek below the Gisela Reach where nonnative fish removal and stocking efforts will occur.

1. In addition to SRP's nonnative fish removal efforts, SRP will collect detailed fish species assemblage data (species, numbers, size, distribution) in all pools where nonnative fish removal activities occur.

2. SRP will conduct a baseline gartersnake trapping survey in the Gisela Reach in June 2024 and will repeat the trapping surveys in 1 out of every 3 years on average for the term of the permit. Surveys will consist of 100 Gee-style minnow traps for a period of 4.5 days (approximately 108 hours of sampling per trap, or an equivalent of 108-person search hours). SRP may choose to deploy pit tags on captured gartersnakes to assist with monitoring efforts. SRP may, with FWS consideration and approval, use alternative methods for monitoring the baseline status of gartersnakes at the Gisela Reach, such as eDNA, fecal DNA, or other advanced technologies (Owens *et al.* 2023).

Alternate Gartersnake Mitigation Locations

After SRP assesses the first five years of mitigation activities on Tonto Creek near the Gisela Reach, SRP (along with FWS) may elect to implement gartersnake fish management mitigation actions at one or both alternate locations in southeastern Arizona (see below). Nonnative predatory fish suppression mitigation activities conducted in these areas could be in lieu of or in tandem with activities in the Gisela Reach of Tonto Creek as needed to generate sufficient mitigation credits to offset incidental take.

1. San Pedro River and Babocomari Rivers within the Bureau of Land Management's (BLM) San Pedro Riparian National Conservation Area (SPRNCA) (benefitting up to 5,237.8 acres of gartersnake critical habitat) (Figure 24).
2. Santa Cruz River within the San Rafael State Natural Area (benefitting up to 110.8 acres of gartersnake critical habitat) (Figure 24).

Effectiveness Monitoring in Lower Tonto Creek for Gartersnakes and its Habitat

The same information that SRP reports to track nonnative fish suppression and stock native fish and frogs will also be provide data to monitor conservation program effectiveness. For example, the number of nonnative fish removed from pools at the specified level of effort is an index of how many fish are present and available. Fish species data collection during suppression also provides information about the relative abundance of native species in treated areas.

In addition, SRP will contribute $150,000 (in 2022 dollars) over the term of the permit to fund periodic gartersnake presence/absence surveys, or alternatively, other research opportunities to further understand the species status and its habitats on lower Tonto Creek. SRP will prioritize the application of these funds toward gartersnake presence/absence surveys along lower Tonto Creek. The methods for such surveys will be determined in collaboration with FWS. In coordination with FWS, SRP may apply these funds to other studies (Table 3). SRP will also

seek input from other state natural resources agencies and/or academic institutions in making decisions about funding for other research opportunities. SRP will ensure that they share all data and findings generated from these adaptive management commitments with the FWS and the AGFD.

SRP intends to spend these funds in increments of approximately $25,000 (in 2022 dollars) on 5-year intervals for the remainder of the ITP term. Applying the average annual inflation rate over the last 30 years (about 2.34%, based on the average annual inflation rate between 1993 and 2022 reported by the U.S. Bureau of Labor Statistics), the inflation-adjusted value of $25,000 spent in Year 5 of the amendment period will be $28,065, in Year 10 will be $31,506, in Year 15 will be $35,369, in Year 20 will be $39,705, in Year 25 will be $44,573, and in Year 30 will be $50,038. The total inflation-adjusted value of the dollars spent by SRP on this type of monitoring will not exceed $229,256 (i.e., the sum of the inflation-adjusted spending increments).

Effectiveness Monitoring for Frog Stocking

SRP will perform monitoring of the frog populations at the Gisela Reach and the lower Tonto Creek portion of the permit area above the FCS. This monitoring will occur at a frequency of at least once every 3 years, with the intent to collect long-term data on species composition and relative abundance (using indices of abundance such as call detections per unit of survey effort or other indirect measures of abundance) of the anuran community at these mitigation locations. Specific methods for this monitoring will prioritize passive detection (e.g., passive acoustic monitoring) or environmental detection (*e.g.*, eDNA) methods and will be determined in coordination with FWS. Any changes to monitoring methods or level of effort will consider the impact on the continuity of the long-term dataset and seek to maintain consistency and compatibility over time.

Other Research for Addressing Data Gaps

SRP expects the activities covered by the RHCP, including this amendment, to continue beyond the remaining ITP term. SRP anticipates that they will need a renewal or amendment of the current ITP in the future. SRP has identified gaps in the current body of best available information that are relevant to better understanding the effects of the covered activities on the gartersnake (Table 3). SRP will assist the FWS and AGFD with monitoring and other studies to collect information during the remaining permit term that will help inform a future permit renewal or amendment. SRP and FWS may consider these efforts for conservation credit on a case-by-case basis when other contemplated actions are impractical. New information on the gartersnake in the permit area may provide insight for more precisely estimating incidental take, the impacts of take, and the effectiveness of conservation/mitigation measures.

Annual Reporting and Coordination with FWS

SRP will compile an annual report and host an annual coordination meeting on or before November 30 of each year to support implementation of the RHCP. Invited attendees will include representatives from SRP, FWS, USFS, AGFD, Corps, and USBR, as relevant. SRP will add the gartersnake conservation program to that standing meeting. During the annual coordination meeting, the group will address the following topics.

1. Review the past year's information. SRP will prepare annual reports of RHCP activities and provide them to the meeting attendees in advance of the meeting.
2. Make decisions for the upcoming year regarding implementation of ongoing conservation/mitigation measures, informed by data collected during nonnative fish removal and native fish/frog stocking efforts and adaptive management measures.
3. Discuss the general status of RHCP implementation. SRP will estimate the credit generated and request FWS review that the actions completed warrant credit.
4. SRP will compare earned credit to-date to credit generation interim benchmarks to determine if conservation/mitigation is on schedule or if Changed Circumstances apply. SRP will provide any updates to its planned conservation/mitigation approach.
5. SRP will make decisions regarding conservation and monitoring implementation for the upcoming year.
6. SRP will coordinate with the FWS following the destruction or abandonment of a bald eagle nest or fledgling drowning in the CS or FCS to determine the proximate cause and whether the event results in incidental take under the RHCP.

RHCP Flycatcher, Cuckoo, Bald Eagle, and Rail Conservation Measures

SRP is not proposing additional flycatcher, cuckoo, bald eagle or rail conservation measures. The initial RHCP (ERO 2002, USFWS 2003) incidental take exceedance measures and the implementation of ongoing conservation and mitigation measures are robust enough to encompass the additional minor effects from FCS operations (see Effects of the Action and Incidental Take sections). The RHCP permit amendment will require adding the FCS to the permit area for the flycatcher, cuckoo, and bald eagle. There are no additional effects to rails from SRP's flood control operations.

Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR § 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects (direct and indirect) of the action on the environment.

The large action area for the original RHCP for Modified Roosevelt Dam conservation storage operations and mitigation sites is described in the RHCP (ERO 2002) and our 2003 biological opinion (USFWS 2003). The RHCP's original action area included the Roosevelt Lake CS (up to 2,151 feet amsl), and Salt River streamflow downstream from Roosevelt Dam to the Gila River, and from the Gila River downstream to the Colorado River. Granite Reef Diversion Dam, located just downstream from the Salt and Verde River confluence, moves stream flow into the canals, and effects to stream flow attenuate with distance from the diversion dam. Mitigation sites for covered birds were conceptually described for site-specific properties along the Verde, San Pedro, and Gila rivers, and possibly other streams.

The RHCP amendment expands the action area at Roosevelt Lake with the addition of Modified Roosevelt Dam FCS operations (including the planned deviation), effects to gartersnakes in lower Tonto Creek from CS operations, and gartersnake conservation/mitigation actions.

The RHCP amendment adds Roosevelt Lake's FCS (2,151-2,175 feet amsl) (Figure 3), two separate sections of lower Tonto Creek where conservation (14.1-mile section above Roosevelt Lake FCS) (Figure 4) and mitigation (3-mile section near the Town of Gisela) actions occur (Figure 17), and possible secondary mitigation sites on the Santa Cruz River (101 acres) at the San Rafael State Natural Area and San Pedro/Babocomari Rivers within BLM's SPRNCA (5,238 acres) (Figure 24).

Because of the addition of normal flood control operations, the action area also includes Salt River streamflow downstream of Modified Roosevelt Dam. The action area for normal flood control operations is like that described for the original RHCP (USFWS 2003). Flood control and the planned deviation are infrequent occurrences. Because the planned deviation's purpose is for additional water delivery, it likely substantially ceases at Granite Reef Diversion Dam.

STATUS OF THE SPECIES AND CRITICAL HABITAT

The information in this section summarizes the rangewide status of each species that we considered in this biological opinion. Further information on the status of these species can be found in the administrative record for this project, documents on our web page (Arizona Ecological Services Office Documents by Species), and in other references cited in each summary below.

Northern Mexican Gartersnake

Listing

The FWS published the notice listing the gartersnake as threatened under the Act on July 8, 2014 (79 FR 38677). We re-proposed critical habitat on April 28, 2020 (85 FR 23608) and issued our final rule designating approximately 8,226 ha (20,326 ac) of critical habitat on April 28, 2021 (86 FR 22518). Please refer to these rules for more in-depth information on the ecology and threats to the species and critical habitat, including references. We have not yet developed a recovery plan for the gartersnake.

Description and Life History

The gartersnake reaches up to 44 inches total length, ranges in color from olive to olive-brown or olive-gray with three lighter-colored stripes that run the length of the body, the middle of which darkens towards the tail. It may occur with other native gartersnake species and can be difficult for people without specific expertise to identify because of its similar appearance to sympatric gartersnake species. The appearance of the lateral stripe anteriorly on scale rows three and four distinguishes this gartersnake from the remaining three-striped gartersnake species native to Arizona (Jones *et al.* 2020).

Sexual maturity in gartersnakes occurs at two to three years of age in males and at two to three years of age in females (Rosen and Schwalbe 1988). Gartersnakes are viviparous (bringing forth living young rather than eggs). Researchers have documented mating in April and May followed by the live birth of between 7 and 38 newborns from June through September (Rosen and Schwalbe 1988, Degenhardt *et al.* 1996, Nowak and Boyarski 2012, Cobbold 2018). Research estimates that longevity in the wild is at least 10 to 11 years (Boyarski *et al.* 2015).

Native predators of the gartersnake include birds of prey, other snakes, wading birds, mergansers, belted kingfishers, raccoons, skunks, and coyotes (Rosen and Schwalbe 1988, Brennan *et al.* 2009). Historically, large, highly predatory native fish species such as Colorado pikeminnow and native chubs may have preyed upon neonate to adult northern Mexican gartersnakes where they co-occurred.

Habitat Requirements and Distribution

Considered a "terrestrial-aquatic generalist" by Drummond and Marcías-García (1989), the gartersnake often occurs in riparian habitat, but also may spend time in terrestrial habitat removed from water (Emmons and Nowak 2016). Examples include grasslands up to 1 mile away from any surface water (Cogan 2015), several hundred yards from rivers (Bauder 2022), or even in highly disturbed, open, developed areas devoid of vegetation or associated lengthy, dry reaches along intermittent streams (Cobbold 2018). Species records suggest it may possess a more terrestrial ecology than previously considered (Jones 2017, Cobbold 2018), foraging on lizards, small mammals, and invertebrates through periods of long(er)-distance dispersal. Terrestrial habitat serves three basic functions for gartersnakes: 1) thermoregulatory purposes; 2) as protective cover while surface active; and 3) for maintaining adequate terrestrial prey populations of small rodents, lizards, or invertebrates.

Gartersnakes use both lentic (stock tanks, ponds, ciénegas) or lotic (low-gradient streams) habitat to forage. In lotic habitats, Emmons and Nowak (2013) found this subspecies most commonly in protected backwaters, braided side channels and beaver ponds, isolated pools near the river mainstem, and edges of dense emergent vegetation that offered cover and foraging opportunities. Dense vegetation may play a key role in protecting gartersnakes when in the presence of predatory nonnative species (Boyarski *et al.* 2015) but may be less critical in native aquatic communities. Aquatic edge habitat is frequently used, followed by terrestrial habitat (for thermoregulatory purposes such as gestation and periods of dormancy) (Boyarski *et al.* 2015) and developed areas, with snakes documented using artificial, human-created objects as surface cover (Boyarski *et al.* 2015). Observations of gartersnakes in México also found them using artificial cover such as tires, solid waste piles, discarded furniture, *etc.* (J. Servoss, USFWS, pers. obs.). Based on studies of closely related snakes, gartersnakes also likely use other types of artificial microhabitat such as building foundations, construction debris, building foundations, gabion structures, *etc.*

In the northernmost part of its range, the gartersnake appears to be most active during July and August, followed by June and September. At Bubbling Ponds gartersnakes are active from March to October with peak activity and abundance from June to August (Sprague and Bateman 2018) but may be visible on the surface any day of the year if the previous night's low is above freezing (Emmons *et al.* 2016). Adult female gartersnake home range size (includes active and inactive seasons) averaged 8.5 ± 4.7 acres (Emmons 2017).

During the winter (inactive season), gartersnakes tend to conceal themselves underground (Emmons 2017). Research conducted in the Verde River located 26 brumation (hibernation) sites used by 21 female and male radio-telemetered gartersnakes. Emmons (2017) found that both female and male snakes selected overwintering locations with more litter/debris ground cover relative to availability and individuals were located a mean distance of 131 ± 28 feet (range 1.6

to 512 feet) from water, including in upland habitats, meadows, and aquatic edges. During the inactive season at Page Springs/Bubbling Ponds hatcheries, gartersnakes selected rocky slopes or woodlands more distant from ponds (Sprague and Bateman 2018). Based on this information, it appears that gartersnakes commonly overwinter in upland habitats, although they also use riparian floodplains and water edges, albeit to a lesser extent.

Gartersnake foraging behavior includes moving along vegetated shorelines, searching for prey in water and on land. Primarily, its diet consists of amphibians and fishes, such as adult and larval (tadpoles) leopard frogs (*Rana* spp.), as well as juvenile and adult native fish (Rosen and Schwalbe 1988); they also eat earthworms, leeches, lizards, and small mammals. Some gartersnake populations may specialize on seasonally available prey such as spadefoot toads (*Scaphiopus couchii*) (d'Orgeix *et al.* 2013) or Woodhouse's toads (*Anaxyrus woodhousii*) (Myrand *et al.* 2017). Manjarrez *et al.* (2017) sampled stomach contents from 262 gartersnakes across 23 discreet locations along the Mexican Plateau and found they consumed fish (42.4 percent) most frequently, followed by leeches (23.7 percent), earthworms (10.6 percent), frogs (10.2 percent), and tadpoles (9.8 percent); remaining prey items included slugs, axolotl, lizards, and mice (Manjarrez *et al.* 2017). In situations where native prey species are rare or absent, the gartersnake diet may include nonnative species, including larval and juvenile American bullfrogs (*Rana catesbeianus*), western mosquitofish (*Gambusia affinis*), or other nonnative fishes (Holycross *et al.* 2006, Emmons and Nowak 2013, Boyarski *et al.* 2015). In some cases where the aquatic community is mostly nonnative, small size classes of predatory nonnative species (excluding crayfish) substitute native prey within the prey community (Emmons *et al.* 2016).

Periods of surface activity in gartersnakes depend on temperature. For example, if several weeks to months occur with consecutive nights below freezing, we expect that gartersnakes would be inactive and below ground during that period. However, in general and across its range, gartersnake could be visible on the surface any day of the year if the preceding evening is above freezing (Emmons 2017). Cumulatively, these cold season behaviors we describe as periods of inactivity or short-term torpor versus hibernation (Emmons and Nowak 2016).

The gartersnake historically occurred within most major watersheds within Arizona (except for the Little Colorado River watershed), including the Colorado, Verde, Salt, San Pedro, and Gila watersheds (Brennan and Holycross 2006, Cotton *et al.* 2013). In New Mexico, the species had a limited distribution that consisted of scattered locations throughout the Upper Gila River watershed in Grant and western Hidalgo Counties (Price 1980, Fitzgerald 1986, Degenhardt *et al.* 1996, Holycross *et al.* 2006). Within México, gartersnakes historically occurred within the Sierra Madre Occidental and the Mexican Plateau, comprising approximately 85 percent of the total range wide distribution of the subspecies (Rossman *et al.* 1996).

Threats

Loss of native prey base, primarily ranid frogs (probably because of chytridiomycosis) and fish, due to nonnative predatory aquatic species, has undoubtedly contributed to widespread population declines in most gartersnake localities in the United States. These nonnative fish and crayfish species can contribute to starvation of gartersnake populations through competitive mechanisms and may reduce or eliminate recruitment of young gartersnakes through predation. Other threats include alteration of rivers and streams from dams, diversions, flood-control

projects, and groundwater pumping that change flow regimes, reduce, or eliminate habitat, and favor nonnative species, and effects from climate change and drought (USFWS 2014a).

Population Status

Within the gartersnake's range in the southwestern United States, many areas the species previously occurred now contain predatory nonnative species or the sites are vulnerable to drought or human water use. Existing sampling data suggest that there are 3 populations of gartersnakes in the United States where the species remains reliably detected: 1) upper Santa Cruz River in the San Rafael Valley; 2) Verde Valley; and 3) the Aquatic Research and Conservation Center (formerly known as Page Springs and Bubbling Ponds State Fish Hatcheries) adjacent to Oak Creek. In New Mexico, the gartersnake may occur in low population densities within its historical distribution along Duck Creek and the Gila River. In New Mexico, access to survey the largely private Mule Creek is limited and biologists presume the gartersnake population is at low density. We know little about the status of the gartersnake on Tribal lands, such as the White Mountain or San Carlos Apache nations. We know even less about the current distribution of the gartersnake in México due to limited surveys and limited access to information on survey efforts and field data from México, although surveys in 2007 suggested populations were doing well, where exotic predators were uncommon or absent.

Previous Consultations

Given the wide range of this species, several Federal actions affect this species every year. AESO maintains a complete list of all formal consultations affecting the gartersnake in Arizona.

Critical Habitat

Designated gartersnake critical habitat occurs in nine units in portions of Arizona and New Mexico, totaling 20,326 acres (USFWS 2021b). The physical and biological features (PBF) essential to gartersnake conservation are:

1. Perennial or spatially intermittent streams that provide both aquatic and terrestrial habitat that allows for immigration, emigration, and maintenance of population connectivity of gartersnakes and contain:
    a. Slow-moving water (walking speed) with in-stream pools, off-channel pools, and backwater habitat;
    b. Organic and natural inorganic structural features (e.g., boulders, dense aquatic and wetland vegetation, leaf litter, logs, and debris jams) within the stream channel for thermoregulation, shelter, foraging opportunities, and protection from predators;
    c. Terrestrial habitat adjacent to the stream channel that includes riparian vegetation, small mammal burrows, boulder fields, rock crevices, and downed woody debris for thermoregulation, shelter, foraging opportunities, brumation, and protection from predators; and
    d. Water quality that meets or exceeds applicable State surface water quality standards.
2. Hydrologic processes that maintain aquatic and terrestrial habitat through:

   a. A natural flow regime that allows for periodic flooding, or if flows are modified or regulated, a flow regime that allows for the movement of water, sediment, nutrients, and debris through the stream network; and
   b. Physical hydrologic and geomorphic connection between a stream channel and its adjacent riparian areas.
3. A combination of amphibians, fishes, small mammals, lizards, and invertebrate prey species such that prey availability occurs across seasons and years.
4. An absence of nonnative fish species of the families Centrarchidae and Ictaluridae, American bullfrogs (*Lithobates catesbeianus*), and/or crayfish (*Orconectes virilis, Procambarus clarki,* etc.), or occurrence of these nonnative species at low enough levels such that recruitment of gartersnakes is not inhibited and maintenance of viable prey populations is still occurring.
5. Elevations from 130 to 8,497 feet.
6. Lentic wetlands including off-channel springs, cienegas, and natural and constructed ponds (small earthen impoundment) with:
   a. Organic and natural inorganic structural features (e.g., boulders, dense aquatic and wetland vegetation, leaf litter, logs, and debris jams) within the ordinary high-water mark for thermoregulation, shelter, foraging opportunities, brumation, and protection from predators;
   b. Riparian habitat adjacent to ordinary high-water mark that includes riparian vegetation, small mammal burrows, boulder fields, rock crevices, and downed woody debris for thermoregulation, shelter, foraging opportunities, and protection from predators; and
   c. Water quality that meets or exceeds applicable State surface water quality standards.
7. Ephemeral channels that connect perennial or spatially intermittent perennial streams to lentic wetlands in southern Arizona where water resources are limited.

Southwestern Willow Flycatcher

Listing

We listed the flycatcher as endangered, without critical habitat on February 27, 1995 (USFWS 1995a). We later designated critical habitat on July 22, 1997 (USFWS 1997a). We published a correction notice in the Federal Register on August 20, 1997, to clarify the lateral extent of the designation (USFWS 1997b).

On January 3, 2013, we completed the flycatcher critical habitat revision, designating approximately 1,227 stream miles (USFWS 2013). We designated areas as stream segments, with the lateral extent including the riparian areas and streams that occur within the 100-year floodplain or flood-prone areas encompassing a total area of approximately 208,973 acres.

The FWS Region 2 Director signed the final flycatcher recovery plan and released to the public in March 2003 (USFWS 2002a). Our recovery strategy is reaching numerical flycatcher territory and habitat related goals for each specific Management Unit established throughout the subspecies range and establishing long-term conservation plans (USFWS 2002a).

We most recently completed a five-year review and a 12-month finding on a petition to de-list the flycatcher in 2017 (USFWS 2017).

Description

The flycatcher is a small grayish-green passerine bird (Family Tyrannidae) measuring approximately 5.75 inches. It is one of four currently recognized willow flycatcher subspecies (Phillips 1948, Unitt 1987, Browning 1993). It is a neotropical migrant that breeds in the southwestern U.S. and migrates to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips 1948, Stiles and Skutch 1989, Peterson 1990, Ridgely and Tudor 1994, Howell and Webb 1995). The historical breeding range of the flycatcher included southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern Utah, extreme southern Nevada, and extreme northwestern Mexico (Sonora and Baja) (Unitt 1987).

Threats

We have attributed the flycatcher's decline primarily to removal, alteration, degradation, and modification of riparian breeding habitat, along with a host of other factors including affects to wintering habitat and brown-headed cowbird brood parasitism (USFWS 1995a, 2002a, Sogge *et al.* 1997, 2010, McCarthey *et al.* 1998). A variety of factors cause habitat degradation, including water diversion and groundwater pumping, channelization, and dams; urban, recreational, and agricultural development; and excessive livestock grazing (USFWS 2002a). Fire is an increasing threat to flycatcher habitat, especially in monotypic saltcedar vegetation and where water diversions and/or groundwater pumping desiccates riparian vegetation (DeLoach 1991, Busch 1995, Paxton *et al.* 1996, Sogge *et al.* 1997, USFWS 2002a). Flycatcher nests can be parasitized by brown-headed cowbirds (*Molothrus ater*), which lay their eggs in the host's nest. The presence of livestock and range improvements such as waters and corrals, agriculture, urban areas, golf courses, bird feeders, and trash areas can enhance cowbird-feeding sites. When these feeding areas are in proximity to flycatcher breeding habitat, especially coupled with habitat degradation, cowbird parasitism of flycatcher nests may increase (USFWS 2002a).

Habitat

The flycatcher breeds in dense riparian habitats from sea level in California to approximately 8,500 feet in Arizona and southwestern Colorado (Sogge *et al.* 2010, USFWS 1995a, 2002a). Historical egg/nest collections and species' descriptions throughout its range describe the southwestern willow flycatcher's widespread use of willow (*Salix* spp.) for nesting (Phillips 1948, Phillips *et al.* 1964, Hubbard 1987, Unitt 1987). Currently, flycatchers primarily use saltcedar (*Tamarix* sp.), Goodding's willow (*Salix gooddingii*), coyote willow (*Salix exigua*), Geyer willow (*Salix geyeriana*), boxelder (*Acer negundo*), Russian olive (*Elaeagnus angustifolio*), and live oak (*Quercus agrifolia*) for nesting. Other plant species less commonly used for nesting include buttonbush (*Cephalanthus* sp.), black twinberry (*Lonicera involucrata*), cottonwood (*Populus* spp.), white alder (*Alnus rhombifolia*), blackberry (*Rubus ursinus*), and stinging nettle (*Urtica* spp.). Based on the diversity of plant species composition and complexity of habitat structure, we described four basic flycatcher habitat types: monotypic native, monotypic exotic, native broadleaf dominated, and mixed native/exotic (Sogge *et al.* 1997, 2010, USFWS 2002a).

The flycatcher's habitat is dynamic and can change rapidly because its location along waterways can frequently flood. Flooding is an important process for the long-term maintenance of elevated groundwater aquifers, and recycling and maintenance of breeding habitat (Poff *et al.* 1997). Nesting habitat can grow into and out of suitability quickly. Saltcedar and willow trees can develop from seeds to nesting habitat in about four to five years. Heavy precipitation runoff can remove/reduce habitat suitability in a day. Also, through time, river channels, floodplain width, vegetation location, and vegetation density may change, affecting habitat quality. The flycatcher's use of habitat in different successional stages can also be dynamic. For example, over-mature or young habitat not suitable for nest placement can be occupied and used for foraging and shelter by migrating, breeding, dispersing, or non-territorial southwestern willow flycatchers (McLeod *et al.* 2005, Cardinal and Paxton 2005). Overall, flycatcher habitat can quickly change and vary in suitability, location, use, and occupancy over time (Finch and Stoleson 2000).

Tamarisk is an important component of the flycatcher's nesting and foraging habitat in Arizona, southern Nevada and Utah, and western New Mexico. In 2001, flycatchers in Arizona built 323 of their 404 (80 percent) known nests in a tamarisk tree (Smith *et al.* 2002). Biologists had once incorrectly concluded that tamarisk, because it was an exotic plant, was lesser quality flycatcher habitat (USFWS 2002a, 2017). Comparisons of flycatcher reproductive performance (USFWS 2002a), prey populations (Durst 2004) and physiological conditions (Owen and Sogge 2002) using native and exotic vegetation revealed no difference (Sogge *et al.* 2005).

Because tamarisk is a component of about 50 percent of all known flycatcher territories (Durst *et al.* 2008, Durst 2017), the introduction and spread of the tamarisk leaf beetle can alter the distribution, abundance, and quality of flycatcher nesting habitat and adversely affect breeding attempts. The introduced tamarisk leaf beetle was first detected affecting tamarisk within the flycatcher's breeding range in 2008 along the Virgin River in St. George, Utah. Initially, Animal Plant and Health Inspection Services (APHIS 2010) thought this insect's introduction and natural history prevented it from moving into and thriving within the southwestern United States and flycatcher's breeding range. Along this Virgin River site in 2009, 13 of 15 flycatcher nests failed following vegetation defoliation (Paxton *et al.* 2010). In 2012, people detected the beetle within the flycatcher's breeding range in southern Nevada/Utah and northern Arizona/New Mexico. By 2022 in Arizona, the beetle occurred along the entire lower Colorado River (Grand Canyon to Mexico), Little Colorado River, and Bill Williams, Santa Maria, and Big Sandy rivers (including Alamo Lake) in northern and western Arizona; Hassayampa and Verde, Salt, and Gila rivers and Tonto Creek in central Arizona; and San Francisco and upper Gila rivers in eastern Arizona. In New Mexico, the beetle occurs along much of the Rio Grande within the flycatcher's breeding range.

Breeding Biology

Throughout its range, the flycatcher arrives on breeding grounds in late April and May (Sogge *et al.* 1997, 2010, USFWS 2002a). Nesting begins in early May and June, and young fledge from late June through mid-August (Sogge *et al.* 1997. 2010, USFWS 2002a). Typically, flycatchers raise one brood per year, but researchers have documented birds raising two broods during one season and renesting after a failure (USFWS 2002a). The entire breeding cycle, from egg laying to fledging, is approximately 28 days.

Southwestern willow flycatcher nests are small (3.2 inches tall and wide) and placement in a shrub or tree is highly variable (1.6 to 60 feet off the ground). Nests are open cup structures, and flycatchers typically place them in the fork of a branch. Nest height varies, and related to height of nest plant, overall canopy height, and/or the height of the vegetation strata that contain small twigs and live growth (USFWS 2002a). Most typically, nests are low, 6.5 to 23 feet above ground (USFWS 2002a). Flycatcher nests built in habitat dominated by box elders occur higher in the tree (to 60 feet) (USFWS 2002a).

The flycatcher is an insectivore, foraging in dense shrub and tree vegetation along rivers, streams, and other wetlands. The bird typically perches on a branch and makes short direct flights, or sallies to capture flying insects. Drost *et al.* (1998) found that the major southwestern willow flycatcher prey items (in Arizona and Colorado) consisted of true flies (Diptera); ants, bees, and wasps (Hymenoptera); and true bugs (Hemiptera). Other insect prey taxa included leafhoppers (Homoptera: Cicadellidae); dragonflies and damselflies (Odonata); and caterpillars (Lepidoptera larvae). Non-insect prey included spiders (Araneae), sowbugs (Isopoda), and fragments of plant material.

Rangewide Distribution and Abundance

There are currently 308 known flycatcher breeding sites in California, Nevada, Arizona, Utah, New Mexico, and Colorado (all sites from 1993 to 2012 where a territorial flycatcher was detected) holding an estimated 1,629 territories (Durst 2017). Since surveyors do not visit all sites annually, it is difficult to arrive at a grand total of flycatcher territories. There are many territories included in the rangewide estimate where surveyors have not returned for many years, reducing the estimate's accuracy. Territory numbers have increased since listing and some habitat remains unsurveyed. Since Unitt's (1987) estimate of 500 to 1000 rangewide territories and about 25 years of targeted surveys, the most recent estimate is not too far beyond his initial conclusion. About 70 percent of the 1,629 estimated territories throughout the southwestern willow flycatcher's breeding range are located at 5 general locations (Cliff/Gila Valley and Middle Rio Grande – New Mexico and Upper Gila River, Roosevelt Lake, San Pedro River/Gila River confluence – Arizona) (Durst 2017).

While flycatcher territory numbers increased, distribution across the bird's range has not proportionally improved. The increase in known numbers is largely due to territory abundance at the five largest population centers in Arizona and New Mexico. Concurrent large territory increases in other parts of its breeding range, such as southern California, Colorado, Nevada, and Utah have not occurred and have retained similar size and distribution since the previous 2008 rangewide estimate (Durst *et al.* 2008).

Arizona Distribution and Abundance

While territory numbers have increased in Arizona (145 to 679 territories from 1993 to 2012) (Durst 2017), overall distribution of flycatchers throughout the state has not proportionally grown. Population stability in Arizona is likely dependent on the presence of three population centers (Roosevelt Lake, San Pedro/Gila River confluence, upper Gila River). Lower Colorado River nesting sites are still few and limited to Topock Marsh, and adjacent tributaries in southern Nevada and Arizona (*e.g.,* Bill Williams River). We have few consistent surveys and known territories from the Santa Cruz, Powell, Middle Colorado, San Francisco, Little Colorado, and

Hassayampa/Agua Fria Management Units. Biologists in the 2010s discovered more territories in the Verde Valley (Perkinsville to Camp Verde), improving the known distribution and abundance of territories/sites within the Verde Management Unit. Some tributaries (Cherry, Pinal, and Granite creeks) of larger streams hold a few flycatcher territories. The result of catastrophic events or substantial population changes either in size or location could greatly change the status and persistence of the bird. Conversely, expansion into new habitats or discovery of populations would improve the known stability and status.

Critical Habitat

The primary constituent elements (PCE) of flycatcher designated critical habitat (USFWS 2013) are riparian plant species, structure and quality of habitat and insects for prey.

1. Primary Constituent Element 1— *Riparian vegetation.* Riparian habitat along a dynamic river or lakeside, in a natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs (that can include Gooddings willow, coyote willow, Geyer's willow, arroyo willow, red willow, yewleaf willow, pacific willow, boxelder, tamarisk, Russian olive, buttonbush, cottonwood, stinging nettle, alder, velvet ash, poison hemlock, blackberry, seep willow, oak, rose, sycamore, false indigo, Pacific poison ivy, grape, Virginia creeper, Siberian elm, and walnut) and some combination of:
    a. Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 6 to 98 ft. Lower-stature thickets (6 to 13 ft tall) are found at higher elevation riparian forests and tall-stature thickets are found at middle and lower-elevation riparian forests;
    b. Areas of dense riparian foliage at least from the ground level up to approximately 13 ft above ground or dense foliage only at the shrub or tree level as a low, dense canopy;
    c. Sites for nesting that contain a dense (about 50 percent to 100 percent) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground);
    d. Dense patches of riparian forests that are interspersed with small openings of open water or marsh or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.25 ac or as large as 175 ac.

2. Primary Constituent Element 2—*Insect prey populations.* A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, which can include: flying ants, wasps, and bees (*Hymenoptera*); dragonflies (*Odonata*); flies (*Diptera*); true bugs (*Hemiptera*); beetles (*Coleoptera*); butterflies, moths, and caterpillars (*Lepidoptera*); and spittlebugs (*Homoptera*).

The physical and biological features of flycatcher critical habitat are the principal biological or physical elements essential to flycatcher conservation which may require special management considerations or protection (USFWS 2013). We primarily identified the features and functions of rivers that generate flycatcher habitat and its food such as low gradient/broad floodplains,

water, saturated soil, hydrologic regimes, elevated groundwater, and fine sediments, etc. (USFWS 2013).

Past Consultations

Since listing in 1995, at least 250 Federal agency actions have undergone (or are currently under) formal section 7 consultation throughout the flycatcher's range. Consultations include, but are not limited to Federal land management planning (USFWS 2005), grazing allotments, bridge building and repair, habitat improvement and vegetation management, dam building and operations, and Habitat Conservation Plans, Safe Harbor Agreements.

Conservation measures associated with some consultations and Habitat Conservation Plans have helped to acquire lands specifically for flycatchers on the San Pedro, Verde, and Gila rivers in AZ and the Kern River in CA. Additionally, along the lower Colorado River, the USBR, as part of a multi-party Habitat Conservation Plan, is currently establishing riparian vegetation to expand and improve the distribution and abundance of nesting flycatchers. Some Native American Tribes in California, Arizona, and New Mexico have established Management Plans to guide flycatcher conservation.

Additionally, during the development of the critical habitat rule, some private landowners created management plans along the Owens and Kern rivers in CA, Pinal Creek, in AZ, and Gila River in NM. These are a small portion of the flycatcher conservation actions that land management agencies and private landowners have established across the subspecies' range.

Western Yellow-Billed Cuckoo

Listing

The FWS listed the western Distinct Population Segment (DPS) of the cuckoo as threatened on October 13, 2014 (USFWS 2014b) and issued a not warranted 12-month finding to a petition to delist the DPS of the cuckoo on September 16, 2020 (USFWS 2020a). We designated cuckoo critical habitat on April 21, 2021 (USFWS 2021c) encompassing 298,845 acres (120,939 hectares) across the western United States. We have not yet developed a recovery plan for the cuckoo.

Description

Cuckoos are slender long-tailed passerines with a fairly stout and slightly down-curved bill. The plumage is grayish-brown above and white below, with reddish primary flight feathers. The tail feathers have bold patterns with black and white below. They are a medium-sized bird about 12 inches in length, and about 2 ounces in weight. The bill is blue-black with yellow on the basal half of the lower mandible. The legs are short and bluish-gray. Males and females differ slightly but are indistinguishable in the field (Hughes 2015).

Life History

The cuckoo is a neotropical migrant bird that breeds in North America and winters in South America, east of the Andes, primarily south of the Amazon Basin in southern Brazil, Paraguay,

Uruguay, eastern Bolivia, and northern Argentina (Sechrist *et al.* 2012, Hughes 2015, McNeil *et al.* 2015). Cuckoos breed from late May through September, although most nesting occurs from late June through August. Timing of spring migration and arrival on the breeding grounds is likely related to climate, habitat, and food availability (Pulido *et al.* 2001, Cresswell *et al.* 2011). Both adults build loose platform nests composed of dry twigs. Nest height ranges from about 4 to 56 feet (Halterman 2001, McNeil *et al.* 2013, Wohner *et al.* 2021). Clutch size is variable, usually two or three (Halterman 2001, McNeil *et al.* 2013, Dillon and Moore 2020). Nestlings grow rapidly, with a period of 17 days from start of incubation to fledgling, which is among the shortest for most bird species (Hughes 2015).

Given that cuckoos are larger birds with a short hatch-to-fledge time, they require access to abundant food sources to successfully rear their rapidly growing offspring (Laymon 1980). In portions of the southwestern United States, high densities of prey species may be seasonally present, often for brief periods of time, during the vegetation growing season. Food availability and foraging distance can vary within and between years, drainages, and geographic area and is largely rainfall related. In areas that typically receive rains during the summer monsoon, an increase in humidity, soil moisture, and surface water flow are important triggers for insect reproduction and cuckoo nesting (Wallace *et al.* 2013). In years of high insect abundance, cuckoos lay larger clutches (three to five eggs rather than two), a larger percentage of eggs produce fledged young, and they breed multiple times (two to three nesting attempts rather than one; Laymon *et al.* 1997). On the upper San Pedro and lower Colorado Rivers, cuckoos renested following both successful and unsuccessful nesting attempts (Halterman 2009, McNeil *et al.* 2013). These subsequent nests are sometimes hundreds of meters away from previous nests.

Cuckoos eat large insects (e.g., cicadas, caterpillars, katydids, grasshoppers, crickets, large beetles, dragonflies, and moth larvae) and small vertebrates (frogs and lizards) during nesting season (Laymon and Halterman 1985, Laymon *et al.* 1997, Halterman 2001, Halterman 2009, Griffin 2015). Minor prey at that site and other sites includes beetles, dragonflies, praying mantis, flies, spiders, butterflies, caddis flies, crickets, and cicadas (Laymon *et al.* 1997, Hughes 2015). In Arizona, cicadas are an important food source (Halterman 2009).

Habitat

Cuckoo breeding habitat across the DPS exists primarily in riparian woodlands along low-gradient streams broad floodplains and open riverine valleys that provide wide floodplain conditions. The general habitat characteristics are areas that are often greater than 325 feet wide, usually dominated by willow (*Salix* spp.) or cottonwood (*Populus* spp.) with above-average canopy closure (greater than 70 percent), and a cooler, more humid environment than the surrounding riparian and upland habitats. These areas contain the moist conditions that support riparian plant communities made up of overstory and understory components that provide breeding sites, shelter, cover, and food resources. In addition to cottonwood and willow, riparian vegetation may include tree species other than cottonwood and willow, including but not limited to boxelder (*Acer negundo*); ash (*Fraxinus* spp.); walnut (*Juglans* spp.); and sycamore (*Platanus* spp.) (Gaines 1974, Gaines and Laymon 1984, Groschupf 1987, Laymon and Halterman 1989, Corman and Magill 2000, Dettling and Howell 2011).

In parts of the southwestern United States and northwest Mexico, cuckoos breed along perennial, intermittent, and ephemeral drainages in montane canyons, foothills, desert floodplains, and arroyos below 6,000 feet elevation. Habitat often consists of narrow, patchy, and/or sparsely vegetated drainages surrounded by arid-adapted vegetation, with a greater proportion of xeroriparian and non-riparian tree species than elsewhere in the DPS.

Habitat may be less than 325 feet wide due to narrow canyons or limited water availability and may be less than 200 acres or more in size, consisting of a series of smaller tree and large shrub patches separated by openings. Canopy closure is variable, and where trees are sparsely scattered, it may be dense only at the nest tree or small grove including the nest tree. The North American Monsoon brings high humidity and rainfall to some of these habitats especially in the ephemeral drainages in southeastern Arizona where winters are mild and warm, wet summers are associated with the monsoon and other tropical weather events (Wallace *et al.* 2013, Erfani and Mitchell 2014). Humidity associated with monsoon rainfall correlates with summer vegetation green-up and insect production. In addition to the riparian trees found across the species' range, the vegetation making up the southwestern breeding habitat includes some other native and nonnative xeroriparian and non-riparian trees and large shrubs, such as, but not limited to: mesquite, hackberry (*Celtis reticulata* and *C. ehrenbergiana*), soapberry (*Sapindus saponaria*), oak (*Quercus* spp.), acacia (*Acacia* spp., *Senegalia greggi*), mimosa (*Mimosa* spp.), greythorn (*Ziziphus obtusifolia*), desert willow (*Chilopsis linearis*), juniper (*Juniperus* spp.), pine (*Pinus* spp.), alder (*Alnus rhombifolia* and *A. oblongifolia*), wolfberry (*Lycium* spp.), Russian olive (*Elaeagnus angustifolia*), and tamarisk (*Tamarix* spp.) (Groschupf 1987, Corman and Magill 2000, Villarreal *et al.* 2014, Griffin 2015, MacFarland and Horst 2015, MacFarland and Horst 2016, MacFarland and Horst 2017, Corson 2018, MacFarland and Horst 2019, Sferra *et al.* 2019).

Cuckoos have placed nests in many species of trees and shrubs including Fremont cottonwood, Goodding's willow (*Salix gooddingii*), red willow (*Salix laevigata*), coyote willow (*Salix exigua*), yew-leaf willow (*Salix taxifolia*), Arizona sycamore, mesquite, tamarisk, hackberry, boxelder, soapberry, Arizona walnut, acacia, ash, alder, seep willow (*Baccharis salicifolia*), oak, juniper, tamarisk, and in nonnative pecan (*Carya* sp.), English walnut (*Juglans regia*), prune (*Prunus domestica*), and almond (*Prunus dulcis*) (Laymon 1980, Kingsley 1985, Groschupf 1987, Laymon 1998, Corman and Magill 2000, Halterman 2001, Halterman 2002, Corman and Wise-Gervais 2005, Holmes *et al.* 2008, McNeil *et al.* 2013, Hughes 2015, MacFarland and Horst 2015, Sferra *et al.* 2019, Stanek *et al.* 2021).

Although tamarisk monocultures generally lack the structural diversity of native riparian habitat, cuckoos may use these areas for foraging, dispersal, and breeding, especially if sites retain some native trees. Tamarisk contributes cover, nesting substrate, temperature amelioration, increased humidity, and insect production where altered hydrology (*e.g.*, reduced flow or groundwater availability) and hydrologic processes (*e.g.*, flooding and sediment deposition) has compromised native habitat regeneration and survivability. Most occupied habitat with a tamarisk component is composed of at least 50 percent native habitat, but in parts of the cuckoo's range, some tamarisk-dominated sites have been used for nesting and foraging, including parts of the Bill Williams,Verde, Gila, Salt, and Rio Grande Rivers (Groschupf 1987, Corman and Magill 2000, Halterman 2001, Leenhouts *et al.* 2006, Sogge *et al.* 2008, Sechrist *et al.* 2009, Dockens and Ashbeck 2011a, b, Jarnevich *et al.* 2011, McNeil *et al.* 2013, USFWS 2014b, Dillon *et al.* 2018,

White *et al.* 2018, Parametrix, Inc. and Southern Sierra Research Station 2019). Thus, expansion of tamarisk defoliation by nonnative tamarisk leaf beetles (*Diorhabda* sp.) may lead to habitat degradation and may render areas unsuitable for occupancy by the cuckoo (Sogge *et al.* 2008).

Home range size is highly variable and may depend on habitat quality and availability. Average 95% Kernal Density Home Range estimates are typically over 49 acres, with individual estimates ranging from 3.7 to 534 acres (Halterman 2009, McNeil *et al.* 2013, Sechrist *et al.* 2013, Dillon and Moore 2020). Cuckoos are also highly mobile, with estimates of movements from the Middle Rio Grande in New Mexico from 669 to 11,014 feet within a single day, and 1,197 to 18,287feet within a season (Sechrist *et al.* 2012, Dillon and Moore 2020).

Rangewide Distribution

The cuckoo's rangewide territory estimates are near 1,300 (USFWS 2019b). Based on historical accounts, the cuckoo was formerly widespread and locally common in California and Arizona, more narrowly distributed but locally common in New Mexico, Oregon, and Washington, and uncommon along the western front of the Rocky Mountains north to British Columbia (American Ornithologists' Union 1998, Hughes 2015). The species may now be extirpated from British Colombia, Washington, and Oregon (Hughes 2015, USFWS 2021c), and rare in scattered drainages in western Colorado, Idaho, Nevada, and Utah, with single, nonbreeding birds most likely to occur (USFWS 2014b, 2020). The largest remaining core breeding populations occur in Arizona, along the Rio Grande in New Mexico, and in northwestern Mexico (USFWS 2020a, 2021c). Population declines continue to occur due to continuing and new threats to the western DPS (USFWS 2020a).

Arizona Distribution

There are an estimated 450 cuckoo breeding territories across Arizona (USFWS 2019b). The cuckoo was a common resident chiefly in the lower Sonoran zones of southern, central, and western Arizona (Phillips *et al.* 1964, Groschupf 1987). The cuckoo now nests primarily in the central and southern parts of the state. Populations in Arizona have declined in many perennial riparian areas from historical levels as well as over the past 35 years, with recent declines at some of the largest populations (*e.g.*, Bill Williams River). The San Pedro River supports the largest population of cuckoos in Arizona in an unregulated riparian system and one of the largest in the DPS. The Gila and lower Colorado rivers also contain large populations of western cuckoos in Arizona. Since listing, surveyors have documented cuckoos breeding in ephemeral and intermittent drainages with a mix of xeroriparian and non-riparian trees, indicating a broader range of habitats and geographic areas than previously known. Fewer than 10 territories are present within most drainages, but combined they make up a large amount of occupied habitat across the landscape. The cuckoo currently nests primarily in the central and southern parts of the state, as well as at revegetation sites along the lower Colorado River (Groschupf 1987, Corman and Magill 2000, Halterman 2009, McNeil *et al.* 2013, Griffin 2015, MacFarland and Horst 2015, MacFarland and Horst 2016, MacFarland and Horst 2017, Sferra *et al.* 2019, USFWS 2014b, 2021c).

Threats

The primary threat to the cuckoo is the loss and degradation of its habitat from altered watercourse hydrology and natural stream processes, livestock overgrazing, encroachment from agriculture, and resulting conversion of native habitat to predominantly nonnative vegetation. Habitat alteration and degradation leads to fragmented and isolated cuckoo breeding populations (USFWS 2014b). Additional threats to the species include the effects of climate change, drought, pesticides, wildfire, and fragmentation of suitable habitat patches (USFWS 2014b). In addition, minerals mining projects adversely affect occupied habitat by reducing streamflow and habitat and increasing disturbance (USFWS 2020a). The tamarisk leaf beetle *(Diorhabda* spp.) may potentially adversely affect occupied habitat by defoliating tamarisk to the extent that it no longer provides protective cover, temperature amelioration, or food (USFWS 2020a). Fatality from collisions with towers and other tall structures and mortality from solar power facilities is an ongoing and serious threat that needs further evaluation (Longcore and Gauthreaux 2005, Kagan *et al.* 2014).

Critical Habitat

Given the wide variety and extent of foraging habitat outside breeding habitat, and the large geographic areas in which cuckoos search for food, we did not designate foraging habitat as critical habitat. Based on our current knowledge of the habitat characteristics required to sustain the species' life-history processes including breeding and dispersing, we have determined that the specific physical or biological features (PBF) essential to the conservation of the cuckoo consist of the following three components:

1. Rangewide breeding habitat - Riparian woodlands across the DPS; *Southwestern breeding habitat*, primarily in Arizona and New Mexico: Drainages with varying combinations of riparian, xeroriparian, and/or non-riparian trees and large shrubs. This physical or biological feature includes breeding habitat found throughout the DPS range as well as additional breeding habitat characteristics unique to the Southwest.
    a. Rangewide breeding habitat (including areas in the Southwest) - Rangewide breeding habitat is composed of riparian woodlands within floodplains or in upland areas or terraces often greater than 325 feet in width and 200 acres or more in extent with an overstory and understory vegetation component in contiguous or nearly contiguous patches adjacent to intermittent or perennial watercourses. The slope of the watercourses is generally less than 3% but may be greater in some instances. Nesting sites within the habitat have an above-average canopy closure (greater than 70%), and have a cooler, more humid environment than the surrounding riparian and upland habitats. Rangewide breeding habitat is composed of varying combinations of riparian species including the following nest trees: cottonwood, willow, ash, sycamore, boxelder, alder, and walnut.
    b. Southwestern breeding habitat - Southwestern breeding habitat, found primarily in Arizona and New Mexico, is more variable than rangewide breeding habitat. Southwestern breeding habitat occurs within or along perennial, intermittent, and ephemeral drainages in montane canyons, foothills, desert floodplains, and arroyos. It may include woody side drainages, terraces, and hillsides immediately adjacent to the main drainage bottom. Drainages intersect a variety of habitat

types including, but not limited to, desert scrub, desert grassland, and Madrean evergreen woodlands (presence of oak). Southwestern breeding habitat is composed of varying combinations of riparian, xeroriparian, and/or non-riparian tree and large shrub species including, but not limited to, the following nest trees: cottonwood, willow, mesquite, ash, hackberry, sycamore, walnut, desert willow, soapberry, tamarisk, Russian olive, juniper, acacia, and/or oak. In perennial and intermittent drainages, Southwestern riparian breeding habitat is often narrower, patchier, and/or sparser than rangewide riparian breeding habitat and may contain a greater proportion of xeroriparian trees and large shrub species. Although some cottonwood and willow may be present in Southwestern riparian habitat, xeroriparian species may be more prevalent. Mesquite woodland may be present within the riparian floodplain, flanking the outer edges of wetter riparian habitat, or scattered on the adjacent hillsides. The more arid the drainage, the greater the likelihood that it will be dominated by xeroriparian and non-riparian nest tree species. Arid ephemeral drainages in southeastern Arizona receive summer humidity and rainfall from the North American Monsoon (PBF 3), with a pronounced green-up of grasses and forbs. These arid ephemeral drainages often contain xeroriparian species like hackberry or non-riparian species associated with the adjacent habitat type like oak, mesquite, acacia, mimosa, greythorn, and juniper. In southeastern Arizona's mountains, breeding habitat is typically below pine woodlands (~6,000 feet).

2. Adequate prey base - Presence of prey base consisting of large insect fauna (for example, cicadas, caterpillars, katydids, grasshoppers, large beetles, dragonflies, moth larvae, spiders), lizards, and frogs for adults and young in breeding areas during the nesting season and in post-breeding dispersal areas.
3. Hydrologic processes - The movement of water and sediment in natural or altered systems that maintains and regenerates breeding habitat. This physical or biological feature includes hydrologic processes found in rangewide breeding habitat as well as additional hydrologic processes unique to the Southwest in southwestern breeding habitat:
    a. Rangewide breeding habitat hydrologic processes (including the Southwest): Hydrologic processes (either natural or managed) in river and reservoir systems that encourage sediment movement and deposits and promote riparian tree seedling germination and plant growth, maintenance, health, and vigor (*e.g.*, lower-gradient streams and broad floodplains, elevated subsurface groundwater table, and perennial rivers and streams). In some areas where habitat restoration occurs, such as on terraced slopes above the floodplain, this may include managed irrigated systems that may not naturally flood due to their elevation above the floodplain.
    b. Southwestern breeding habitat hydrologic processes: In southwestern breeding habitat, elevated summer humidity and runoff resulting from seasonal water management practices or weather patterns and precipitation (typically from North American Monsoon or other tropical weather events) provide suitable conditions for prey species production and vegetation regeneration and growth. Elevated humidity is especially important in southeastern Arizona, where cuckoos breed in intermittent and ephemeral drainages.

Bald Eagle

Legal Status

The FWS listed the bald eagle south of the 40th parallel as endangered under the Endangered Species Act in 1978, reclassified it to threatened in 1995 (USFWS 1995b), and delisted the eagle in 2009 (USFWS 2007). FWS temporarily relisted the bald eagle in Arizona in 2008 to resolve whether the bird in the Sonoran Desert Area is a Distinct Population Segment (DPS). In 2010 and 2011, the FWS concluded the bald eagle was not a DPS in central Arizona and removed it from the list of threatened and endangered species (USFWS 2010a, 2011).

The bald eagle's primary Federal protection currently is the Bald and Golden Eagle Protection Act of 1940 (Eagle Act; 16 U.S.C. §§ 668-668d, 54 Stat. 250 as amended). We implement bald eagle incidental take permits under the Eagle Act and its governing regulations under 50 C.F.R. § 22.80.

Description

The bald eagle is a large bird of prey with a wingspan ranging from 6 to 8 feet that typically reaches its adult plumage at 4 to 5 years old (Stalmaster 1987). Adult bald eagles have a brown body, white head and tail, and yellow eyes, legs, feet, and beak (Stalmaster 1987). Nestling and juvenile bald eagles are various shades of brown all over with dark eyes and bills. As eagles reach sub-adult plumage, they will distinguish itself from a golden eagle, with white mottling on its head, chest, and wings, and cream-yellow un-feathered legs (Stalmaster 1987).

Habitat

The bald eagle occurs in association with aquatic ecosystems, frequenting estuaries, lakes, reservoirs, major rivers systems, and some seacoast habitats (Stalmaster 1987, USFWS 1995b). Generally, bald eagle habitat includes those areas which provide an adequate food base of fish, waterfowl, and/or carrion, with large trees (and cliffs in areas like Arizona or coastal Alaska) for perches and nest sites (USFWS 1995b). In winter, bald eagles often expand their occurrence across the landscape, and can congregate at specific wintering sites that are generally close to open water and offer good perch trees and night roosts (USFWS 1995b).

Diet

Bald eagles typically focus on eating fish, but will commonly supplement its diet with waterfowl, small mammals, and carrion (USFWS 1995b). In Arizona, bald eagles nesting on central Arizona streams typically target suckers, catfish, and carp, while at lakes eat dead and dying sportfish and hunt live waterfowl and other aquatic birds (Hunt *et al.* 1992).

Rangewide Status

The FWS (2020b) estimated 316,700 bald eagles were present in the Pacific North, Central, Mississippi, and Atlantic Flyway Ecological Management Units in the 2019 breeding season, 4.4 times more eagles than in 2009. This indicates the bald eagle population has continued to increase rapidly since delisting and the previous survey. The FWS's model better incorporated

floaters, juveniles, and subadults into estimates of overall population size, which they could not do effectively with the previous efforts, and this also contributed to the increase.

Arizona Status

In Arizona, the bald eagle nesting populations has increased and expanded, currently occurring primarily along major rivers and lakes in the central, western, and central-eastern parts of the state (McCarty *et al.* 2022). Arizona's nesting population has grown from just under 30 territories in the late 1980s (Hunt *et al.* 1992) to 95 territories in 2022 (McCarty *et al.* 2022). From the 1970s through the mid-1990s, Arizona bald eagle nests were primarily located along the central Sonoran Desert's Gila, Verde, Salt, and Bill Williams river drainages below about 4,000 feet in elevation (Hunt *et al.* 1992). Since, bald eagles began to nest more frequently at lakes at higher elevations near Prescott, Flagstaff, and east across the Mogollon Rim and White Mountains (McCarty *et al.* 2022). Bald eagles now nest from about 500 feet elevation amsl along the lower Colorado River to about 8,000 feet in elevation amsl at Luna Lake in eastern Arizona. Recently, a few bald eagle pairs have established nests in more urban locations in Maricopa County, targeting agricultural fields, urban lakes, and golf courses for food and nesting sites (McCarty *et al.* 2022).

Threats

Even though the bald eagle has been delisted, threats to bald eagles in Arizona occur from a variety of factors (Driscoll *et al.* 2006). Federal and State agencies, Tribes, industry, and non-governmental organizations collaborate regarding ongoing management and monitoring through the Southwestern Bald Eagle Management Committee (SWBEMC) and AGFD's Conservation Assessment and Strategy (Driscoll *et al.* 2006) and associated Memorandum of Understanding. AGFD is the SWBEMC chair and coordinates bald eagle management with cooperators. Threats persist in Arizona largely due to the proximity of bald eagle breeding areas to major human population centers, recreation areas, and managed rivers/lakes. Because water is a scarce resource in the Southwest, recreation and human disturbance is often concentrated along lakes and water courses. Eagles have expanded into developed areas and development is expanding into rural and more undeveloped areas. Large riparian trees for nesting, foraging, and cover continue to be affected by vegetation clearing, groundwater pumping, stream diversion, dam operations, livestock grazing, recreation, and other various factors (Driscoll *et al.* 2006). Some of the continuing threats to bald eagles include monofilament fishing line and tackle entanglement; nonnative fish predation of native fish; malicious and accidental harassment; low-level aircraft overflights; transmission line and vehicles collision; wind power development; poisoning; heavy metal contaminants; nest parasites; and electrocution (Stalmaster 1987, Hunt *et al.* 1992, Driscoll *et al.* 2006, McCarty *et al.* 2022).

Spikedace

Listing

The FWS originally listed the spikedace (*Meda fulgida*) as a threatened species on July 1, 1986 (51 FR 23769) and it was reclassified to endangered status, with designated critical habitat on February 23, 2012 (77 FR 10810). We completed a spikedace recovery plan in 1991 (USFWS 1991) and a revision is underway.

Description

Spikedace is a small, silvery fish whose common name alludes to the well-developed spine in the dorsal fin (Minckley 1973). Spikedace are omnivores that feed primarily upon insects transported in stream drift. They have specific preferences, depending on season and location, for members of the families Baetidae (mayflies) and Simulidae (black flies) and/or Chironomidae (midges) and Hydropsychidae (Anderson 1978, Schreiber and Minckley 1981, Barber and Minckley 1983, Propst *et al*. 1986). There is both spatial and temporal variation associated in their diets due to resource availability.

Taxonomic and genetic work on spikedace indicates there are substantial differences in morphology and genetic makeup between remnant spikedace populations. Remnant populations occupy fragmented stream segments in the Gila River basin and are isolated from each other. Anderson and Hendrickson (1994) found that spikedace from Aravaipa Creek are morphologically distinguishable from spikedace from the Verde River, while spikedace from the upper Gila River and Eagle Creek have intermediate measurements and partially overlap the Aravaipa and Verde populations. Mitochondrial DNA and allozyme analyses have found similar patterns of geographic variation within the species (Tibbets 1992, Tibbets 1993).

Life History

Spikedace eggs are approximately 0.08 inches in diameter upon release and protolarvae are about 0.20 inches total length on hatching. After hatching, individuals grow rapidly during the summer, obtaining 1.4 to 1.6 inches standard length by November. Spikedace spawns from March through May with some yearly and geographic variation (Barber *et al*. 1970, Anderson 1978, Propst *et al*. 1986). Spawning behavior and captive studies indicate spikedace lay eggs over gravel and cobble where they adhere to the substrate.

Spikedace live about two years in the wild, with reproduction occurring primarily in one-year old fish (Barber *et al*. 1970, Anderson 1978, Propst *et al*. 1986). They feed primarily on aquatic and terrestrial insects (Schreiber 1978, Barber and Minckley 1983, Marsh *et al*. 1989). We provide additional details on habitat preferences in the 2012 critical habitat designation (77 FR 10810).

Habitat

Spikedace live in flowing water with slow to moderate velocities over sand, gravel, and cobble substrates (Propst *et al*. 1986, Rinne and Kroeger 1988). Specific habitat for this species consists of shear zones where rapid flow borders slower flow, areas of sheet flow at the upper ends of mid-channel sand/gravel bars, and eddies at the downstream riffle edges (Propst *et al*. 1986). Juveniles occur in quiet areas along pool edges over finer-grained substrate. Specific habitat can vary seasonally, among streams and ontogenetically (Anderson 1978, Rinne 1985 and 1991, Propst *et al.* 1986).

Diet

Spikedace are omnivores that feed primarily upon insects transported in stream drift. They have specific preferences, depending on season and location, for members of the families Baetidae (mayflies) and Simulidae (black flies) and/or Chironomidae (midges) and Hydropsychidae (Anderson 1978, Schreiber and Minckley 1981, Barber and Minckley 1983, Propst *et al.* 1986).

There is both spatial and temporal variation associated in their diets due to resource availability. Other foods, including larval fishes and Culicidae (midge-like flies), are occasionally eaten but are minor components of the diet. Adults and larval individuals are opportunistic with smaller, post-larval spikedace consuming a variety of small, soft-bodied animals and adults feeding primarily on drifting invertebrates.

Distribution

Spikedace were once common throughout much of the Gila River basin, including the mainstem Gila River upstream of Phoenix, and the Verde, Agua Fria, Salt, San Pedro, and San Francisco subbasins. Habitat destruction and competition and predation by nonnative aquatic species reduced their range and abundance (Miller 1961, Lachner *et al*. 1970, Ono *et al*. 1983, Moyle 1986, Moyle *et al.* 1986, Propst *et al*. 1986). Spikedace are now restricted to 10 to 15% of their historical range, and are restricted to:

1. portions of the upper Gila River (Grant, Catron, and Hidalgo Counties, New Mexico);
2. Aravaipa Creek (Graham and Pinal Counties, Arizona);
3. Eagle Creek (Graham and Greenlee Counties, Arizona); and
4. the Verde River (Yavapai County, Arizona) (Marsh *et al.* 1990, M. Brouder pers. comm. 2002, Stefferud and Reinthal 2005, Paroz *et al*. 2006, Propst 2007).

Managing agencies have recently translocated spikedace to additional streams as part of recovery efforts for the species. Translocation efforts include Hot Springs and Redfield canyons, in Cochise County and Pima counties, Arizona (2007); Fossil Creek in Gila County, Arizona (2007); Bonita Creek in Graham County, Arizona (2008), the upper San Francisco River in Catron County, New Mexico (2011), and the Blue River, Greenlee County (2012). Efforts to establish spikedace in Hot Springs and Redfield canyons were not successful, nor were efforts at Bonita Creek to date. Agencies established spikedace in Fossil Creek and the Blue River (Robinson *et al*. 2014, T. Robinson, AGFD, pers. comm. 2017, Hickerson *et al.* 2021, Shollenberger *et al*. 2021). Monitoring through traditional means and with the use of eDNA detected spikedace in the San Francisco River in 2017 and in 2020 (Shollenberger *et al*. 2021). Monitoring, and potentially augmentation of spikedace, in the San Francisco River will continue; however, insufficient time has elapsed to determine if the translocation effort will ultimately be successful and result in establishment of a new population of spikedace in the San Francisco River in New Mexico.

Spikedace is now common only in Aravaipa Creek in Arizona (ASU 2002, Reinthal 2022) and one section of the Gila River south of Cliff, New Mexico (NMDGF 2008, Propst *et al.* 2009). We presume spikedace occupy the upper Verde River; however, the last captured fish from this river was from a 1999 survey (M. Brouder, pers. comm. 2002). Similarly, Eagle Creek is presumed occupied; however, the last captured spikedace from the Eagle Creek population was in 1989 (Marsh 1996).

Threats

Primary threats to spikedace include habitat alteration and destruction, introduction and spread of nonnative species, wildfire, and drought and climate change.

Within the historical range of spikedace, groundwater withdrawals, surface water diversions, and construction of impoundments have converted large portions of flowing streams into intermittent streams, large reservoirs, or dewatered channels, and eliminated suitable spikedace habitat in impacted areas (Propst *et al*. 1986, Tellman *et al*. 1997). Removal of groundwater in hydrologically connected areas can change the long-term average rates of inflow to and outflow from aquifer systems through time which directly affects the presence of surface water (Barlow and Leake 2012, USGS 2010, 2013). Groundwater also is important for sustaining streamflow between storms and during drier periods of the year (Barlow and Leake 2012). Water diversions directly affect water availability by removing all or a portion of available streamflow, while almost any dam may prevent movements of fish between populations. Larger dams dramatically alter flow regimes and water quality through water impoundment (Ligon *et al*. 1995). Maintenance or reconstruction of diversions can result in habitat damages and inputs of sediment into the active channel.

Impacts to spikedace from recreation can occur from movement of people, vehicles, and horses or mules along streambanks, trampling, soil compaction and erosion, loss of vegetation, water quality issues, and increased danger of fire (NAU 2005, Monz *et al*. 2010). In the arid Gila River Basin, recreational impacts disproportionately occur along streams (Briggs 1996). Overuse through camping and other recreational activities can lead to decreased riparian vegetation (USFS 2008) and subsequent increases in stream temperatures, as well as soil compaction and vegetation loss, which in turn can lead to increased runoff and sedimentation in waterways (Monz *et al*. 2010, Andereck 1993).

Livestock grazing has been one of the most widespread and long-term causes of adverse impacts to native fishes and their habitat (Miller 1961, Platts 1990). Improper livestock grazing can destabilize stream channels, disturb riparian ecosystem functions, and contribute to nutrient loading in streams (Platts 1990, Armour *et al*. 1991, Tellman *et al*. 1997, Wyman *et al*. 2006, Brown and Froemke 2012). Excessive grazing can reduce or eliminate riparian vegetation that affects fish habitat by increasing stream temperatures and sedimentation, eroding soils, and degrading water quality (Armour *et al*. 1991). Federal land managers have reduced effects from livestock grazing in the last 20 years due to improved management (USFWS 1997c) and discontinuation of grazing in many riparian and stream corridors.

In the Gila River basin, introduction of nonnative species is the primary factor in the decline of native fish species (Minckley 1985, Williams *et al.* 1985, Minckley and Deacon 1991, Douglas *et al*. 1994, Rinne and Stefferud 1997, Bonar *et al*. 2004, Rinne 2004, Clarkson *et al*. 2005, Olden and Poff 2005, Minckley and Marsh 2009). Nonnative fishes that co-occur are a major source of concern for spikedace. Ictalurid and Ameiurid catfishes are likely to interact strongly with natives, and there is direct evidence of native fish predation by nonnatives (Propst *et al*. 1986, Bonar *et al*. 2004). Channel catfish and yellow bullhead tend to be benthic omnivores, but flathead catfish are piscivorous and have had a major impact via predation throughout the historic range of spikedace (Pilger *et al*. 2010). Channel catfish of all sizes move onto riffles to feed, often on the same animals most important in the diets of spikedace, and juvenile flathead catfish also feed in riffles at night.

Nonnative channel catfish, flathead catfish, and smallmouth bass all prey on spikedace, as indicated by prey remains of native fishes in the stomachs of these species (Propst *et al*. 1986, Propst *et al*. 1988, Bonar *et al.* 2004). Smallmouth bass co-occur with spikedace and are documented predators (USFWS 1991, Paroz *et al*. 2009). When smallmouth bass densities increased on the East Fork Gila River, densities of native fishes decreased (Stefferud *et al*. 2011). Green sunfish are also thought to be a predator, likely responsible for replacement of native species like spikedace and loach minnow. While there are no direct studies on predation by green sunfish on spikedace or loach minnow, they are a known predator of fish that size, and they occur within areas occupied by these species.

Declines of native fish species appear linked to increases in nonnative fish species. In 1949, for example, biologists collected 52 spikedace at Red Rock on the Gila River, while channel catfish composed only 1.65% of the 607 fish collected. However, in 1977, only 6 spikedace were located at the same site, and the percentage of channel catfish had risen to 14.5% of 169 fish collected. The decline of spikedace and the increase of channel catfish is likely related (Anderson 1978). Similarly, biologists observed interactions between native and nonnative fishes in the upper reaches of the East Fork of the Gila River. Prior to the 1983 and 1984 floods in the Gila River system, native fish were limited, with spikedace being rare or absent, while nonnative channel catfish and smallmouth bass were moderately common. After the 1983 flooding, adult nonnative predators were generally absent, and spikedace were collected in moderate numbers in 1985 (Propst *et al.* 1986).

The majority of areas considered occupied by spikedace have seen a shift from a predominance of native fishes to a predominance of nonnative fishes. On the upper Verde River native fish species dominated the total fish community at greater than 80% from 1994 to 1996, before dropping to approximately 20% in 1997 and 19% in 2001. At the same time, three nonnative species increased in abundance between 1994 and 2000 (Rinne *et al*. 2005). Similar changes in the dominance of nonnative fishes have occurred on the Middle Fork Gila River, with a 65% decline of native fishes between 1988 and 2001 (Propst 2002). In other areas, nonnative fishes may not dominate the system, but their abundance has increased, while spikedace abundance has declined, as is the case for the Cliff-Gila Valley area of the Gila River (Propst *et al*. 1986), the Redrock and Virden valleys on the Gila River (Propst *et al*. 1986), and the East Fork Gila River (Propst 2005). Nonnative fishes are a management issue in other areas including Eagle Creek, the San Pedro River, West Fork Gila River, and to a lesser extent on the Blue River and Aravaipa Creek. Generally, when the species composition of a community shifts in favor of nonnative fishes, a decline in spikedace abundance occurs (Olden and Poff 2005). The effects of nonnative fishes often occur with, or are exacerbated by, changes in flow regimes or declines in habitat conditions and should be considered against the backdrop of historical habitat degradation that has occurred over time (Minckley and Meffe 1987, Rinne 1991).

Nonnative channel catfish, flathead catfish, and smallmouth bass are present in most spikedace habitats, including the Verde River (Minckley 1993, Jahrke and Clark 1999, Rinne 2004, Bahm and Robinson 2009a, Robinson and Crowder 2009), the Gila River (Propst *et al*. 1986, Springer 1995, Jakle 1995, Propst *et al*. 2009); the San Pedro River (Jakle 1992, Minckley 1987); the San Francisco River (Papoulias et al. 1989, Propst *et al.* 2009); the Blue River (ASU 1994 and 1995,

Clarkson *et al.* 2008); Forks of the Gila River (Paroz *et al*. 2009, Propst *et al.* 2009) and Eagle Creek (Marsh *et al*. 2003, ASU 2008, Bahm and Robinson 2009b).

Nonnative fishes known to occur within the historical range of spikedace include channel catfish, flathead catfish, red shiner, fathead minnow, green sunfish, largemouth bass, smallmouth bass, rainbow trout, western mosquitofish, carp, warmouth, bluegill, yellow bullhead, black bullhead, and goldfish (Miller 1961, Nico and Fuller 1999, Clark 2001, Bahm and Robinson 2009b). The aquatic ecosystem of the central Gila River basin has relatively small streams with warmwater and low gradients, and many of the native aquatic species are small. In these areas, small, nonnative fish species pose a threat to spikedace (Deacon *et al.* 1964). Examples of this are the impacts of mosquitofish and red shiner, which may compete with, or predate upon, native fish in the Gila River basin (Meffe 1985, Douglas *et al*. 1994).

Negative interactions also occur between small native and large nonnative individuals. On the East and Middle Forks of the Gila River, where large nonnative predators were comparatively common, small native species were uncommon or absent. Conversely, on the West Fork Gila River, when large nonnative predators were rare, most small-bodied and young of large-bodied native fishes persisted (Stefferud *et al.* 2011). For spikedace and loach minnow, every habitat that land managers have not renovated or protected by barriers has at least six nonnative fish species present, at varying levels of occupation.

Several of the nonnative species now in spikedace habitat arrived since its listing, such as red shiner in Aravaipa Creek (Stefferud and Reinthal 2005). Nonnative red shiners compete with spikedace for suitable habitats, as the two species occupy essentially the same habitat types. The red shiner has an inverse distribution pattern in Arizona to spikedace (Minckley 1973). Where the two species occur together, there is evidence of displacement of spikedace to less suitable habitats than previously occupied (Marsh *et al.* 1989). As a result, if red shiners are present, they reduce spikedace habitat quality. In addition, the introduction of red shiner and the decline of spikedace have occurred simultaneously (Minckley and Deacon 1968, Douglas *et al.* 1994).

Following 1980, biologists regularly collected red shiner, fathead minnow, channel catfish, and western mosquitofish within the range of spikedace. Mosquitofish may negatively affect populations of small fishes through predation and competition (Courtenay and Meffe 1989). Nonnative crayfish have also invaded occupied spikedace habitats (Taylor *et al*. 1996, Robinson and Crowder 2009, USGS 2009). Crayfish are known to eat fish eggs, especially those bound to the substrate (Dorn and Mittelbach 2004), as is the case for spikedace. Additionally, crayfish cause decreases in macroinvertebrates, amphibians, and fishes (Hanson *et al.* 1990, Lodge *et al*. 2000).

Wildfires affect streams and fish in a variety of ways. A number of rivers and streams that contain suitable habitat for spikedace originate within or flow through areas that fire has affected, such as the Gila, San Francisco, Blue, and Verde Rivers, and Eagle Creek.

Drought

Drought can cause more pronounced effects due to their combination with reduced habitat suitability from other effects, as described above. Drought can eliminate streamflow, or result in

lower streamflow, and consequently can elevate water temperatures beyond the species' upper tolerance limits. Drought also can cause crowding as surface waters shrink, which in turn can result in more crowded habitats with higher levels of predation or competition. In other areas, drought reduces flooding that would normally rejuvenate habitat and reduce populations of some nonnative species that are less adapted to the relatively large floods of southwestern streams (Minckley and Meffe 1987, Stefferud and Rinne 1996). Drought conditions may have a more severe impact on spikedace than in the past due to their current fragmented distribution. Small, fragmented spikedace populations are less likely to recolonize areas, compared to when it was more widely distributed. Nonnative species, habitat alteration, or lack of genetic diversity may also compromise the spikedace's ability to rebound from these conditions.

Critical Habitat

The spikedace critical habitat designation includes eight units based on river sub-basins, including the Verde River, Salt River, San Pedro, Bonita Creek, Eagle Creek, San Francisco River, Blue River, and Gila River sub-basins.

PCEs include those habitat features required for the physiological, behavioral, and ecological needs of the species. The PCEs describe appropriate flow regimes, velocities, and depths; stream microhabitats; stream gradients; water temperatures; and acceptable pollutant and nonnative species levels (77 FR 10810).

Spikedace PCEs include:

1. PCE 1: Habitat to support all egg, larval, juvenile, and adult spikedace, which includes:
   a. Perennial flows with a stream depth generally less than 3.3 feet, and with slow to swift flow velocities between 1.9 and 31.5 inches/second;
   b. Appropriate stream microhabitat types including glides, runs, riffles, and the margins of pools and eddies, and backwater components over sand, gravel, and cobble substrates with low or moderate amounts of fine sediment and substrate embeddedness;
   c. Appropriate stream habitat with a low gradient of less than approximately 1%, at elevations below 6,890 feet; and
   d. Water temperatures in the general range of 46.4 to 82.4°F;
2. PCE 2: An abundant aquatic insect food base consisting of mayflies, true flies, black flies, caddisflies, stoneflies, and dragonflies;
3. PCE 3: Streams with no or no more than low levels of pollutants;
4. PCE 4: Perennial flows, or interrupted stream courses that are periodically dewatered but that serve as connective corridors between occupied or seasonally occupied habitat and through which the species may move when the habitat is wetted;
5. PCE 5: No nonnative aquatic species or levels of nonnative aquatic species that are sufficiently low as to allow persistence of spikedace; and
6. PCE 6: Streams with a natural, unregulated flow regime that allows for periodic flooding or, if flows are modified or regulated, a flow regime that allows for adequate river functions, such as flows capable of transporting sediments.

Previous Consultations

Our information indicates that, rangewide, the FWS has completed more than 1,100 formal, informal, and technical assistance consultations for actions potentially affecting spikedace as of

spring 2021. Most of these opinions concerned the effects of road and bridge construction and maintenance, grazing, water developments, fire, species control efforts, or recreation. Small numbers of projects occur for timber, land acquisition, agriculture, sportfish stocking, flooding, Habitat Conservation Planning, native fish restoration efforts, alternative energy development, and mining.

ENVIRONMENTAL BASELINE

The environmental baseline includes past and present impacts of all Federal, State, or private actions in the action area, the anticipated impacts of all proposed Federal actions in the action area that have undergone formal or early section 7 consultation, and the impact of State and private actions that are contemporaneous with the consultation process. The environmental baseline defines the current status of the species and its habitat in the action area to provide a platform to assess the effects of the action now under consultation.

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

Roosevelt Dam

Water was first stored in Roosevelt Lake in 1910, and USBR completed constructing the original Roosevelt Dam in 1911 (CS at 2,136 feet amsl). In an agreement with the Salt River Valley Water Users' Association (Association) dated September 6, 1917 (the 1917 contract), the United States turned over to and vested in the Association the authority to care for, operate, and maintain SRP facilities, of which Roosevelt Dam is an integral component. SRP operates Roosevelt Dam, including subsequent modifications to the dam, pursuant to the 1917 contract and subsequent agreements with the United States. Roosevelt Dam captures water from the Salt River and Tonto Creek watersheds.

Modified Roosevelt Dam

From 1989 through early 1996, USBR modified Roosevelt Dam for additional conservation storage capacity (2,151 feet amsl), flood control, and concerns under the Reclamation Safety of Dams Act of 1978 (Figure 1). SRP optimizes Modified Roosevelt Dam and Lake operations consistent with its original purpose as a water storage and power generation facility.

SRP operates Modified Roosevelt in accordance with the 1917 contract between SRP and the United States, and the 1993 Modified Roosevelt Dam Operating Agreement among SRP, USBR, Flood Control District of Maricopa County, and various Arizona cities. Federal agencies completed numerous evaluations, including FWS biological opinions to address the development

of Modified Roosevelt Dam, described in the original RHCP (ERO 2002) and RHCP amendment (SWCA 2023a).

Modified Roosevelt Dam Conservation Storage

SRP's RHCP (ERO 2002), USBR (1989, 1992, 1996), and FWS (USFWS 1990, 1993, 1996, 2002b, 2003) addressed Roosevelt Dam's modification, construction, and ongoing conservation storage operations effects to listed species. SRP's RHCP (ERO 2002) addressed conservation storage effects to the flycatcher, cuckoo, rail, and bald eagle. SRP has implemented the RHCP, completing annual reports (SRP 2003-2022). SRP's RHCP reports typically describe implementation, such as Modified Roosevelt Dam operations, annual effects to covered species, permit compliance, Rockhouse Farm development and management, San Pedro and Verde River mitigation property management, and covered species survey results.

SRP's water conservation storage activities change water elevation within Roosevelt Lake, causing the lake to continuously rise and fall (Figure 2). SRP typically collects water between November and April and delivers water between May and October. The lake elevation's most variation in timing and magnitude occurs during April and May. Roosevelt Lake levels can start declining as early as March, following a dry winter, or continue to rise into May, following a wet winter. Rising water levels are primarily associated with snowmelt and rainfall. Declining water levels are primarily associated with water delivery and evaporation.

Roosevelt Lake's typical daily elevation changes are small (0.2 vertical foot per day; 25 feet horizontal per day or about 1 horizontal foot per hour) but can accumulate over time. Over several months, small daily changes can result in a moderate change of 20 to 30 vertical feet (equating to 3,000 to 4,500 horizontal feet of lake edge movement).

SRP estimates that greater magnitude changes to Roosevelt Lake's water level (exceeding 30 vertical feet) occurs every 7 to 8 years. Atypical water elevation changes generally occur across several months within a calendar year.

In rare instances (about every 18 to 19 years), Roosevelt Lake's water elevation may undergo an extreme elevation change (exceeding 40 feet), due to exceptional precipitation. Most extreme changes are the result of accumulated changes that take place over 4 to 10 months, though in some cases large increases can occur in just 1 to 2 months. Major weather events tend to occur when the lake is exceptionally low (*i.e.*, less than 2,100 feet amsl) or exceptionally high (*i.e.*, 2,151 feet amsl).

Modified Roosevelt Dam Normal Flood Control Operations

Flood control operations were included in USBR's (1989, 1996) evaluation and our biological opinion for Modified Roosevelt Dam (USFWS 1990,1996), concluding that it would not incidentally take listed species. FCS operations are short duration (20 days) and typically occur during normal winter and early spring flooding. Since Modified Roosevelt Dam's completion, water has entered the FCS 3 times; twice no more than about 12 inches and once about 4 feet in 2023. SRP did not include the FCS and FCS operations in their original RHCP (ERO 2002).

When water levels in Roosevelt Lake rise within the CS and water physically occupies the FCS, SRP operates the Salt River reservoir system under "spill conditions" (see description below), as described in the Modified Roosevelt Operating Agreement. The Modified Roosevelt Dam Operating Agreement minimizes water past Granite Reef Diversion Dam and downstream flood damage from the Salt and Verde rivers. During spill conditions, water may or may not physically move past or over Granite Reef Diversion Dam or from spillways on the Salt River dams, depending on whether inflows on the Verde River and the lower Salt River Reservoirs (Saguaro Lake, Canyon Lake, and Apache Lake) exceed available storage and SRP deliveries at Granite Reef Diversion Dam. SRP anticipates, due to their climate change model (see below), increased future use of the FCS compared to the past.

Climate Change and Reservoir Planning Model

Warming of the earth's climate is unequivocal, as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of glaciers and the polar ice cap, and rising sea level (IPCC 2007, 2014). The IPCC (2007) describes changes in natural ecosystems with potential widespread effects on many organisms. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species abundance and distribution is dynamic, and dependent on a variety of factors, including climate (Parmesan and Galbraith 2004). Typically, as climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities.

The Southwest is the hottest and driest region in the U.S. (Garfin *et al.* 2014). The IPCC (2007) stated that there would be an increase in the frequency of hot extremes, heat waves, and heavy precipitation events. Climate forecasts predict a northward shift in the jet stream and winter-spring storm tracks, which are consistent with observed trends over recent decades (Trenberth 2007). This would result in future drier conditions for the Southwest and an increasing probability of drought for the region (Trenberth 2007). Seager *et al.* (2007) show that there is a broad consensus among climate models that the Southwest will get drier in the 21st century and that the transition to a more arid climate is already under way. Only one of 19 models showed a trend toward a wetter climate in the Southwest (Seager *et al.* 2007).

The following are the future effects of climate change in Arizona and the Southwest (Frankson *et al.* 2017):

1. Average annual temperature has increased by almost 1.1 degree Celsius (2 degrees Fahrenheit) since the 1970s, and the number of hot days and warm nights has increased. Historically unprecedented future warming is likely.

2. The summer monsoon rainfall, which provides much needed water for agricultural and ecological systems, varies from year to year and future trends in such precipitation are highly uncertain.

3. Droughts are a serious threat in this water-scarce state. Experts predict that drought intensity will increase, and snowpack accumulation will decrease, which will pose a major challenge to environmental, agricultural, and human systems. Models project that wildfire frequency and severity will increase in Arizona.

Changes associated with climate change to riparian areas and aquatic habitats present some of the most important challenges for federally listed aquatic species within the action area. Predicted climate change effects include reduced precipitation and increased water losses from elevated evapotranspiration rates (Cayan *et al*. 2010, Easterling *et al.* 2017); altered flow regimes and increases in drought severity during summer low flows (Jaeger *et al.* 2014); and, increasing water temperatures in small streams that further limit habitat during seasonal low flows (Jaeger *et al.* 2014).

Key climate change factors affecting the entire action include increases in the frequency of extreme weather events and landscape level, high-intensity wildfire. Climate-induced changes to forest, riparian, and aquatic systems will continue to threaten listed species within the project area (Hagman *et al.* 2021).

SRP used the Reservoir Planning Model to simulate reservoir storage and water that is not diverted at Granite Reef Diversion Dam and moves downstream (*i.e*., spill water) using historical hydrologic records of the Salt and Verde Rivers from 1914 to 2019. SRP adjusted the record for expected climate change effects on hydrology to develop the elevations, durations, and timing considered for the proposed planned deviation while optimizing beneficial use of spill waters. Using the climate change–adjusted hydrology, the Reservoir Planning Model estimated reservoir inflows, storage levels, elevations, releases, and spills based on existing dam infrastructure and operational rules in place as of 2021 and a current system demand of 750,000 acre-feet per year.

The Salt River watershed follows a typical long-term oscillation pattern from wet periods (above median runoff) to dry periods (below median runoff) every 20 to 25 years. Water entering the FCS is more common during wet periods and less frequent during dry periods. SRP used the modeled reservoir inflows, reservoir releases (for delivery and spill), and water accruals to further develop the proposed planned deviation. SRP has not previously sought planned deviation authorization for Modified Roosevelt Dam. Robles *et al.* (2021) anticipates climate change will influence water resources in the arid West, though the Salt River Basin has been relatively resilient to changes in annual streamflow. Winter precipitation input to streamflow offset snow loss in the Salt River Basin (Robles *et al.* 2021).

Roosevelt Lake Fish and Stocking

Modified Roosevelt Dam and SRP's conservation storage operations creates lake conditions supporting the persistence of 19 nonnative predatory fish species: largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieu*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), redear sunfish (*Lepomis microlophus*), yellow bass (*Morone mississippiensis*), channel catfish (*Ictalurus punctatus*), flathead catfish (*Pylodictis olivaris*), yellow bullhead (*Ameiurus natalis*), black bullhead (*Ameiurus melas*), threadfin shad (*Dorosoma petenense*), gizzard shad (*Dorosoma cepedianum*), bigmouth buffalo (*Ictiobus cyprinellus*), smallmouth buffalo (*Ictiobus bubalus*), black buffalo

(*Ictiobus niger*), common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), and red shiner (*Cyprinella lutrensis*). The U.S. Bureau of Sport Fisheries and AGFD began stocking fish at Roosevelt Lake in the 1930s and 1940s.

AGFD stocked the first 11 sport fishes described above, which are predaceous on a variety of aquatic and semi-aquatic organisms. The above-listed 19 fish species are not native to the Salt River or to the Colorado River Basin. Each fish was either part of an AGFD sport fishing program introduction, or anglers introduced them as bait fish, forage, or sport fish (AGFD 2019). AGFD periodically stocks nonnative rainbow trout (*Oncorhynchus mykiss*) as a put and take fishery. The only remaining native fish in Roosevelt Lake is the riverine Sonora sucker (*Catostomus insignis*), occurring in Tonto Creek and the lake inflow, but generally not in the lake proper.

Starting in about 2008, the AGFD reported a decline in the abundance and quality of largemouth bass and two other sport fish at Roosevelt Lake (AGFD 2019). AGFD explained the fishery decline was possibly due to several complex factors, such as the recent appearance and expansion of gizzard shad, ongoing water level fluctuations, water quality, diseases, and a lack of habitat and productivity from an aging reservoir.

In 2011 (USFWS 2011), and most recently in 2021 (USFWS 2021d), AGFD included Roosevelt Lake into its statewide 10-year plans to stock the lake with largemouth bass, bluegill, and black crappie. AGFD proposed to stock over 4.8 million largemouth bass (including the Florida strain of largemouth bass), bluegill, and black crappie annually into Roosevelt Lake, including fry, fingerling, sub-catchable, and catchable sizes (USFWS 2021d). AGFD receives funding under the Dingell-Johnson Sport Fish Restoration Act through FWS's Division of Wildlife and Sportfish Restoration (USFWS 2021d).

AGFD's purpose for stocking Florida strain largemouth bass at Roosevelt Lake is to alter the population, promoting higher growth rates, larger fish, and increased predation of gizzard shad (USFWS 2021d). AGFD recorded gizzard shad in Roosevelt Lake in 2007, and by 2008, it was the second most abundant fish in Roosevelt Lake surveys (AGFD 2019). The Florida strain bass can grow to a larger size than the northern strain (Bailey and Hubbs 1949), with fish up to 20 pounds, and 10- to 15-pound fish being common. AGFD's stocking of bluegill and black crappie supplements poor natural reproduction and recruitment believed to be a result of the abundant gizzard shad. Gizzard shad and young-of-year largemouth bass, bluegill, and black crappie compete for zooplankton. AGFD hopes the Florida largemouth bass strain will control gizzard shad, because this shad grows rapidly and exceeds the mouth gape size of northern largemouth bass and most other predators presently in Roosevelt Lake.

AGFD's gartersnake conservation measures included in our 2021 sportfish stocking biological opinion, include nonnative predatory fish suppression in lower Tonto Creek pools if AGFD stocks sportfish into the lake (USFWS 2021d). AGFD will remove all predatory nonnative fish in two of the larger pools in lower Tonto Creek between Gisela and Roosevelt Lake (in coordination with SRP) in any year AGFD stocks sportfish at Roosevelt Lake.

Tonto Creek, Flows, and Fish

A primary difference between the two lower Tonto Creek sections included in the project for conservation and mitigation is stream flow and proximity to Roosevelt Lake. The Gisela Reach of lower Tonto Creek is perennial and the lowest section near Roosevelt Lake intermittent. Additionally, Roosevelt Lake influences the fishery on lower Tonto Creek due to proximity, periodic connectivity, and lack of barriers, and those largely cease due to culverts at East Del Chi Drive.

Gisela Reach

Lower Tonto Creek from the Town of Gisela downstream to near the Rye Creek confluence is perennial, consisting of riffles, runs, and pools, with native cottonwood, willow, and mesquite plant species lining the stream (Figure 17). Common fish species included sucker species, carp, and channel catfish (Hunt *et al.* 1992). Aside from the small Town of Gisela, this Tonto Creek stream section is primarily within the Tonto National Forest and is typically difficult to access without a four-wheel drive vehicle. Within this segment is a seasonal USFS closure to protect nesting bald eagles from human disturbance upstream of 76 Ranch at the Rye Creek/Tonto Creek confluence.

Lowest 14.1 Miles of Tonto Creek

The lowest 14.1 miles of Tonto Creek from East Del Chi Drive to the Roosevelt Lake FCS is an intermittent stream, yet the flow can dramatically fluctuate from winter/spring flooding to summer pooling (Figure 16). For example, the Gun Creek gaging station in this segment recorded just over 20,000 cfs on March 21, 2023, and 0 cfs on September 18, 2023.

In contrast to the more remote Gisela Reach, Highway 188 parallels Tonto Creek for much of the lowest segment, and includes USFS managed lands, along with adjacent private ranches/homes, agricultural fields, businesses, and within channel gravel processing plants, stream diversions, road crossings, and a bridge (currently under construction near Punkin Center). At East Del Chi Drive, large culverts in Tonto Creek can act as a barrier, reducing/preventing upstream fish movement.

Nonnative predatory fish from Roosevelt Lake can swim upstream into lower Tonto Creek under a range of hydrologic conditions (ERO-GEI 2022a). SRP estimates that between about 200 and 1,100 cfs (measured at the Gun Creek gaging station) there is sufficient hydraulic connectivity for nonnative predatory fish to swim upstream into lower Tonto Creek. A sufficient stream flow is necessary for fish to leave Roosevelt Lake and larger flows make it more difficult for fish to swim against the current. The number of fish that originate from Roosevelt Lake and swim upstream is unknown, but it is likely limited by the duration of flows between about 200 and 1,100 cfs. Nonnative fish originating from upstream of lower Tonto Creek or in tributaries can also swim downstream or move by streamflow into the lower sections of the creek.

During the summer months as lower Tonto Creek flows subside, nonnative predatory fish can concentrate in pools. Sportfish, more acclimated to lake environments, can diminish if isolated pools continue to dry up or dissolved oxygen levels get too low for fish to breathe and live.

Tonto Creek FCS

The lowest portion of Tonto Creek in the Roosevelt Lake FCS is undeveloped downstream of A+ Road in the Tonto Creek channel. Immediately surrounding this area outside of the floodplain is Highway 188, USFS roads, and recreation areas (Indian Point).

This Tonto Creek/Roosevelt Lake confluence holds a variety of native and nonnative aquatic species. Nowak *et al.* (2019) described the following fish, amphibian, and invertebrate species occurring within their study area: longfin dace (*Agosia chrysogaster),* western mosquitofish (*Gambusia affinis),* black bullhead*,* yellow bullhead*, g*reen sunfish*,* bluegill*,* largemouth bass*,* yellow bass*,* smallmouth bass*,* bigmouth buffalo*,* gizzard shad*,* threadfin shad*,* common carp*,* red shiner*,* fathead minnow*,* American bullfrog*,* lowland leopard frog, Woodhouse toad (*Anaxyrus woodhousii),* red-spotted toad (*Anaxyrus punctatus*), Colorado River toad (*Incilius alvarius*), and crayfish.

Roosevelt Lake CS and FCS Riparian Habitat and Tamarisk Leaf Beetle

Riparian vegetation fluctuates with Roosevelt reservoir level and flood events. Currently, riparian habitat within the Roosevelt Lake CS and FCS is a mixture of saltcedar (*Tamarix ramosisimma*), cottonwood (*Populus fremontii*), willow (*Salix spp*.), seepwillow (*Baccharis salicifolia*), desert broom (*Baccharis sarothroides*), and arrowweed (*Pluchea sericea*). At the Tonto Creek delta, the water levels are typically shallow and slow moving, and the river braids in some areas with side channels and ponds. The riparian habitat is diverse with mosaics of tamarisk and willows, some marsh vegetation persists, and vegetated areas are interspersed with open cobble or sandy areas. On the Salt River side of the lake, the river forms a single, wide channel. Salt River flows are typically higher and more turbid than Tonto Creek. At the upper end of the Salt River CS, riparian habitat is similar to Tonto Creek (mosaic of woody vegetation), but lower in the reservoir large wide stands of monotypic tamarisk can dominate. In 2023, on the Salt River arm near Meddler Point, approximately 150 acres of riparian habitat burned in a fire.

Similar to a natural system, riparian vegetation growth and loss is dynamic in the Roosevelt Lake CS; however, the cycle occurs irregularly and is typically more extreme than a natural system. Vegetation may be flooded or completely inundated for many months or years, resulting in complete kill of riparian vegetation. As the reservoir empties, groundwater can drop below the rooting zone of many riparian plants, resulting in desiccation and mortality. For some periods, inundation of both the Salt River and Tonto Creek deltas may not occur for several years. However, lakebed saturation can create conditions favorable for establishment of new vegetation or rejuvenation of existing vegetation. The timing of reservoir drawdown, during the late spring and summer, does not favor the establishment of native riparian trees that seed in the late winter and early spring (ERO 2002, USFWS 2002a, 2003). Instead, exposing wet soil during the summer more typically causes tamarisk to flourish (ERO 2002, USFWS 2002a, 2003). Establishment of new, mid-succession riparian habitat generally takes 3 to 5 years (USFWS 2002a). Riparian vegetation grows within the reservoir bed, and along the reservoir margin and tributary watercourses. The changing water levels that accompany normal operation of the reservoir result in constantly changing amounts, types, and distribution of riparian vegetation.

The dynamic cycle of disturbance and regeneration creates, desiccates, and then periodically inundates riparian habitat.

Depending on the age, height, and plant species, the three typical riparian trees (Goodding willow, tamarisk, and cottonwood) have different tolerance to short and long-term inundation (ERO 2002). There are information gaps in assessing how the effects of varying inundation levels and duration effect riparian trees. Temporary inundation of seedlings and short stature riparian trees of all species typically leads to death, when inundation extends longer than would normally occur in nature. Taller and mature willow is likely the most tolerant riparian tree of short and long-term partial inundation. Goodding's willows showed little mortality after 12 months of inundation and had higher growth rates when their root crowns were inundated (ERO 2002). Mature cottonwoods showed no mortality after 73 days of inundation but had complete mortality after 2 years (ERO 2002). There is no information for evaluating intermediate time periods. Cottonwood researchers indicated that trees would tolerate partial submersion for 4 months (Markovchick 2021). Mature tamarisk appeared to be more sensitive to inundation than either cottonwoods or willows, with some mortality possible after 80 or more days of inundation, although mortality rates varied widely between studies. Tamarisk survival was higher for plants that were tall enough to extend above the water surface.

Within the Roosevelt Lake FCS, the duration and frequency of normal flood control operations, influences riparian vegetation like natural flooding. In contrast to CS operations, the rise and fall of FCS water is like natural stream flooding because it is infrequent, short-duration (20 days), and occurs across the floodplain during the winter and spring when native trees are seeding.

Tamarisk leaf beetles were found adjacent to Roosevelt Lake for the first time in 2021, along lower Tonto Creek, and across the greater Tonto Basin, including the upper Salt River in 2022 (RiversEdge West 2022a). Tamarisk leaf beetles can defoliate 22 to 40 miles of river-corridor tamarisk habitat each year. It is likely that the beetle will rapidly colonize tamarisk stands in Roosevelt Lake's FCS and CS, where tamarisk is abundant. Repeated tamarisk leaf beetle defoliation can cause 40% of tamarisk to die within 5 years (Jamison and van Riper 2018) and 70%–85% in the long term (RiversEdge West 2022b). The establishment and spread of the tamarisk leaf beetle at Roosevelt Lake will lead to a substantial reduction in the amount of tamarisk in the permit area. Because SRP's timing of water storage and release in the Roosevelt Lake CS typically favors the establishment of tamarisk and not native riparian trees, we are uncertain what plant species may establish following beetle-killed plants.

Santa Cruz and San Pedro/Babocomari Rivers

SRP identified alternate gartersnake mitigation sites along the upper Santa Cruz River within the San Rafael State Natural Area and San Pedro/Babocomari Rivers within BLM's SPRNCA (Figure 24). The SPRNCA is a 40-mile length of the upper San Pedro River, designated by Congress in 1988 as Riparian National Conservation Area. The primary purpose for the river's designation is to protect and enhance the desert riparian ecosystem, a rare remnant of what was once an extensive network of similar riparian systems throughout the Southwest. The BLM manages SPRNCA and has implemented efforts to improve native aquatic vertebrate populations, including gartersnakes, and expected those efforts to persist (Simms 2016), along with other traditional resource management/uses (BLM 2022, USFWS 2022). Arizona State

Parks, private landowners, and The Nature Conservancy helped to establish the 35-square mile San Rafael State Natural Area in 1999. Arizona State Parks currently manages the area to retain its scenic, undeveloped, and natural conditions. The Nature Conservancy has a 17,000-acre conservation easement to keep the land undeveloped in perpetuity, and the area is currently not open to the public.

Flycatcher, Cuckoo, and Bald Eagle Incidental Take Exceedance Levels from Original RHCP

SRP's original RHCP based its flycatcher and cuckoo incidental take exceedance levels on the amount of acres of a bird habitat affected annually within Roosevelt Lake's CS from conservation storage operations (ERO 2002, USFWS 2003). SRP and FWS based bald eagle exceedance levels upon observations associated with productivity and lake levels (ERO 2002, USFWS 2003).

1. Flycatcher - SRP cannot exceed adversely affecting more than 750 acres of flycatcher habitat annually (or up to 1,250 acres annually with adaptive management).
2. Cuckoo - SRP cannot exceed adversely affecting more than 313 acres of cuckoo habitat annually (or up to 1,113 acres annually with adaptive management).
3. Bald Eagle - SRP may incidentally take no more than 18 bald eagles resulting from reduced productivity caused by declining lake levels. SRP may adversely impact the nest or perch trees within the permit area for all bald eagle breeding areas at or near Roosevelt resulting in incidental take in conjunction with the permitted activity.

Previous Related Consultations within the Action Area

SRP summarized the long history of past biological opinions at Roosevelt Lake, primarily including the flycatcher and bald eagle in its original RHCP (ERO 2002). These projects, consulting with USBR and the USFS, go back to the 1980s and involve actions such as safety of dams, recreation facilities, and raising Roosevelt Dam (ERO 2002). As noted above, SRP developed a Habitat Conservation Plan (ERO 2002) specific to conservation storage up to 2,151 feet amsl that included the bald eagle, flycatcher, cuckoo, and rail, and we conducted a consultation on the issuance of their 10(a)(1)(B) permit (USFWS 2003). While SRP developed this RHCP amendment, we issued a 10(a)(1)(A) recovery permit for further information acquisition and completed associated biological opinions for the recovery permit and an amendment (USFWS 2019a, 2021a).

We recently completed a biological opinion that addressed Wildlife and Sportfish Restoration (WSFR) funding a suite of activities related to AGFD's aquatic species management under the State Wildlife Grant and Sport Fish Restoration Grant for a period of 10 years (USFWS 2021d). The project area covers a wide variety of Arizona aquatic habitats, including Roosevelt Lake. We also informally consulted (02EAAZ00-2017-I-0923) with the FWS's National Fish Habitat Partnership for funding AGFD to purchase materials for, construct, and place fish habitat structures within Roosevelt Lake for sport fish.

BLM's Tucson Field recently evaluated cattle grazing and vegetation management on SPRNCA (BLM 2022, USFWS 2022). The Federal Highway Administration and Arizona Department of

Transportation completed consultation (02EAAZ00-2020-F-1428-R1) and began construction on a bridge over Tonto Creek near Punkin Center on lower Tonto Creek.

Description of the Action Area

The original 2003 RHCP (ERO 2002) and biological opinion (USFWS 2003) describes the overall large action area for Modified Roosevelt Dam conservation storage operations which is largely limited to river floodplains and Roosevelt Lake storage areas and dictated by overall Modified Roosevelt Dam water management and flycatcher, cuckoo, and rail mitigation sites outside of the permit area on different Arizona river drainages.

The RHCP amendment expands the action area to include the entire Roosevelt Lake FCS (2,151 to 2,175 feet amsl), a small subset of the FCS for the planned deviation (2,151 to 2,156 feet amsl) and two separate sections of lower Tonto Creek. Stream flow from FCS operations and the planned deviation is a subset of the broader Roosevelt Dam conservation storage operations. The planned deviation largely ceases at Granite Reef Diversion Dam just downstream of the Salt and Verde River confluence. One lower Tonto Creek section is 14.1 miles long from the Roosevelt Lake FCS to East Del Chi Drive, where large, elevated culverts can act as a fish barrier for upstream fish movement. A three-mile Tonto Creek segment near the Town of Gisela is a gartersnake mitigation area for fish management.

The completion of Roosevelt Dam in 1911 created Theodore Roosevelt Lake. The Tonto National Forest surrounds Roosevelt Lake and the lake covers much of the southern portion of the Tonto Basin, situated between the Sierra Ancha, Mazatal, and Superstition mountains. As originally constructed, Roosevelt Dam was 280 feet high and had a water storage capacity of 1,284,205 acre-feet. Subsequently, capacity slightly increased and decreased over time from spillway modifications and silt accumulation.

From 1989 through early 1996, USBR modified Roosevelt Dam to provide additional conservation storage capacity (to 1,653,043 acre-feet) and to address safety concerns identified under the Reclamation Safety of Dams Act of 1978 (43 USC § 506 et seq.) (Figure 1). The modified Roosevelt Dam provides for additional water conservation storage space, dam safety, and for the first time, dedicated FCS. The top of SRP's original conservation storage space was at an elevation 2,136 feet. This elevation represents the existing storage capacity held by SRP in 1995 when Roosevelt Dam modifications added additional conservation storage and FCS.

The top of Modified Roosevelt Dam's new CS is at elevation 2,151 feet amsl and the uppermost increment of storage for flood control and dam safety purposes occurs up to 2,218 feet amsl (Figure 1). SRP operates Modified Roosevelt Dam and its other reservoirs to provide water to their shareholder lands, various Phoenix area cities, Indian communities, and irrigation and water conservation districts pursuant to a complex set of laws, contracts, and agreements (ERO 2002). The reservoir is also an important recreation site, and supports boating, camping, fishing, and other recreational pursuits.

In 1903, USBR withdrew the land that the original water storage space occupies behind Roosevelt Dam for purposes of the Salt River Federal Reclamation Project. Reclamation withdrew additional land in 1999 in areas that water could inundate because of the Roosevelt

Dam modifications (64 FR 67929). SRP, USBR, and the USFS manage the withdrawn land surrounding the reservoir under a three-way agreement with the Tonto National Forest being responsible for management of recreation and other public land uses. Land along lower Tonto Creek is a combination of USBR withdrawn/USFS managed, private, and USFS land.

Two distant southeastern Arizona locations are potential alternative gartersnake mitigation sites at San Rafael State Natural Area on the upper Santa Cruz River and BLM's National Riparian Conservation Area (SPRNCA) on the upper San Pedro and Babocomari Rivers (Figure 24). Arizona State Parks manages the San Rafael Natural Area, while the BLM administers SPRNCA.

Status of the Species and Critical Habitat within the Action Area

Northern Mexican Gartersnake

Roosevelt Lake/Lower Tonto Creek

In 1995, biologists found gartersnakes along lower Tonto Creek (USFWS 2014), and surveyors, using aquatic trapping, visual encounters, or cover board arrays further recorded their distribution within and upstream of the lower Tonto Creek permit area, including the Tonto Arm of Roosevelt Lake (Figure 8) (Altemus 2020, Burger 2010, Holycross *et al.* 2006, Madara 2012, Nowak *et al.* 2015, 2019).

At Nowak *et al.*'s (2019) three lower Tonto Creek gartersnake study sites (Orange Peel, A+ Road Crossing, and Bar-X Road Crossing), they detected 81 unique gartersnakes between 2015 and 2017. Of the 81 individual gartersnakes, 39 were male and 38 were female. The number of unique gartersnakes detected per study site was Orange Peel - 54, A+ Road Crossing - 13, and Bar-X Road Crossing - 14. At the A+ Road Crossing study site, all gartersnake detections were in the Roosevelt Lake CS below A+ Road.

Aside from Nowak *et al.*'s (2019) recent studies, other biologists have recorded gartersnakes in the lower Tonto Creek area. Burger (2010) and Madara (2012) detected three gartersnakes each along lower Tonto Creek. Holycross *et al.* (2006) detected 17 gartersnakes at the upper end of the Tonto Creek FCS and upstream of the permit area between Gun Creek and Houston Creek (Gisela occurs between these two creeks). A unique gartersnake detection occurred at Punkin Center along lower Tonto Creek at the base of a car's tire in a parking lot (Cobbold 2018).

All gartersnakes observed in the Roosevelt Lake area occur along lower Tonto Creek and the Tonto Arm of Roosevelt Lake. Lower Tonto Creek consists of an intermittent braided stream, side channels, shallow water, and ponds for gartersnake food and hunting. A variety of aquatic and terrestrial gartersnake prey occur in lower Tonto Creek, including native and nonnative fishes, amphibians, and lizards (Nowak *et al.* 2019). The riparian zone is a mosaic of typical woody and herbaceous vegetation interspersed with cobble or open sandy areas for gartersnake cover, thermoregulation, and features for hibernacula (Nowak *et al.* 2019).

Nonnative aquatic gartersnake predators and competitors in lower Tonto Creek and Roosevelt Lake have aggressive behavior, generalized diet, and large gape size. Nonnative predatory fish such as largemouth bass, catfish species, green sunfish, and others, American bullfrogs, and

crayfish can eat gartersnake prey reducing prey diversity, abundance, and availability (USFWS 2014a, 2021b). Larger nonnative predatory fish and bullfrogs can eat gartersnakes (USFWS 2014a, 2021b). Gartersnakes are also able to consume small individuals of these nonnative species. Avian species including wading birds and raptors are also known or suspected gartersnake predators (Boyarski *et al.* 2019, Gawlik 2002, Jones *et al.* 2020, Nowak *et al.* 2019).

Detecting actual gartersnake predation and injury is difficult due to the snake's cryptic appearance and a biologist's ability to be present to observe these periodic events (Owens *et al.* 2023). Therefore, biologists have implemented unique methodologies to acquire predation information and made conclusions based upon observations elsewhere. For example, ERO-GEI (2022b) sampled the lower Tonto Creek FCS near A+ Road over three separate trips, collecting 1,473 fish representing 8 nonnative and 1 native fish species. Largemouth bass, bluegill, and carp represented 77% of the fish species. ERO-GEI (2022b) visually examined the stomach contents of 231 largemouth and smallmouth bass, green sunfish, and yellow bullhead and channel catfish from this lower Tonto Creek area without finding any gartersnakes consumed by these fish. Owens *et al.* (2023) extracted DNA from 98 sportfish fecal samples from two similar locations at lower Tonto Creek and its confluence with Roosevelt Lake, confirming largemouth bass predation of gartersnakes at both sampling sites. Based upon Emmons *et al.*'s (2016) observations elsewhere, gartersnake ingestion of nonnative predatory fish with spines can lead to puncture injury and possible death.

In contrast to other perennial streams, lower Tonto Creek's intermittent and dynamic nature may help reduce, but not eliminate effects of nonnative predatory fish on gartersnakes and prey. Nonnative predatory fish can congregate into pools during flow reduction, creating gartersnake foraging opportunities, but also increased predation of gartersnakes and native aquatic species. Yet, nonnative predatory fish can also die through the summer as isolated Tonto Creek pools diminish. Native riverine fish are likely more adapted to these dynamic conditions, than lake sport fish. These dynamic stream features may be important for maintaining prey availability and diversity, and gartersnake persistence.

Our current understanding is that gartersnakes do not occur on the Salt River arm of Roosevelt Lake (Salt Arm) (SWCA 2022). Surveyors did not detect gartersnakes during recent surveys on the Salt Arm (Baker *et al.* 2019, Grimsley-Padron *et al.* 2020, Nowak *et al.* 2015). The surveys collectively totaled 96,312 trap hours and 24.2 visual survey hours and there are no other incidental observations. The lake's conservation pool, lack of prey availability, predatory nonnative fish, and other topographical features may inhibit gartersnake movement from the Tonto Arm to the opposite side of the lake, approximately 20 miles away. Biologists also consider the gartersnake extirpated from the lower Salt River below Roosevelt Dam (Baker *et al.* 2019, USFWS 2014a, 2021b, Holycross *et al.* 2006, Jones *et al.* 2020).

In contrast to Tonto Creek, various Salt River habitat characteristics immediately above Roosevelt Lake, such as hydrology, aquatic nonnative predators, and prey resources may reduce or prevent gartersnake occurrence. The Salt Arm consists of a single, wide perennial stream channel with higher flows and greater turbidity, possibly creating difficult conditions to acquire aquatic prey. Nonnative predatory fish are likely a greater presence in the perennial and deeper Salt River Arm, with voracious predatory species like flathead catfish. Amphibian prey

abundance differs by one or two orders of magnitude between the Tonto Arm and the Salt Arm (Baker *et al.* 2019, Grimsley-Padron *et al.* 2020, Nowak *et al.* 2019).

At the Roosevelt Lake/lower Tonto Creek area, tracked gartersnakes used cover in riparian woodland, meadow, dry edge, dead woodland floodplain, shrub-forb upland, and mesquite upland habitats for brumation (a state of sluggishness, inactivity, or torpor) during cold winter temperatures (Nowak *et al.* 2019). Roosevelt gartersnake brumation sites were located an average of about 272 ± 70 feet (range=2.3 to 1,256 feet) from the water's edge and included rodent and crayfish burrows, cavities formed by partially buried woody debris and cracked clay soils, and the spaces under piles of flood debris (Nowak *et al.* 2019).

The gartersnake may use multiple brumation sites within and between years (Emmons 2017, Emmons and Nowak 2016, Nowak *et al.* 2019, Sprague 2017). Nowak *et al.* (2019) documented Roosevelt Lake/lower Tonto Creek gartersnakes changing brumation sites nine times. The 9 new brumation sites were located a mean distance of 148 ± 82 feet (range = 16 to 771 feet) from previous brumation sites. Flooding of sites caused gartersnakes to move their brumation site five times (Nowak *et al.* 2019).

San Rafael State Natural Area and San Pedro National Conservation Area

Gartersnake populations in the upper Santa Cruz River were documented at the time of listing and we considered them likely viable and reliably found, including the San Rafael State Natural Area (USFWS 2014a). The upper Santa Cruz River contains suitable habitat, and combinations of both native prey species and harmful nonnative predator species (USFWS 2014a). Since 2008, AGFD's consistent surveying has found 55, 24, 15, 29, and 5 individual gartersnakes (Stingelin *et al.* 2009, Lashway 2012, 2014, 2015, and Bauder 2022).

The San Pedro/Babocomari Rivers have suitable gartersnake habitat, with combinations of native prey and harmful nonnative aquatic predators at the time of listing (USFWS 2014a). We considered gartersnake populations along these two streams are not likely viable (USFWS 2014a). Biologists have not surveyed these streams regularly for gartersnakes, and last found gartersnakes along the Babocomari River in 2007 and 2009, and the San Pedro River upstream of Interstate 10, near Highway 82 and State Route 90 in 2006 and 2018 (USFWS 2021b).

AGFD's long-term management goals for both San Rafael State Park (and broader upper Santa Cruz River) and San Pedro National Conservation Area do not include current or future sportfish stocking (USFWS 2021b).

Critical habitat

We designated eight gartersnake critical habitat units; all but one of the units is in Arizona (UFWS 2021b). The seven gartersnake critical habitat units in Arizona total 19,193 acres (FWS 2021b) and represent 94% of designated critical habitat. The RHCP amendment and lower Tonto Creek occur in the Tonto Creek Unit. Possible secondary mitigation sites occur along the Santa Cruz River at San Rafael State Park (Upper Santa Cruz Unit) and upper San Pedro/Babocomari rivers at BLM's San Pedro National Conservation Area (San Pedro River Unit).

Within the RHCP amendment project area, the Roosevelt Lake CS is not designated gartersnake critical habitat, but the lower Tonto Creek FCS and conservation/mitigation areas are designated critical habitat (USFWS 2021b) (Figure 9). The FCS contains 232 acres of critical habitat along one river mile. The lowest Tonto Creek portion of the permit area contains 2,143 acres along 14.1 river miles of the Tonto Creek Unit (USFWS 2021b). The Gisela segment of Tonto Creek is 3 miles long and includes 221 acres of gartersnake critical habitat (Figure 17).

Potential alternate gartersnake mitigation sites on the upper Santa Cruz River and upper San Pedro and Babocomari rivers also occur within designated gartersnake critical habitat (Figure 24). The targeted secondary mitigation sites at the San Pedro and Babocomari rivers within the BLM's San Pedro Riparian National Conservation Area occur within 5,237.8 acres of gartersnake critical habitat, and the Santa Cruz River within the San Rafael State Natural Area consists of 110.8 acres of gartersnake critical habitat.

Southwestern Willow Flycatcher

The amount of flycatcher habitat and number of territories within the Roosevelt Lake CS and FCS varies widely depending on lake elevation fluctuations and stream flow. The number of flycatcher territories at Roosevelt Lake can be some of the highest at a single location in Arizona (Ellis *et al*. 2008). Low lake elevations cause riparian vegetation to develop on exposed sediments, and high lake elevations submerge or alter vegetation (Paxton *et al.* 2007). For example, in 2019, the flycatcher habitat satellite image model (Hatten and Paradzick 2003) estimated 563.2 acres of flycatcher habitat in the Roosevelt Lake CS, and in 2020, when the lake was approximately 30 feet higher, there was 164.8 acres of flycatcher habitat (SRP 2020). In addition to the flycatcher habitat changes from Roosevelt Lake CS operations, Tonto Creek, and Salt River flow, as well as infrequent FCS operations, can influence flycatcher habitat quality across the FCS.

In 2020, EcoPlan Associates, Inc. (EcoPlan), found 236 flycatcher territories within the Roosevelt Lake CS and FCS (Liknes and Ashbeck 2021). There were 220 flycatcher territories in the CS, and 16 territories in the FCS (SWCA 2023a). Eleven flycatcher territories were in the planned deviation area between 2,151 and 2,156 feet amsl (SWCA 2023a). Five flycatcher territories occurred above 2,156 feet amsl in the FCS (SWCA 2023a). Of all the 236 flycatcher territories, 58% were in the Tonto Arm and 42% were in the Salt Arm.

In 2021, EcoPlan surveyed for flycatcher territories in the FCS, finding 53 territories. Some flycatcher territories occurred near CS/FCS boundary at 2,151 feet amsl, others at the height of the 2,156 feet amsl planned deviation, and a few more even higher in the FCS (Liknes and Ashbeck 2022). Field personnel detected 45 flycatcher territories (3 at the Tonto Arm and 42 at the Salt Arm) centered in the CS. On the Salt Arm, 3 of the 42 territories were within about 30 feet of an elevation of 2,151 feet amsl. Between 2,156 and 2,175 feet amsl, surveyors found 8 flycatcher territories (5 in the Tonto Arm and 3 in the Salt Arm). Two of these Salt Arm territories were within about 30 feet of 2,156 feet amsl.

Roosevelt Lake is within the Roosevelt Management Unit with a 50-territory recovery goal (USFWS 2002a). The Recovery Team established Management Units across the flycatcher's breeding range and identified numerical territory and habitat goals (USFWS 2002a). Additional

flycatcher territories in the Roosevelt Management Unit occur on the upper Salt River, Tonto Creek, Pinal and Cherry Creeks, and Rock House Demonstration Site. Outside of the Roosevelt Lake CS and FCS, flycatcher surveys are periodic and territory abundance is smaller, but together can total about 20 to 40 territories.

Whether it is higher or lower water levels at Roosevelt Lake, flycatcher territories within the Roosevelt Management Unit have regularly surpassed the 50-territory numerical goal established in the Recovery Plan (USFWS 2002a). Biologists estimated the number of flycatcher territories in the Roosevelt Management Unit were 196 in 2004 (Durst *et al*. 2005), 158 in 2005 (Durst *et al.* 2006), 117 in and 2006 (Durst *et al*. 2007), 75 in 2007 (Durst *et al.* 2008), and 99 in 2012 (Durst 2017). Biologists raw survey results in 2020 just at Roosevelt Lake totaled 236 flycatcher territories (Liknes and Ashbeck 2021), and in limited surveys, 53 territories in 2021 (Liknes and Ashbeck 2022). Overall, the Roosevelt Management Unit is one of the few Management Units across the bird's breeding range, even with lake fluctuations, that has consistently exceeded its numerical goals.

EcoPlateau Research personnel sampled and found no tamarisk leaf beetles in 2020 and 2021 on both the Salt and Tonto Arms (Johnson 2021, Johnson *et al.* 2021), but beetles did occur in July 2022 on both the Salt and Tonto Arms (Valencia 2022). Because so much of the flycatcher's habitat at Roosevelt Lake consists of tamarisk, we anticipate noticeable changes in the future in territory abundance from the effects of the beetle.

SRP's RHCP flycatcher conservation and mitigation measures for Modified Roosevelt Dam's CS operations include a Forest Protection Officer to assist in habitat protection at Roosevelt Lake, the development and maintenance of flycatcher habitat at the off-channel Rock House demonstration site along the Salt River inflow, and acquisition and management of flycatcher habitat along the San Pedro, Verde, and Gila rivers (ERO 2002, USFWS 2003, SRP 2003-2022).

Critical habitat

We excluded the Roosevelt Lake CS from the final flycatcher critical habitat designation due to SRP's RHCP and ongoing USFS management, but designated sections of lower Tonto Creek and the upper Salt River above 2,151 feet amsl where the FCS and CS meet (USFWS 2013) (Figures 10 and 11). Overall, we designated approximately 382.9 acres of the Tonto Arm FCS and 506.5 acres of the Salt Arm FCS as flycatcher critical habitat (2,151 to 2,175 feet amsl). The specific area for the planned deviation, between 2,151 and 2,156 feet amsl on these two arms of the lake combined, consist of 208.2 acres of flycatcher critical habitat.

Western Yellow-Billed Cuckoo

The amount of cuckoo habitat and number of territories within the Roosevelt Lake CS and FCS varies depending on lake elevation fluctuations and stream flow. Low lake elevations cause riparian vegetation to develop on exposed sediments, and high lake elevations submerge or alter vegetation (Paxton *et al.* 2007). In addition to the cuckoo habitat changes from Roosevelt Lake CS operations, Tonto Creek and Salt River flow, as well as infrequent FCS operations, can influence cuckoo habitat quality across the FCS.

In 2020, EcoPlan estimated nine cuckoo territories in the Roosevelt Lake CS and FCS up to

2,175 feet amsl (Liknes and Ashbeck 2021). Field personnel estimated 2 cuckoo territories in the CS (1 at each the Tonto and Salt Arms) and estimated 4 territories in the FCS (3 in the Tonto Arm and 1 in the Salt Arm). Likeness and Ashbeck (2021) estimated there were an additional three territories at the Salt Arm that likely occurred within both the CS and FCS. Six cuckoo territories in the FCS occurred in the planned deviation area between 2,151 and 2,156 feet amsl.

In 2021, after lake levels increased, EcoPlan's FCS cuckoos surveys estimated a total of 3 cuckoo territories, 1 in the Salt Arm and 2 in the Tonto Arm (Liknes and Ashbeck 2022). All cuckoo territories were located higher in the FCS than in 2020, near the 2,175-foot amsl elevation contour.

EcoPlateau Research personnel sampled and found no tamarisk leaf beetles in 2020 and 2021 on both the Salt and Tonto Arms (Johnson 2021, Johnson *et al.* 2021), but beetles did occur in July 2022 on both the Salt and Tonto Arms (Valencia 2022). Tamarisk can support the cuckoo's nesting habitat. Because so much of the riparian habitat within the Roosevelt Lake CS is tamarisk, we can anticipate changes to cuckoo abundance and distribution from the effects of the beetle. In contrast to the flycatcher, that relies more on tamarisk, we are less certain how severe these changes will be.

SRP's RHCP cuckoo mitigation measures for Modified Roosevelt Dam's CS operations include a Forest Protection Officer to assist in habitat protection at Roosevelt, the development and maintenance of cuckoo habitat at the off-channel Rock House demonstration site along the Salt River inflow, and acquisition and management of cuckoo habitat along the San Pedro, Verde, and Gila rivers (ERO 2002, USFWS 2003, SRP 2003-2022).

Critical habitat

We excluded the Roosevelt Lake CS from the final cuckoo critical habitat designation due to SRP's RHCP and ongoing USFS management, but designated sections of lower Tonto Creek and the upper Salt River above 2,151 feet amsl where the FCS and CS meet (USFWS 2013) (Figures 12 and 13). Overall, we designated approximately 429.9 acres of the Tonto Arm FCS and 423.2 acres of the Salt Arm FCS as cuckoo critical habitat (2,151 to 2,175 feet amsl). The specific area for the planned deviation, between 2,151 and 2,156 feet amsl on these two arms of the lake combined, consist of 181.0 acres of cuckoo critical habitat.

Bald Eagle

The number of breeding bald eagle territories relying on Roosevelt Lake has fluctuated, but overall has increased since Arizona began tracking bald eagles and completion of the original RHCP. Roosevelt Lake supports more bald eagle territories than any other lake in Arizona (McCarty *et al.* 2022). In the late 1970s, we knew of a single bald eagle territory relying on Roosevelt Lake (Pinal breeding area), and in the mid-1980s, that grew to two territories (Pinal and Pinto breeding areas) (Hunt *et al.* 1992). When the RHCP was completed, the Pinal, Pinto, Tonto, Dupont, Rock Creek, and Sheep breeding areas (n=6) relied or partially relied on Roosevelt Lake resources. Since completion of the RHCP, the highest number of bald eagle breeding areas associated with Roosevelt Lake resources on AGFD's active list was eight.

Following the 2023 breeding season, AGFD has seven bald eagle territories on their active list that rely (or partially rely) on Roosevelt Lake for food (Pinal, Pinto, Tonto, Bachelor Cove, Armer Gulch, Two Bar, and Sheep breeding areas) (McCarty *et al.* 2022). Bald eagles established the Rock Creek and Dupont breeding areas (located in the Sierra Ancha and Four Peaks Wilderness Areas) in the 1990s, and AGFD relegated them to historical status after 10 consecutive years of unoccupancy. In 2023, AGFD removed the Campaign Bay breeding area from the list of current territories after also being unoccupied for 10 consecutive years.

Breeding bald eagles relying on Roosevelt Lake place nests in either trees/snags within or adjacent to the CS and FCS, or farther away on cliffs and trees/snags outside of Roosevelt Lake's influence on nest sites. Bald eagles breeding areas nesting in trees/snags within or adjacent to the CS and FCS are Tonto, Pinto, and Bachelor Cove. The Pinal, Armer Gulch, Two Bar, and Sheep breeding areas nest on cliffs and trees/snags farther from the CS and FCS.

Nesting bald eagles located at and surrounding Roosevelt Lake rely on the fish and waterfowl the lake supports for food (Hunt *et al.* 1992). Across Arizona and at Roosevelt Lake, where multiple breeding bald eagle pairs rely on dynamic lakes for food, the surface area can drop (likely to elongated drought) affecting eagle territory size, food availability and acquisition, and competition (USFWS 2003).

Comparing bald eagle reproductive rates in Roosevelt territories with all other territories statewide during SRP's 2003-2021 RHCP permit period, mean nest success (number of successful breeding attempts/number of occupied nesting territories) was 0.62 ± 0.29 SD (0.63 ± 0.30 SD for territories within the inundation zone) and was 0.59 ± 0.06 SD statewide (SWCA 2023b). There was not a significant difference in nest success between the statewide population and the population using Roosevelt Lake ($t_{36} = 0.6$, $p = 0.57$) or within the inundation zone ($t_{36} = 0.7$, $p = 0.51$) (SWCA 2023b). During 2003-2021, mean productivity for territories that use Roosevelt was 1.19 ± 0.64 SD (1.18 ± 0.64 SD for territories within the inundation zone) and was 0.92 ± 0.12 SD statewide (SWCA 2023b). Productivity did not differ significantly between the statewide population and the population using Roosevelt ($t_{36} = 1.8$, $p = 0.09$) or within the inundation zone ($t_{36} = 1.7$, $p = 0.09$) (SWCA 2023b). Examining mean nest success and productivity during SRP's pre- and post-RHCP permit periods, reproductive rates increased in Roosevelt territories after 2003, which also occurred statewide (SWCA 202b3). The differences in nest success ($t_{31} = 1.3$, $p = 0.19$) and productivity ($t_{31} = 1.7$, $p = 0.09$) in Roosevelt territories pre- and post-RHCP permit were not significant (SWCA 2023b).

SRP's RHCP bald eagle conservation measures, including nestwatchers, USFS protection officer, and helicopter flights contribute to the ongoing protection, management, and monitoring of Roosevelt Lake breeding eagles. SRP collaborates with AGFD to fund nestwatchers throughout the breeding season (10-days-on/4-days-off schedule). There are typically one or two nestwatch teams monitoring Roosevelt Lake nesting eagles each season. Information from nestwatch monitoring guides land management, assesses closure effectiveness, and identifies emerging issues. In addition to collecting nesting information and behavioral responses to human activities, nestwatchers alert AGFD when eagles are in life-threatening situations (*e.g.*, rising lake levels near tree nests), which allows for the threat to be eliminated or reduced, or injured eagles to be rescued and rehabilitated (McCarty *et al.* 2022). SRP also funds a year-round USFS Protection Officer to patrol seasonal bald eagle nest closures to minimize recreation impacts,

educate recreationists, protect habitat, and detect and monitor eagles. SRP provides annual helicopter flights that gives AGFD the ability to monitor all known breeding eagle territory productivity and seek alternate nest locations and new territories.

The amount of bald eagle territories relying (or partially relying) on Roosevelt Lake for food, and their nest locations, nesting activity, and productivity will likely be dynamic from year to year. Based upon the eagle's history of growth and persistence since the 1970s, we anticipate breeding bald eagles can sustain their territory numbers and can possibly increase (with some fluctuation), yet their nest location will likely continue to move. For example, throughout Tonto (established in 1990) and Pinto's (established in 1986) long breeding area history, bald eagles have placed nearly 20 nests in different trees within the CS and FCS (McCarty *et al.* 2022). Only a few of those territories' nest trees still currently persist. SRP developed a platform for the Pinto breeding area that could be a stable location should birds decide to use it. The supporting nest branches in the recently historical Campaign Bay breeding area were unable to support the nest for much longer than a breeding season. The Dupont and Rock Creek nest areas were in distant areas from Roosevelt and eventually AGFD removed them from the list of active territories after extended consecutive years of unoccupancy, and soon after eagles established the Two-Bar, Armer Gulch, and Bachelor Cove breeding areas.

Critical habitat

There is no designated bald eagle critical habitat because FWS delisted the eagle. The eagle is not a threatened or endangered species, nor is there a parallel critical habitat designation under the Bald and Golden Eagle Protection Act.

Spikedace

There are no spikedace in the Roosevelt Lake CS, FCS, lower Tonto Creek, or upper Salt River. To date, biologists have not reintroduced spikedace in Tonto Creek or the Salt River, or its immediately adjacent tributaries, nor are there existing plans due to the abundance of nonnative predatory aquatic species. We described that "large areas of the (Salt River Sub-basin and Tonto Creek Unit) are unsuitable, either because of topography or because of reservoirs and other stream-channel alterations (USFWS 2012)."

Spikedace historical records (USFWS 2010b) exist for the areas upstream and downstream of Roosevelt Lake on the Salt River:

1. the upper Salt River at the confluence of Cibecue Creek;
2. downstream of the Roosevelt Dam on the lower Salt River; and
3. the lower Salt River prior to the creation of Saguaro Lake, but where Saguaro Lake currently exists.

Critical habitat

We designated approximately 44 miles of spikedace critical habitat in the Tonto Creek Unit of the Salt River Sub-basin, which includes Tonto Creek, Rye Creek, and Greenback Creek. We clarified that spikedace were historically present in the Tonto Creek Unit, but not currently

extant and the Tonto Creek Unit is for recovery (USFWS 2010b). No spikedace critical habitat occurs on the Salt River above or below Roosevelt Lake.

Spikedace critical habitat does not occur within the Roosevelt Lake CS but occurs along lower Tonto Creek and the Tonto Creek FCS (USFWS 2010b). The lower Tonto Creek portion of the permit area, from the top of the FCS to East del Chi Drive, contains approximately 14.4 miles (1,337.8 acres) of critical habitat. The Tonto Creek FCS contains a total of 1.06 miles (78.47 acres) of spikedace critical habitat, which includes 0.84 mile (73.46 acres) in Tonto Creek and 0.22 mile (5.01 acre) in Greenback Creek (Figures 14 and 15).

EFFECTS OF THE ACTION

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time but are still reasonably certain to occur.

In accordance with 50 CFR § 402.02, effects of the action are all consequences to listed species or critical habitat caused by the proposed action, including the consequences of all other activities that are caused by the proposed action. "A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see § 402.17)."

Permit Area

In contrast to the large action area, the effects of the action to listed species and its critical habitat, or the permit area, occurs within the Roosevelt Lake CS (2,151 feet amsl and below), FCS (2,151 to 2,175 feet amsl), and the lowest 14.1 miles of Tonto Creek (defined as the floodplain from East Del Chi Drive to the Roosevelt Lake FCS at 2,175 feet amsl) (Figures 3 and 4). The planned deviation occurs in the lowest 5 feet of the FCS, between 2,151 and 2,156 feet amsl (Figures 6 and 7).

Northern Mexican Gartersnake

<u>Conservation Storage Operations within the Conservation Space</u>

Roosevelt Lake's dynamic lake fluctuations can expose/create gartersnake habitat when water level recedes and adversely affect gartersnakes by covering habitat with water and altering essential behaviors, causing an increase in predation, possibly killing snakes during larger lake elevation changes, and physiological effects leading to reduced survivorship and reproduction. Gartersnakes are not solely aquatic snakes, and do not rely on open deep lakes for foraging and food. Active season gartersnakes more typically occur near the edge of streams or pools to capture food (Nowack *et al.* 2019), only occurring in shallow water's edge when capturing fish or amphibians and rarely use deep open water to forage (Harrow *et al*. 2022).

When gartersnakes occur within the Roosevelt Lake CS and typical slow rising water elevations occur, we anticipate active season snakes can move and escape, preventing drowning, predation, or physiological effects. Gartersnakes typically occur along stream sides and must account for changing river flow and water across a floodplain. Nowak *et al.* (2019) observed gartersnakes in the CS tracking natural features associated with the Tonto Creek channel. SRP's Reservoir Planning Model estimates typical changes in lake elevation are small on a daily time step (*i.e*., 0.2 vertical foot per day; 25 feet horizontal per day, or about 1 horizontal foot per hour). These daily changes have slow water velocities (*i.e.,* slower than walking speed) (Emmons and Nowak 2016), and we expect they are within the gartersnake's ability to move without consequence.

During the gartersnake active season when SRP is capturing water, periodic rapid increases in lake elevations can cause adverse effects to gartersnakes from drowning and predation. Rapid increases in lake elevation may occur faster than gartersnakes are able to move across land, increasing the predation risk of gartersnakes from terrestrial and aquatic predators. If gartersnakes are not able to swim to shorelines safely, gartersnakes may drown or be consumed by aquatic predators. Gartersnakes trying to escape rising water by moving longer distances without shelter may increase their exposure to terrestrial predators and die. Predators may more easily detect more sedentary pregnant female gartersnakes displaced by rising waters (Emmons 2017, Emmons and Nowak 2016, USFWS 2014a, Myrand 2019, Rosen *et al*. 2001, Sprague 2017, Sprague and Bateman 2018).

Should gartersnakes require extensive changes in location from SRP's conservation storage operations, it may reduce opportunities for mating or cause energy expenditure that adversely affects reproduction. Rising lake elevations that disrupt gartersnake locations may disconnect male and female gartersnakes, reducing or prevent mating opportunities. Lake elevation changes that occur between April and August could adversely affect gartersnake reproductive success. Pregnant females are more sedentary toward the end of gestation (*e.g*., May) (Rosen and Schwalbe 1988, Sprague and Bateman 2018), and lake elevation changes during this time may cause pregnant females to move when they would otherwise be sedentary. Increased movements by pregnant females may divert metabolic energy away from embryo development, which may in turn adversely affect the physiology and the survivorship of the pregnant females and their offspring (Boyarski *et al*. 2019, Sprague and Bateman 2018). SRP's conservation operations can adversely affect gartersnake foraging behaviors by changing the availability, location, and quality of gartersnake habitat resources. In the CS, Myrand (2019) documented increased gartersnake movements during inundation. The disruption of foraging and feeding activities in response to the need to move could reduce energy intake. Reduced energy intake could lead to reduced fitness or body condition and may increase the likelihood of death (by predation or lack of fitness) or decrease the likelihood of successful reproduction.

SRP's changes to CS lake elevations may adversely affect gartersnake recruitment, especially neonates, juveniles, or small adult gartersnakes (Nowak and Boyarski 2012, Nowak *et al*. 2019, Rosen and Schwalbe 1997, Sprague 2017). These smaller gartersnake size classes may be more vulnerable to predation and the physiological effects of increased movements, relative to adult gartersnakes. Nowak *et al*. (2019) suggest that neonates have specific physiological requirements (*e.g*., thermoregulation, water loss, prey size limits) that create an increased reliance on aquatic features.

We anticipate Roosevelt Lake inundation will disrupt gartersnakes brumating in the CS, which may cause, in some instances, adverse effects from drowning, predation, or survival and reproduction. Gartersnakes can brumate in the Roosevelt Lake CS at the same time SRP stores water in the cooler winter and early spring months. Large or multiple precipitation events can cause rapid and/or repeated increase in lake levels. On five occasions, Nowak *et al.* (2019) documented gartersnakes brumating in the CS changing sites due to rising lake levels. We can expect with moderate, slow, and brief lake level changes, brumating gartersnakes can move short distances and find an alternate brumation site without consequences from drowning, predation, or physiological/reproduction effects. However, if lake levels rise quickly or repeatedly, brumation site inundation can force gartersnakes to move moderate to longer distances during a season, increasing exposure to predation on land and water, and risk of drowning. Longer or repeated gartersnake movements may also cause adverse effects to gartersnake physiology, survivorship, or subsequent reproduction from expending energy to relocate when they would otherwise be conserving energy while brumating (Nowak *et al*. 2019).

Over several months, daily Roosevelt Lake increases in water elevation can accumulate causing the lake to rise approximately 20 to 30 vertical feet, temporarily adversely affecting gartersnakes and its habitat. These changes can equate to approximately 3,000 to 4,500 feet of horizontal movement of the lake edge. The rise in lake levels of this magnitude would typically occur when SRP stores water from the winter through the spring into May. These larger lake elevation increases causes gartersnake habitat in the CS to become temporarily unavailable that may persist for months or years. Habitat inundation alters areas for essential gartersnake feeding, mating, and reproduction behavior, and forces gartersnakes from established locations into areas where competition for resources may increase and diminishes resources that could adversely affect carrying capacity.

When Roosevelt Lake recedes, SRP exposes gartersnake habitat along the Tonto Creek Arm in the CS that gartersnakes can use successfully. Previously inundated Tonto Creek channel pools for hunting and feeding will be reestablished and resting and brumation sites become available. Saturated soils promote the growth of riparian and herbaceous vegetation for cover. The increased moisture benefits amphibian and other small aquatic or terrestrial prey populations. Gartersnakes can hunt and acquire accessible smaller nonnative predatory fish in Tonto Creek pools as the lake recedes. Increased gartersnake habitat and prey resources attracts and supports gartersnakes.

SRP's Modified Roosevelt Dam operations draw gartersnakes into the CS by exposing gartersnake habitat, increasing the risk of nonnative fish predation. Roosevelt Lake is a source of nonnative predatory fish, and therefore larger predatory fish can occur where gartersnakes hunt in Tonto Creek Arm CS pools after the lake recedes or along the lake's edge (at any lake elevation). Owens *et al.* (2023) extracted DNA from sportfish fecal samples from its confluence with Roosevelt Lake, confirming largemouth bass predation of gartersnakes. Additionally, based upon Emmons *et al.*'s (2016) observations elsewhere, gartersnake ingestion of nonnative predatory fish with spines can lead to puncture injury and/or death.

Conservation Space Operations and Lower Tonto Creek

SRP's long-term storage of water in the CS provides an environment that allows nonnative predatory fish to persist and proliferate and periodically move into lower Tonto Creek, adversely affecting gartersnakes from predation and injury, and its survivorship and reproduction.

When there is hydrologic connectivity between Roosevelt Lake and Tonto Creek, there is an opportunity under certain flow conditions for nonnative fish to swim out of the lake and upstream into lower Tonto Creek. SRP estimates that when Tonto Creek flows between 200 and 1,100 cfs occur (typically between February 1 and May 31), nonnative fish residing in the lake can move upstream into Tonto Creek (ERO-GEI 2022a). The spawning behaviors of nonnative predatory sportfish make it more likely that these fish will seek habitat outside of the lake and move into stream habitats between February 1 and May 31 (ERO-GEI 2022a). These sportfish are likely limited in further upstream movement by large culverts at East Del Chi Drive 14.1 miles upstream of the Tonto Creek FCS. Nonnative predatory fish spawning behavior make it more likely fish will move into stream habitats between February 1 and May 31 (ERO-GEI 2022a).

The effects of SRP's conservation storage activities that lead to incidental take of gartersnakes in lower Tonto Creek are limited to the effects of nonnative fish that leave Roosevelt Lake and move into the creek. Nonnative predatory sportfish have an adverse effect to gartersnakes by increasing predation and wounding and affecting prey resources by reducing survivorship and reproduction. Once Tonto Creek stops flowing and nonnative fish become trapped in residual channel pools and aquatic habitat becomes more restricted, the adverse effects to gartersnakes intensify. These pools are important elements of gartersnake habitat in lower Tonto Creek since they extend the availability of aquatic habitat and the aquatic edge/riparian resources gartersnakes rely on. The presence and abundance of nonnative fish in lower Tonto Creek relates to the amount of time that the lake and the creek are connected. It is reasonable to conclude that the longer this connectivity occurs, the more nonnative fish will make the move from the lake into the creek.

Nonnative predatory sportfish from the lake in lower Tonto Creek can become trapped in pools as the creek or lake recedes, posing increased risks (and in some cases benefits) to foraging gartersnakes. Smaller sportfish that move upstream can provide gartersnake foraging opportunities, sportfish prey with spines can injure gartersnakes following consumption (Emmons *et al.* 2016), and larger sportfish fish can eat gartersnakes (Owens *et al.* 2023). All predatory nonnative sportfish can eat native fish and amphibian species, reducing gartersnake prey diversity, survivorship, and reproduction. Larger nonnative sportfish in lower Tonto Creek can consume gartersnakes, with smaller snakes likely at greater risk. Lower Tonto Creek through the late spring and early summer typically becomes intermittent with fish stranded in pools. Condensing fish in isolated pools creates situations where smaller fish may be more accessible to foraging gartersnakes, but also where predatory fish congregations can more effectively consume native prey species and increasing the risk of gartersnake predation.

Because sportfish's alteration of gartersnake prey is a prominent factor in its listing as a threatened species and disappearance from a large portion of its range, predatory sportfish effects to gartersnake prey diversity and abundance in lower Tonto Creek may adversely affect its

survivorship and reproduction. The gartersnake's diet can be diverse, consisting of terrestrial and aquatic species, shifting its behavior to consume readily available prey (Emmons *et al*. 2016, Manjarrez *et al*. 2013, Nowak *et al*. 2019). Although gartersnake diet studies in the permit area are unavailable, d'Orgeix *et al*. 2013 documented its diet changing over time to what was seasonally available. Gartersnakes handled and weighed in lower Tonto Creek did not demonstrate they were emaciated (Nowak *et al.* 2015, 2019). Still, sportfish predation can have adverse effects to native fish and other aquatic prey reproduction, recruitment, and growth that are not consistent annually (Jenney *et al*. 2022). Prey diversity and abundance can increase and decrease over time due to precipitation, flooding, drought, fire, vegetation abundance, and other factors. Nonnative sportfish predation can further affect prey species abundance and availability when they are at their most vulnerable from natural events. Therefore, along lower Tonto Creek, nonnative predatory sportfish originating from Roosevelt Lake may reduce a suite or a particularly essential prey species that gartersnakes rely upon, adversely affecting its reproduction or survivorship periodically or slowly over time.

Normal Flood Control Space Operations

We anticipate SRP's normal FCS operations between 2,151 and 2,175 feet amsl is likely to adversely affect gartersnakes like what occurs in the CS, but at a reduced frequency and duration. Normal FCS operations will cover gartersnake habitat with water and alter essential behaviors (brumation, feeding, mating, gestation), causing an increased risk to gartersnakes from nonnative sportfish predation/injury, the possible death of gartersnakes during larger lake elevation changes, and reduced survivorship and reproduction from physiological effects. Because normal FCS operations are most likely to occur in the winter or early spring (December to May), when the weather can be coldest, we anticipate there is a greater likelihood of adverse effects to brumating gartersnakes from water covering the FCS.

Normal FCS operations are unpredictable in occurrence and magnitude, yet SRP expects them to be infrequent, short duration, and timed mostly during winter/spring flooding. Since the raising of Modified Roosevelt Dam in the mid-1990s, SRP has only used the FCS three times. Water has reached no farther than 2,155 feet amsl. SRP expects to use the FCS more frequently over the next 30 years due to influence of climate change and their reservoir planning model results. The greater the horizontal movement of water in the 24-foot FCS, the higher the likelihood that gartersnake displacement will result in physiological effects, reducing survivorship and productivity, and increased exposure to predators.

The WCM guides SRP to reduce the lake's elevation to 2,151 within 20 days, therefore limiting the duration Roosevelt Lake covers gartersnake habitat with water. On rare occasions, multiple storms in a season can cause SRP to cover the FCS with water for months or cause multiple movements of water into the FCS, leading to further physiological effects to survivorship/reproduction and increased exposure to predators. Unlike CS operations, water's shorter duration in the FCS will not create a long-term lentic environment to support nonnative predatory sportfish and sportfish reproduction, reducing the likelihood of infusing lower Tonto Creek with sportfish.

Following the lake's recession, like CS operations, we can anticipate an increase in gartersnake food availability when the lake deposits smaller nonnative sportfish in pools and invigorates the

floodplain with moisture, improving terrestrial and aquatic prey. Because Tonto Creek is also concurrently flooding during this period, downstream flows can also bring nonnative sportfish into the FCS. These pools with concentrated predatory sportfish, especially as the stream dwindles and isolates sportfish, can increase the risk of gartersnake predation/injury.

Planned Deviation

We anticipate SRP's requested planned deviation between 2,151 and 2,156 feet amsl in three out of five years is likely to adversely affect gartersnakes like CS and FCS operations, but with some small differences (Figure 23). SRP's proposed planned deviation is limited to three years, causing fewer recurring effects to gartersnakes and its habitat compared to CS and FCS operations. The amount of gartersnake habitat affected by the planned deviation (2,151 to 2,156 feet amsl) is less when compared to FCS operations (2,151 to 2,175 feet amsl). Yet unlike short-duration 20-day normal FCS operations, the planned deviation's duration can extend to 120 days.

Like CS operations, the planned deviation will cover gartersnake habitat with water and can alter essential behaviors (brumation, feeding, mating, gestation), increase the risk of nonnative sportfish predation/injury, reduce survivorship and reproduction, and increase exposure to predators. The planned deviation will likely begin in the winter or early spring when the weather is the coldest, increasing the likelihood of adverse effects to brumating gartersnakes in the FCS.

The proposed planned deviation extends the duration of water in the FCS from 20 days to 120 days, thereby, in contrast to normal FCS operations, elongating the period that gartersnake habitat in the FCS is unavailable and increasing predation risk to gartersnakes. Extending the inundation duration during the later portions of the gartersnake breeding season increases the likelihood of gartersnake and neonate predation in the FCS, affecting gartersnake survivorship and reproductive success.

In comparison to the larger horizontal lake movements that CS and normal FCS operations can generate, the planned deviation will increase the lake's size on the Tonto Creek Arm by about a third of a mile, which can still displace gartersnakes, resulting in predation, or reduced survivorship and productivity from physiological effects. Any catalyst causing gartersnakes to disperse increases their physiological expenditure of energy and exposure to predators. If the height of the lake is nearer to the top of the CS at 2,151 feet amsl when initiating the planned deviation and water rises slowly, the relatively small increase in lake size can minimize the likelihood or degree of adverse physiological effects and exposure to predation. In contrast, if larger horizontal movement of water in the CS precedes the planned deviation, there is a greater certainty that physiological effects from displacement will manifest in reduced survivorship and/or productivity and increased exposure to predation.

Like CS and FCS operations, following the lake's recession, we can anticipate an increase in gartersnake food availability when the lake deposits smaller nonnative sportfish in pools and invigorates the floodplain with moisture (and subsequent vegetation growth), improving terrestrial and aquatic prey production. These pools with concentrated predatory sportfish, especially as the stream dwindles and isolates sportfish, can increase the risk of gartersnake predation/injury.

Modified Roosevelt Dam Operations and Lower Tonto Creek Gartersnake Population

We can reach some general conclusions about the gartersnake recovery and persistence on lower Tonto Creek even though biologists have not studied the long-term effects of SRP's Modified Roosevelt Dam operations and various natural and manmade effects to gartersnakes and its habitat. We have no detailed long-term information about population demographics and the primary causes for any changes over time. SRP's Modified Roosevelt Dam operations and the extent and duration of water covering the landscape in the CS, likely prevents the CS from being an essential long-term gartersnake recovery location. The 22-mile-long lake likely provides a substantial barrier to gartersnake dispersal to the upper Salt River. Predatory nonnative sportfish consume gartersnakes along lower Tonto Creek and Tonto Arm of Roosevelt Lake. Gartersnakes have persisted in lower Tonto Creek and used the Roosevelt Lake CS, even with Roosevelt Dam modifications, expansion to Roosevelt Lake's CS, and nearly a century of stocking predatory sportfish in Roosevelt Lake. There is likely a dynamic complex relationship between the intermittent lower Tonto Creek stream flow and fluctuating Roosevelt Lake surface area that creates gartersnake habitat and foraging opportunities, which to date can overcome or limit the adverse effects of nonnative predatory fish and the duration that Roosevelt Lake covers gartersnake habitat.

Conservation/Mitigation Program

SRP's gartersnake conservation/mitigation program, habitat-based surrogates, and crediting system appropriately apply measures to fully address the impacts of incidental take because they target the most impactful threat to the gartersnakes from the proposed action (predatory nonnative fish); implement actions in appropriate locations inside and outside the permit area (nonnative fish suppression and native fish/frog stocking); address uncertainty and mitigation lag times; and establish an effective crediting system (Tables 1 and 2). We expect with the implementation of this program will fully replace the biological value affected by the covered activities.

SRP's gartersnake conservation program for Modified Roosevelt Dam's long-term conservation storage operations will offset adverse effects along lower Tonto Creek by suppressing nonnative predatory fish and stocking native fish. SRP's conservation efforts immediately above Roosevelt Lake along lower Tonto Creek offset the effects of long-term conservation storage by directly suppressing the nonnative predatory fish that leave Roosevelt Lake, enter lower Tonto Creek's gartersnake habitat, and consume gartersnakes and its prey. Replacing predatory sportfish with non-predatory native fish replenishes gartersnake prey that may, in the long-run, help improve overall lower Tonto Creek native fish abundance and diversity. SRP's trigger to initiate fish management conservation efforts relies upon the stream flows most likely to allow sportfish to leave Roosevelt Lake and travel upstream. Suppressing fish when they become isolated in pools is efficient because there is little effectiveness to suppressing fish while Tonto Creek has sustained flows. SRP suppression strategy occurs across the entire length of Tonto Creek where fish from Roosevelt Lake persist, ending at barriers created by large culverts at East Del Chi Drive. Suppression efforts are most concentrated closest to Roosevelt Lake where fish dispersal is most likely to occur, coinciding with the persistence of year-round water in the channel, and gartersnake distribution.

SRP's nonnative predatory fish suppression and native fish/frog stocking efforts outside of the permit area upstream along lower Tonto Creek near Gisela offset the adverse effects of water covering gartersnake habitat and nonnative predatory fish from conservation storage and normal flood control operations. The frequency, amount, and area covered by water in the CS and FCS prevents reasonable or effective conservation implementation in the CS and FCS. SRP will target large pools for suppression and stocking throughout the permit duration along this perennial three-mile Tonto Creek segment in gartersnake habitat. SRP will implement these aquatic species management actions based upon a reasonable schedule and effectiveness of the actions. Implementing mitigation actions along Tonto Creek focuses efforts within the same local gartersnake population, but outside the influence of Roosevelt Lake.

SRP's conservation actions for the planned deviation, focus on stocking native fish in the planned deviation area to offset the adverse effects from covering gartersnake habitat with water and predatory nonnative fish. Because of the existing aquatic baseline, short duration of the planned deviation, and limited area of effect, this conservation approach is appropriate to improve the availability and diversity of gartersnake prey.

SRP is not initiating or crediting nonnative predatory sportfish suppression efforts in the FCS specifically to offset normal FCS operations and the planned deviation because it is our expectation that conservation storage is the primary action that supports nonnative predatory nonnative fish. Both normal FCS operations and the planned deviation are shorter duration and periodic events that cover a smaller area and are unlikely to establish substantial lentic environments for sportfish and reproduction. Yet, there are sportfish suppression efforts in the portions of the FCS credited toward CS operations. Additional efforts would likely have minimal benefits due to the short-term duration of these flood control actions.

We anticipate SRP's alternate mitigation locations where gartersnakes occur on the San Pedro, Babocomari, and Santa Cruz rivers can be effective, and because they are distant from Tonto Basin, they are appropriate secondary sites. Gartersnake distribution limits where SRP can complete alternate mitigation actions. Should SRP use these mitigation sites, we anticipate similar benefits to gartersnakes by reducing the risk of gartersnake predation by nonnative sportfish and stocking native fish to improve prey diversity.

SRP has considered uncertainties in the development of their conservation/mitigation program and accounted for any delays in its implementation. SRP's conservative approach to offsetting incidental take in Roosevelt's CS and FCS is protective of the gartersnake, setting conservation/mitigation objectives that are likely to exceed the actual impacts of take. To the extent practicable, SRP will generate conservation credit concurrent with or in advance of take to ensure there is no lag time in implementing mitigation. In the rare event a substantial lag in the timing of implementation occurs, a 5% increase in the mitigation still owed will accrue each year the lag persists.

SRP has constructed their gartersnake habitat surrogate and crediting system based largely on acres affected by Modified Roosevelt Dam operations and units of acre-years influenced by conservation/mitigation actions (Table 2 and 4). We expect the influence of suppression and stocking activities will extend beyond the footprint of actual suppression and stocking locations because fish and frogs are able to disperse upstream and downstream. SRP has conservatively

applied, based upon their professional opinion, and input from our office, how to convert credit generated by funding a lowland leopard frog breeding facility into acres. SRP has also appropriately weighted, with the input from our office, the relative value and duration of the conservation and mitigation actions. Overall, SRP's planned conservation and mitigation credit opportunities exceed the anticipated effects from the project.

Tipping Point for Recovery

In *Wild Fish Conservancy v. Salazar*, 628 F.3d 513 (9th Cir.2010), the Ninth Circuit held that the FWS must identify when a species would pass the tipping point for recovery and determine whether the proposed action would cause the species to reach that tipping point. That case, and subsequent cases addressing "tipping point," involved challenges to biological opinions that analyzed the effects of project-specific Federal actions.

Our evaluation of whether Roosevelt Dam operations reaches the tipping point for recovery is based upon the long-term persistence of gartersnakes under existing SRP operations compared to the proposed operations with conservation/mitigation measures. Gartersnakes have occurred on lower Tonto Creek since at least 1995, and likely were present through the extensive modifications to the Tonto Creek/Salt River confluence when building Roosevelt Dam in the early 1900s, through dam modifications in the mid-1990s. Throughout most of this period and up to the current date, conservation storage operations supported nonnative sportfish habitat. There is likely a dynamic complex relationship between the intermittent lower Tonto Creek stream flow and fluctuating Roosevelt Lake surface area that creates gartersnake habitat and foraging opportunities, which to date can overcome or limit the adverse effects of nonnative predatory fish and the duration that Roosevelt Lake covers gartersnake habitat. Additionally, the gartersnake conservation and mitigation measures in this RHCP amendment will offset the adverse effects of Modified Roosevelt Dam conservation and normal flood control operations (including the planned deviation) by suppressing predatory nonnative fish and stocking nature aquatic prey, and improving its persistence along lower Tonto Creek. Accordingly, due to the gartersnake's persistence during past SRP operations, and the addition of the conservation and mitigation measures planned for the proposed actions, the Modified Roosevelt Dam operations and the RHCP amendment will not reach the tipping point for gartersnake recovery.

Critical Habitat

We anticipate Modified Roosevelt Dam conservation and flood control operations will adversely affect gartersnake critical habitat located upstream of Roosevelt Lake along Tonto Creek, between East Del Chi Drive and elevation 2,151 (Figure 9). There is no gartersnake critical habitat designed below 2,151 feet amsl in the Roosevelt Lake CS. SRP's conservation and mitigation measures to suppress nonnative predatory sportfish and stock native fish and frogs along lower Tonto Creek helps to reduce and minimize effects to designated critical habitat.

SRP's conservation storage operations maintain habitat for nonnative predatory fish which can leave Roosevelt Lake and travel up Tonto Creek, affecting PBF 3 and 4. SRP estimates that flows between 200 and 1,100 cfs creates conditions where sportfish are most likely to leave Roosevelt Lake and enter Tonto Creek. In addition to Roosevelt Lake, predatory sportfish can populate lower Tonto Creek from tributaries and farther upstream. Lower Tonto Creek is an intermittent stream, where the decline in stream flow annually factors into reduction of nonnative

sportfish. When adequate flows in Tonto Creek occur, Roosevelt Lake's nonnative predatory sportfish helps to repopulate lower Tonto Creek adversely affecting native aquatic prey species (PBF 3) and abundance of nonnative predatory fish (PBF 4).

Both normal FCS operations (2,151 to 2,175 feet amsl) and the planned deviation (2,151 to 2,156 feet amsl) can temporarily cover the streams, pools, backwaters, sheltering sites, vegetation, and other terrestrial sites that gartersnakes rely upon (PBF 1) by converting them to open lake water. Once SRP evacuates water from these temporary uses of the FCS, the FCS can return to habitats gartersnakes rely upon. These temporary uses of the FCS can also deposit nonnative predatory fish into the streams and pools of the Tonto Creek channel affecting PBF 3 and 4.

Raising Roosevelt Lake temporarily into the FCS through normal operations and the planned deviation adversely affects hydrologic processes (PBF 2) in a unique way. SRP's FCS operations mimic the effect of natural stream flooding, but dam operations exacerbate the effects through the manipulation of wide expanses of open lake water. FCS operations expand the distribution of water across the floodplain, including riparian areas, for a temporary periods of time.

SRP's gartersnake conservation/mitigation program in lower Tonto Creek and near Gisela to suppress nonnative predatory sportfish and stock native fish and frogs both help to minimize the abundance of nonnative predatory sportfish abundance (PBF 4) and their effect on native prey species (PBF 3).

The lower Tonto Creek segment that represents 14.1 miles of Tonto Creek and the Roosevelt Lake FCS consists of 2,375 acres of gartersnake critical habitat, and the 3 miles of the Gisela Reach 221 acres. Overall, these 2,596 acres are approximately 13% of the entire 20,326-acre designation in Arizona and New Mexico. The adverse effects to critical habitat within the FCS by enlarging the lake from normal FCS operations and the planned deviation occur over a small area, are periodic and temporary, and the terminal end of the critical habitat segment will retain its function for gartersnake recovery. While there will be continued nonnative predatory fish movement from Roosevelt Lake into lower Tonto Creek, SRP's conservation measures will, throughout the permit duration, suppress and reduce the duration these predatory nonnative fish occur in Tonto Creek and improve the occurrence of native fish. Farther upstream near Gisela, outside of the permit area, SRP's mitigation measures similarly suppress aquatic nonnative predatory fish and stock native fish and frog species. We anticipate the implementation of the conservation and mitigation measures will minimize adverse effects to critical habitat by reducing the duration and abundance of nonnative predatory sportfish in these two Tonto Creek segments, and overall improving the environmental baseline for gartersnake recovery.

Southwestern Willow Flycatcher and Yellow-Billed Cuckoo

The adverse effects of SRP's conservation storage operations to flycatchers and cuckoos and their habitats is described in the original RHCP (ERO 2002) and our biological opinion (USFWS 2003). We anticipate the same types of adverse effects to the birds and their habitat from the planned deviation, and do not anticipate adverse effects from normal flood control operations.

We will amend SRP's permit area to include the FCS for effects to flycatcher and cuckoos from the planned deviation, but no additional incidental take is necessary. The type of adverse effects

from the planned deviation are the same effects described for conservation storage operations in the original RHCP and biological opinion (breeding habitat alteration), yet over a smaller area. The adverse effects to flycatchers and cuckoos from the planned deviation will occur from 2,151 to 2,156 feet amsl and within territories that rely upon habitat across the boundaries. SRP based its existing flycatcher and cuckoo incidental take habitat surrogate metrics on annual affected habitat acreage. Those annual exceedance limits (flycatcher = 750 acres, cuckoo = 313 acres) are robust enough to not require additional incidental take coverage or additional conservation measures for affects associated with the FCS and proposed planned deviation. Based upon the current existing higher lake elevation, nearer to 2,151 feet amsl and minor effects from the planned deviation, we think it is not likely that SRP will surpass its existing incidental take exceedance limits while implementing the planned deviation over the next five years.

Normal Flood Control Space Operations

We anticipate normal flood control operations will not adversely affect flycatchers and cuckoos because of the timing and limited duration of flood control operations. Flood control activities typically occur during winter and spring precipitation, and run off events, prior to the arrival of flycatchers and cuckoos in their territories in very end of April and early May (flycatchers) and June (cuckoos). Normal flood control operation places water in the FCS for a maximum of 20 days, with the rare instance where consecutive multiple storms may cause water to persist for longer. Regardless of the various scenarios, water is likely to recede below the FCS to 2,151 feet elevation amsl prior to flycatchers and cuckoos arriving and establishing territories.

We anticipate normal flood control operations will have an insignificant effect to flycatcher and cuckoo habitat. SRP's normal flood control operations typically occur during flood events in the winter and spring and the 20-day duration is like natural flooding. If stream flooding occurs on the Salt River or Tonto Creek immediately preceding a lake elevation increase from normal flood control operations, it will be difficult to distinguish natural effects from flood water inflow and any minor effects from short-term normal flood control operations. Mature cottonwood (Markovchick 2021), willow (Stevens and Waring 1986), and likely tamarisk (Ellis *et al*. 2008, Gladwin and Roelle 1998, Stromberg 1997, and Stromberg *et al*. 1993) can withstand short-term 20-day inundation. Based upon SRP's reservoir planning model, they estimate there is a low likelihood shallow water could persist in the lowest foot of the FCS for three to six months into the early summer, affecting seedlings and sapling trees. We think the low likelihood and small area affected is not likely to adversely affect flycatcher and cuckoo territories, and these small plants will immediately regenerate after the lake recedes resulting in an insignificant effect. Raising water in the FCS will have the effect of replenishing the groundwater table and aquifer across the floodplain the helps initiate native plant regeneration. Therefore, normal FCS operations closely mimic the effects of natural flooding, mature vegetation is likely to withstand short-term inundation, and any minor effects to regenerating riparian trees are likely insignificant to flycatchers and cuckoos.

Planned Deviation

We anticipate the 120-day duration of the planned deviation (over 3 breeding seasons in 5 years) can adversely affect flycatcher and cuckoo reproductive success between 2,151 and 2,156 feet

amsl by affecting existing nesting habitat availability and suitability, and temporarily preventing riparian habitat from growing into suitable nesting habitat (Figures 19 to 22).

The planned deviation will cover nesting habitat with water for 120 days and reduce its availability for returning nesting flycatchers and cuckoos, reducing, or preventing reproduction. SRP estimated, using Light Detection and Range (LIDAR) data, the flycatcher/cuckoo satellite habitat suitability model (Hatten and Paradzick 2003), and known nesting height and vegetation information that the water's height would diminish the availability of approximately 12 acres of flycatcher nesting habitat and 2.6 acres of cuckoo nesting habitat on the Tonto and Salt Arms. These acreage estimates may change based upon continued changes in habitat quality prior to and because of the planned deviation (see next paragraph). Flycatchers typically have higher fidelity to territories than cuckoos, but both can return to previous year's nesting sites. Altering nesting habitat availability can force flycatchers and cuckoos to find alternate nesting sites and mates. Flycatchers and cuckoos may not find secondary nesting sites or mates or may find locations and mates but in less suitable habitat, leading to reduced or failed reproduction.

The 120-day planned deviation can reduce flycatcher and cuckoo breeding habitat quality between 2,151 and 2,156 feet amsl, and territories within and adjacent to these boundaries in breeding seasons during, between, and following deviation implementation, preventing, or reducing reproduction. SRP estimates adverse effects to 75.9 acres of suitable flycatcher breeding habitat and 43.0 acres of suitable cuckoo breeding habitat, based upon the current vegetation conditions along the Salt and Tonto Arms. Mature willow is likely to withstand partial 120-day inundation and may thrive with additional water (ERO 2002), but short, sapling, and seedling willows can succumb from complete inundation for 120 days. Mature cottonwood is at risk from partial inundation near 120 days, and any seedling and saplings will not likely survive (Markovchick 2021). Mature, short, and sapling tamarisk completely covered with water is likely the most sensitive to inundation, with mortality documented after 80 days (Warren and Turner 1975). There are gaps in the literature documenting exactly how mature riparian trees, especially cottonwood, will respond to partial or complete inundation, the specific tolerance duration, how much of the plant above water is necessary to live, and how the frequency of repeated inundation over time influences persistence. Reducing habitat suitability can adversely affect the availability of cuckoo or flycatchers nesting habitat above the water's elevation during each deviation (see first paragraph), and more likely, the quality of breeding habitat in breeding seasons between deviation implementation and after the entire deviation is completed. Altering nesting habitat suitability can force flycatchers and cuckoos to find alternate nesting sites, preventing reproduction or causing reduced success. Due to site fidelity, flycatchers and cuckoos may still attempt to nest in less suitable habitat within the deviation space, resulting in nest failure, reduced productivity, or increased exposure to predation/parasitism.

We anticipate that the planned deviation, if fully executed, can adversely affect flycatchers and cuckoos and its habitat through the 5-year deviation duration, and for 3 to 4 years longer following the last implementation. The duration of the planned deviation's effects to flycatcher and cuckoo habitat can be less if the deviation occurs in fewer than three out of five seasons. We anticipate the planned deviation will adversely affect the availability and suitability of existing nesting habitat, described above. Overall, the planned deviation will occur across 208.2 acres of flycatcher habitat and 181.0 acres of cuckoo habitat, temporarily affecting habitat from growing into suitable flycatcher and cuckoo nesting habitat. Once SRP completes a deviation for a season,

the exposed wet floodplain will likely stimulate plant growth. Any subsequent deviations will likely adversely affect any plants that began to re-establish. In contrast to normal flood control operations, the deviation will expose the wetted floodplain in the summer, after native willows and cottonwoods seed in the winter and spring, likely causing tamarisk to flourish. With the presence of the tamarisk leaf beetle at Roosevelt Lake, we are uncertain to what extent tamarisk can re-establish into flycatcher or cuckoo habitat. Subsequent winter or spring flooding may occur following the deviation that helps to re-establish native cottonwood or willows.

Tipping Point for Recovery

As noted above, we must identify when the effects of project-specific Federal actions may cause a species to pass the tipping point for recovery.

We base our evaluation of whether SRP's requested planned deviation reaches the tipping point for flycatcher recovery upon the flycatcher recovery plan (USFWS 2002a) and its status rangewide, in Arizona, and at Roosevelt Lake, and for the cuckoo, its local, statewide, and rangewide status. There is not a completed cuckoo recovery plan.

The increase in flycatcher territories across its range and Arizona since listing, the high number of flycatcher territories in the Roosevelt Management Unit, and conservation and mitigation SRP has implemented for Modified Roosevelt Dam operations prevents the temporary adverse effects from the planned deviation to reach the tipping point for recovery. Durst's (2017) most recent numerical estimate of flycatcher territories across its range was just over 1,600 territories, greater than Unitt's (1987) estimate of 500 to 1,000 rangewide territories near the time of listing in the mid-1990s. In Arizona, the statewide estimate has increased since listing from 145 in 1993 to 679 territories in 2012 (Durst 2017).

The Roosevelt Management Unit has a recovery goal of 50 flycatcher territories (USFWS 2002a), which flycatchers have regularly surpassed, even with the wide fluctuation of Roosevelt Lake water levels. In 2021, surveyors found 236 flycatcher territories in the Roosevelt Lake CS and FCS. Additional flycatcher territories in the Roosevelt Management Unit, outside of the Roosevelt Lake CS and FCS, occur on the upper Salt River, Tonto Creek, Pinal and Cherry Creeks, and Rock House Demonstration Site. Together, these non-Roosevelt Lake sites can total about 20 to 40 territories. Importantly, at Roosevelt Lake's highest water elevation, flycatcher territories can still occur in taller vegetation above the water's surface (Ellis *et al.* 2008). Thus, the high number of populations in the area are somewhat insulated from threat even when water levels are higher and, as discussed below, will also benefit from SRP's ongoing conservation and mitigation measures. Overall, the Roosevelt Management Unit is one of the few Management Units across the bird's breeding range, even with lake fluctuations, that has consistently exceeded its numerical recovery goals. Additionally, SRP has implemented conservation and mitigation measures from their initial RHCP that will offset the anticipated adverse effects from the planned deviation, as well as conservation storage. In conclusion, based upon the flycatcher's improved status since listing across its range, Arizona, and Roosevelt Management Unit, and SRP's ongoing RHCP conservation and mitigation measures for Modified Roosevelt Dam operations, we conclude that the temporary effects of the planned deviation prevent the flycatcher from reaching the tipping point for recovery.

The abundance and distribution of cuckoos across its breeding range and Arizona, and conservation and mitigation SRP has implemented for Modified Roosevelt Dam operations prevents the temporary adverse effects from the planned deviation to reach the tipping point for cuckoo recovery. The cuckoo's rangewide territory estimates are near 1,300 and there are an estimated 450 cuckoo breeding territories across Arizona (USFWS 2019b). Cuckoo territories at Roosevelt Lake can fluctuate but are lower in comparison to other areas in Arizona, with 9 territories in the Roosevelt CS and FCS in 2020, and 2 territories in the FCS in 2021. There is no completed cuckoo recovery plan to evaluate its status against recovery goals. However, with so few cuckoo territories in Roosevelt, the temporary and periodic effects would not tip the cuckoo away from recovery because periodic harm to such a small number of territories would have minimal impact on cuckoo recovery as a whole. Despite the smaller number of cuckoo territories at Roosevelt Lake, SRP's conservation and mitigation measures help protect the cuckoo at Roosevelt Lake and mitigate for effects elsewhere by acquiring and managing cuckoo habitat. The types of anticipated effects to cuckoos and its habitat from the planned deviation are similar to what occurs within the Roosevelt Lake CS, but across a much smaller area. The planned deviation's effects are temporary and when the lake recedes, cuckoo habitat re-establishes, and nesting cuckoos can again take advantage. SRP has implemented conservation and mitigation measures from their initial RHCP that will offset the anticipated adverse effects from the planned deviation, as well as conservation storage. Based upon the cuckoo's wide distribution and abundance across its range and Arizona, its low numbers at Roosevelt Lake, and SRP's ongoing cuckoo RHCP conservation and mitigation measures for Modified Roosevelt Dam operations, we conclude that the temporary effects of the planned deviation prevent the cuckoo from reaching the tipping point for recovery.

Conservation/Mitigation Program

There are no additional conservation or mitigation actions proposed in SRP's RHCP amendment for flycatchers or cuckoos because the effects will not surpass SRP's existing incidental take exceedance limit identified in their permit. SRP will continue to implement the conservation and mitigation measures described in their 2002 RHCP (ERO 2002), which included land acquisition and management of flycatcher and cuckoo habitat, development, and management of the Rock House Demonstration Site, and funding a Forest Protection Office at Roosevelt Lake.

Critical Habitat

We anticipate that normal flood control operations between 2,151 and 2,175 feet amsl will have an insignificant effect to flycatcher and cuckoo riparian habitat and insect PCEs and PBFs that describe the processes supporting riparian plant development and growth. Normal 20-day flood control operations closely mimic the timing, duration, and magnitude of natural flooding on Tonto Creek and the Salt River. Any mature, small, or sapling trees affected by rising water will likely be insignificant due to the short 20-day duration water occurs in the FCS. Any small amount of water persisting longer in the lowest foot of the FCS, however unlikely, would occur across a small area of the floodplain, resulting in an insignificant effect to sapling and seedling plants or shorter tamarisk trees. Any persisting water would likely enhance aquatic and terrestrial insects. The moisture from the lake following recession, similar to a river after flooding subsided, would likely enhance insect populations and immediately regenerate any small plants or saplings adversely affected.

We anticipate the planned deviation and extended 120-day plant inundation between 2,151 and 2,156 feet amsl will have an adverse effect to flycatcher and cuckoo riparian habitat PCEs and PBFs that describe the processes supporting riparian plant persistence, development, and growth. For however long SRP implements the deviation, we anticipate the adverse effects are most likely to affect the regeneration of flycatcher and cuckoo critical habitat, and the persistence and growth of a dense understory. The extended 120-day duration of water across the floodplain in 3 out of 5 years is likely to kill some mature riparian trees and most likely any small trees, seedlings, and saplings completely covered by water across 208.2 acres of flycatcher critical habitat and 181.0 acres of cuckoo critical habitat. Mature tamarisk, especially those completely covered by water, are the most likely to succumb from long-term and repeated inundation. Mature cottonwoods are at risk from extended inundation and possibly from repeated inundation across multiple seasons, however the literature is less certain how they will respond. Mature willow trees are most likely to withstand inundation for 120 days and some may thrive from the additional water. These adverse effects are temporary and limited to the 5-year deviation and the duration for habitat regeneration following its completion. The persistence of some taller riparian trees above the lake's surface across the planned deviation area, combined with lake's water, will likely have an insignificant effect to flycatcher insect prey populations; increased water surface area may temporarily alter terrestrial insects, but enhance aquatic insects. The cuckoo breeding season occurs a little later in the season than flycatchers, and the exposed moist floodplain following the lake's recession could improve terrestrial cuckoo insect prey.

Bald Eagle

The bald eagle is currently a delisted species, and the Eagle Act is the primary Federal regulation addressing adverse effects and eagle incidental take permits. The Eagle Act describes that a valid HCP permit under the Section 10 of the Endangered Species Act constitutes a valid permit under the Eagle Act. The EA includes our analysis of this entire project, including conservation and all flood control operations, under the Eagle Act.

The original RHCP (ERO 2002) and our biological opinion (USFWS 2003) described effects to bald eagles, their nests, nest trees, eggs, nestlings, and productivity from raising and lowering water in the CS. We still anticipate those effects for the 30-year remainder of the permit. Lake water can inundate, kill, degrade, and destroy eagle tree nests; inundate and destroy nests; and inundate and kill eggs and nestlings. Long-term drought and drying can also influence the longevity and suitability of nest trees. Adult breeding eagles may abandon breeding attempts or nests with eggs or nestlings as rising lake water approaches the tree nest, without covering the nest with water. When the lake in the CS reaches extremely low levels below 2,100 feet in elevation amsl for an extended duration during the breeding season, some bald eagle foraging areas may be affected, reducing the eagle's acquisition of food, resulting in failed nesting attempts, reduced number of eggs laid, death of eaglets, and reduced overall productivity for the collection of pairs relying on fish resources.

We are including an analysis of this RHCP amendment under the Endangered Species Act, should the bald eagle become listed species in the future, addressing effects from normal flood control operations and the planned deviation.

We anticipate normal flood control operations and the planned deviation have the minor risk of some additional effects not considered in the original HCP. We did not previously describe an increased risk to newly fledged eaglets drowning based upon the extended duration of water surrounding or near nest trees in the FCS and nest trees at the highest elevations of the CS. We also describe the increased risk to bald eagle nest trees, breeding attempts, and habitat from normal flood control operations and the planned deviation, which are similar to effects described in the original RHCP for both the Pinto and Tonto breeding areas.

After reviewing the original RHCP, our biological opinion, and the status of the eagle at Roosevelt Lake, we recognized that our incidental take exceedance measures for the RHCP could be more thorough, measurable, and better incorporate the eagle's changing distribution and abundance at Roosevelt Lake. For example, we did not specify how many eagle nests, nest trees, eggs, or nestlings SRP may incidentally take by Modified Roosevelt Dam operations. We did specify the number of fewer eaglets from lower lake levels, but that metric was difficult to accurately measure. In both of those instances, our exceedance metrics could better reflect the frequency of occurrence and anticipate the eagle's changing distribution and abundance. As a result, we will replace the exceedance measures from the original RHCP with improved metrics that people can observe and measure, which also include the possible minor effects from normal FCS operations and the planned deviation (Table 5).

Normal Flood Control Operations

Normal flood control operations, due to their typical short duration and timing in the winter and early spring, mimic natural flooding and in most circumstances will likely have an insignificant effect to bald eagle nest trees and habitat. Normal FCS operations may have a minor effect to sapling trees from inundation, in particular those rare instances where consecutive storms extend the presence of water in the FCS. However, we think this effect to bald eagle habitat would be temporary and insignificant due to the recession of water creating immediate opportunities to stimulate habitat regeneration and growth of both cottonwood and willow in the FCS. It is unlikely the typical short duration 20-day normal flood control operations or any rare extended duration of water will adversely affect existing mature bald eagle cottonwood or willow nest trees. Both mature cottonwood and willow trees can withstand 20-day periods where water surrounds the tree, with increased risks to cottonwood near four months of inundation. Elevating water near bald eagle nest areas can increase bald eagle access to both fish and waterfowl food resources.

In most expected normal flood control operations, we anticipate the timing, frequency, and magnitude of water will not adversely affect bald eagle nest attempts and productivity. Bald eagles may be nesting in trees in the FCS, yet we anticipate that most water elevations will not reach high up a nest tree where nests typically occur, risking nest inundation or nest abandonment. SRP anticipates using the FCS more in the future, but since Roosevelt Dam modifications in the mid-1990s, the water has only previously entered the lowest four feet of the FCS, without adversely affecting any bald eagle nest from inundation.

There may be unusual circumstances over the next 30 years, where the location of an eagle nest tree, height of nest, and magnitude/duration/height of water in the FCS from normal flood control operations risk adversely affecting breeding attempts from inundation, destroys nests,

and kills nest trees. The FCS space extends all the way to 2,175 feet in elevation amsl. We think these instances are a possibility, but it is likely a rare circumstance, and may not ever occur.

Planned Deviation

The likelihood of effects to bald eagle nest trees from the planned deviation relies on whether bald eagles have nest trees within the 2,151 to 2,156-foot elevation amsl. Water from the planned deviation can occur in this area for 120 days annually in 3 out of the next 5 years. At Roosevelt following the 2023 breeding season, the Pinto eagle's lone nest occurs within the planned deviation area on the Salt Arm, while to the Tonto eagle's nest presently sits in the CS on the Tonto Arm. During the period of the planned deviation, bald eagles may build other nests in trees located in the planned deviation area. It is not unusual for bald eagles to have multiple nest trees in their territories where they may choose to lay eggs.

Water from the extended 120-day duration of the planned deviation increases the risk of killing mature live cottonwood bald eagle nest trees, but water from the deviation is not likely to rise high enough to inundate nests or disrupt breeding attempts. There is not robust information in the literature about how mature cottonwood trees respond to long-term inundation or repeated inundation for consecutive years. Cottonwood trees may withstand multiple months of inundation near the duration of the 120-day planned deviation (Markovchick 2021), but due to the lack of robust literature on this subject and effects of inundation occurring repeatedly across seasons, there is an increased risk to eagle nest trees as the deviation reaches the limits of projections. The Pinto nest tree is approximately 37 feet tall (SWCA 2023a), therefore there is little to no risk that water from the deviation can rise high enough to destroy eagle nests or affect nestlings, eggs, or productivity in this location. There are no currently known bald eagle nests placed in willow trees within the planned deviation area, but in contrast to cottonwood, mature willows have regularly withstood over four months of inundation.

The planned deviation will extend the lake approximately a third of a mile horizontally at either end of the lake, possibly giving eagles an increased shallow area for foraging. These areas will likely have some vegetation above the water, generating perching opportunities and shallow water for eagles to acquire live fish, waterfowl, and carrion.

The extended 120-day duration of the planned deviation will have the effect of disrupting any regenerating or small trees that could grow into bald eagle nesting habitat between 2,151 and 2,156 feet in elevation amsl. The planned deviation's extended 120-day inundation of vegetation in 3 seasons over 5 years will likely cause any submerged saplings or small trees to die. Water from the deviation will recede in the late spring or early summer, after the winter/spring seeding seasons for cottonwood or willow, stimulating tamarisk growth. Bald eagles in Arizona have not used tamarisk for nest placement due to its smaller and shorter stature. Therefore, the planned deviation will have the effect of temporarily disrupting the establishment and growth of bald eagle nesting habitat between 2,151- and 2,156-feet in elevation amsl on Roosevelt's Tonto and Salt Arms. Normal stream flooding during the normal winter and early spring can help to stimulate cottonwood and willow regeneration.

Planned Deviation, Normal Flood Control Operations, and Drowned Fledglings

Depending on the timing of bald eagle nesting attempts, both normal flood control operations and the planned deviation can extend water around bald eagle nests during the fledging period, increasing the likelihood of newly fledged eagles drowning. Unlike conservation storage operations, FCS operations can extend the duration of the lake above 2,151 feet in elevation amsl farther into the nesting season when eaglets are old enough to take their first flight. Fledglings have yet to develop strong flight muscles and skills, are awkward once they leave the nest, and have difficulty managing extended flight. Fledglings can leave the nest with no place to land but water. If they land in the water and are unable to raise out of the water or swim to nearby shore, they will likely drown. Our expectation is that normal flood control operations are less likely to increase the drowning risks to fledgling due to their infrequency and typical short 20-day duration and occurrence in winter and early spring. Yet there may be rare circumstances with consecutive storms, extended duration of water, and early nesting that creates risks to fledglings. The planned deviation and its 120-day duration is more likely to overlap the fledging season, creating higher risks to bald eagles fledging into water and drowning from nest trees below 2,156 feet in elevation amsl in the FCS and CS.

Lower Tonto Creek Fish Management

We anticipate the effects of SRP's lower Tonto Creek fish management actions will have an insignificant effect to bald eagles due to the magnitude and timing of fish suppression efforts, and the possible short-term benefits of food availability and long-term benefits to fish diversity. SRP will suppress nonnative predatory sportfish in the lowest parts of Tonto Creek when the creek has dried into isolated pools during the end of the bald eagle nesting season when eaglets are typically near fledging or have recently fledged from the nest. Eagles may have difficulty acquiring live fish in deeper pools, because they typically trap live fish in shallow water against the creek bottom (Hunt *et al*. 1992). Therefore, creating fish carrion from electrofishing may have a short-term benefit by creating easily accessible food for eagles during a period when acquiring live fish may be difficult. Farther upstream near Gisela, where Tonto Creek is perennial, we expect similar short-term benefits to breeding eagles from creating carrion from electrofishing. Breeding bald eagles typically have difficulty acquiring live largemouth bass in streams due to their persistence in deeper water and upward orientation yet can rely on catfish and carp in shallow water and as carrion (Hunt *et al*. 1992). As a result, we anticipate suppressing largemouth bass in lower Tonto Creek will have an insignificant effect to eagle's diet or foraging. We expect any temporal effects from SRP's catfish and carp suppression in lower Tonto Creek will be insignificant by limiting suppression to pools, only suppressing fish periodically, and stocking native suckers. Suckers are a critical eagle prey item that eagles rely on in free-flowing streams, especially when they become accessible while spawning in the late winter and early spring (Hunt *et al*. 1992). Native suckers are vulnerable to bass and catfish predation (Hunt *et al*. 1992, Driscoll *et al.* 2006). Therefore, we anticipate SRP's suppression and stocking efforts can have periodic increases to carrion availability for bald eagles, and improve the overall fish diversity for bald eagles by reducing predatory nonnative fish pressure on native suckers and stocking native suckers.

Bald Eagle Distribution and Abundance is Unpredictable

Through time, we can anticipate the number of bald eagle territories, nest sites, and use of nest trees in the Roosevelt CS and FCS in any single season will be unpredictable. Bald eagles nesting at the Tonto Creek (Tonto Breeding Area) and Salt River Arms (Pinto Breeding Area) have persisted since establishment in the 1980s and 1990s. In the initial RHCP, we anticipated both the Tonto and Pinto bald eagles would be at risk from conservation storage operations causing adverse effects to their nest trees, nests, eggs/nestlings, and productivity. Yet, while these eagle territories persist, they have placed nests in 20 different trees, with some inside the CS and others in the FCS. Since completion of the initial RHCP, additional bald eagle pairs established territories and nest trees within the heart of the CS (Campaign Bay breeding area) and at the perimeter of the FCS (Bachelor Cove breeding area). Eagles from all these territories have collectively placed nests in mature cottonwoods, cottonwood snags, and willow trees (rarely), and the height of the nest in these trees varies. We can anticipate the number, distribution, and location of eagle territories, nest trees, and nests within the Roosevelt Lake CS and FCS will not be static over time, and therefore it is difficult to know with certainty how many eagles may be at risk when SRP implements flood control operations.

In general, over time, the persistence of existing large cottonwoods in the CS for eagle nesting should diminish because of ongoing dam operations. The establishment and growth of cottonwoods large enough to support eagle nests in the CS may occur but is not as great due to the time it takes for these trees to grow and the effects of ongoing inundation and drying. The timing of Modified Roosevelt Dam's water delivery typically exposes the CS's wet floodplain during the late spring and early summer favoring the establishment of tamarisk, but some willow has established on both the Salt and Tonto Arms. Willows are more likely to persist within the CS because they are more resistant to inundation. Willows can grow quickly and become a possible place for eagle nest placement, but nests are not likely to persist as long due their weight and size, and the willow's weaker branches.

The stream processes to establish future bald eagle nest trees that can grow and persist through time in proximity to Roosevelt Lake is more likely in the FCS or further upstream in adjacent tributaries. Future nest trees are not limited to the FCS, but our opinion is that bald eagles have general fidelity to nest areas, are territorial, and prefer to be in proximity to food resources to reduce energy expenditure. The FCS retains normal stream function, and except for the effects from the planned deviation, can regenerate native cottonwoods and willows which are more likely to grow large enough and persist for eagle nest placement. Should normal FCS operations occur more frequently in the future, as SRP anticipates, more frequent temporary FCS inundation during the winter and spring may be a catalyst to not only regenerate but accelerate tree growth. SRP has created other potential habitats for nesting bald eagles (most likely the Pinto breeding area) on the Salt Arm, including an artificial nest structure and tall riparian trees within the Rock House Demonstration Site.

<u>Conservation/Mitigation Program</u>

SRP's initial RHCP includes mitigation and conservation measures to address the effects of rising and lowering lake levels on all eagle territories using Roosevelt Lake's CS. These conservation/mitigation measures include annual helicopter flights to find new eagle territories,

nests, and assess productivity; a year-round Forest Protection Office at Roosevelt; and annual Arizona bald eagle nestwatchers. These have been effective measures to help protect Roosevelt nesting bald eagles; track Roosevelt and Arizona bald eagle distribution, abundance, and success; and improve bald eagle management at Roosevelt and across Arizona. Arizona bald eagle nestwatchers at Roosevelt nest sites throughout the breeding season provide the best opportunity to rescue any eggs, eaglets, or fledglings in a life-threatening situation. SRP is not proposing any additional conservation/mitigation measures because the additional effects from FCS actions are minor; existing RHCP conservation measures occur at eagle nest sites territories where RHCP amendment effects occur; and existing conservation/mitigation measures are the same reasonable measures that can be implemented to offset effects.

Tipping Point for Recovery

As noted above, we must identify when the effects of project-specific Federal actions may cause a species to pass the tipping point for recovery.

Based upon the increasing national, statewide, and local bald eagle populations, we conclude that SRP's RHCP amendment will not reach the tipping point for recovery. The bald eagle is currently a recovered species across its breeding range in the United States and there is no DPS for the eagle in central Arizona. There are currently no recovery goals for the bald eagle regionally or nationally since it was delisted. The FWS (2020b) recently estimated nearly 317,000 bald eagles occurred across the country, 4.4 times more eagles than in 2009. In Arizona, the bald eagle population grew from just under 30 territories in the late 1980s (Hunt *et al.* 1992) to 95 territories in 2022 (McCarty *et al*. 2022). Nesting eagles have expanded their distribution in Arizona from central Arizona Sonoran Desert streams to nesting in northern, northeastern, western, and southern Arizona. At Roosevelt Lake, with modifications to Roosevelt Dam in the mid-1990s and RHCP implementation since 2003, the number of bald eagle pairs relying on the lake has increased from two known territories in the late 1980s to six territories in 2023. The lake resources at Roosevelt supports the most breeding eagles of any impounded Arizona water body. We expect that ongoing conservation/mitigation measure implementation will continue to offset any ongoing periodic additional adverse effects from the RHCP amendment, and Roosevelt Lake will continue to generate habitat for breeding eagles to persist and reproduce successfully, not reaching the tipping point for recovery locally, regionally, or nationally.

Spikedace

Critical Habitat

SRP's long-term conservation storage operations create a consistent aquatic habitat for nonnative predatory fish to persist in Roosevelt Lake and travel into designated spikedace critical habitat in lower Tonto Creek (and possibly lower Greenback Creek) adversely affecting PCE 5 (nonnative fish). Similar to our discussion about this aspect of northern Mexican gartersnake critical habitat, SRP estimates that when lower Tonto Creek flows are between about 200 to 1,100 cfs, nonnative fish can leave the lake and travel up lower Tonto Creek for about 14.4 miles. Large culverts at East Del Chi Drive can act as a barrier reducing the likelihood of fish moving farther upstream. Diminishing flows throughout the year on this intermittent section of lower Tonto Creek can reduce the persistence of these predatory nonnative fish. This cycle continues through time; long-term CS operations creates an environment that supports the fish that can move into lower Tonto

Creek (and possibly Greenback Creek) critical habitat when appropriate stream flows occur, and diminishing flows reduces those fish's persistence.

Long-term CS operations up to 2,151 feet amsl do not have any noticeable adverse effect on the remaining spikedace PCEs. There is no spikedace critical habitat on the upper or lower Salt River, where Roosevelt Dam and the lake affect stream flows and connectivity. We do not anticipate Modified Roosevelt Dam CS operations noticeably affecting the occurrence of aquatic insects or water quality in lower Tonto Creek. Any change in Roosevelt Lake water quality is unlikely to move upstream in lower Tonto Creek, nor will it influence insect production on the stream.

We anticipate that normal FCS operations and the planned deviation will have an insignificant effect to spikedace critical habitat PCE 1 (perennial stream, etc.), 4 (connected corridors) and 5 (nonnative fish) based upon the operation's short duration, small area of intersection with critical habitat at its perimeter, and the existing baseline. Lower Tonto and Greenback creeks are located at the end of their segments, are not perennial streams, and do not connect to occupied or other recovery areas. Lower Tonto and Greenback creeks are intermittent and dry into isolated pools during the summer. Normal flood control operations intersect with 0.84 miles of spikedace critical habitat along Tonto Creek and 0.24 miles along Greenback Creek at the terminal end of the lower Tonto and Greenback Creek segments (78.47 total acres) (Figure 15). The planned deviation intersects with a smaller area of the end of spikedace critical habitat along Tonto Creek (0.54 acres) (Figure 18). SRP infrequently uses the FCS for 20-day normal flood control operations and the 120-day (3 times in 5 years) deviation. Nonnative predatory fish currently occur in lower Tonto Creek and its tributaries, and during flood events, when normal flood control operations and the deviation will likely occur, enter lower Tonto and Greenback creeks. We expect that this combination of factors likely results in a temporary and insignificant change to the spikedace critical habitat baseline for PCEs 1, 4, and 5.

We expect SRP's normal FCS operations and the planned deviation will have an insignificant effect to PCE 2 (aquatic insects), 3 (pollutants), and 6 (natural, unregulated flow). Infrequent use of a small area of spikedace critical habitat for FCS operations will change how water occurs in the floodplain. The persistence of water and short duration is likely to have temporary and insignificant influence on aquatic insects and may improve the occurrence of some aquatic insects. SRP's FCS operations will not increase the level of pollutants, because the lake does not generate pollutants and SRP's water use is for municipal and agricultural purposes. FCS operations will not affect the overall natural stream flow of Tonto Creek or its capability to flood. FCS operations occur at the very end of the Tonto and Greenback creek segments where its unregulated flow is not affected.

Due to there being no effects to individual spikedace from the proposed action, the existing baseline, and a reduction of nonnative predatory sportfish in lower Tonto Creek from gartersnake conservation/mitigation actions, SRP's periodic adverse effects to spikedace critical habitat should not inhibit spikedace's recovery. Large areas of the Salt River Sub-basin and Tonto Creek Unit are currently unsuitable for spikedace either because of topography or because of reservoirs and other stream-channel alterations. SRP's implementation of nonnative predatory fish suppression and native fish stocking (no spikedace will be stocked) for the gartersnake should

minimize adverse effects to spikedace critical habitat and incrementally improve the spikedace environmental baseline in lower Tonto Creek.

Conservation/Mitigation Program

SRP is proposing no spikedace conservation or mitigation actions, because there are no effects to individual fish. However, SRP's implementation of nonnative predatory fish suppression and native fish stocking (no spikedace will be stocked) for the gartersnake should help to diminish the effects to spikedace critical habitat from long-term conservation storage.

CUMULATIVE EFFECTS

Cumulative effects are those "effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area" considered in this biological opinion (50 CFR § 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Since the Tonto National Forest and Bureau of Reclamation primarily manage land within the action area at Roosevelt Lake and lower Tonto Creek, most of activities that could potentially affect these listed species are Federal activities and would be subject to additional section 7 consultation.

Along lower Tonto Creek, where a mixture of private lands occurs, we anticipate the small communities of Tonto Basin, Punkin Center, and Gisela are reasonably certain to continue to exert pressure on water and streamside habitat over the remaining 30-year duration of SRP's permit. These communities are likely to grow incrementally over time, however the occurrence of National Forest lands surrounding these communities likely limits their growth. These pressures include commercial and residential development, water diversions, groundwater pumping, agricultural fields, and floodplain use such as gravel mining. Non-federal flood control activities have occurred near Gisela in the past and there is a reasonable expectation these will occur in the future. We can also anticipate ongoing and possibly increased recreational use, such as all-terrain vehicles, within the floodplain on private lands. The development of the Tonto Creek Bridge is likely to increase some limited development opportunities and water use, especially on the northern side of Tonto Creek. Local anglers may periodically introduce nonnative predatory species to Tonto Creek and AGFD could stock fish without using Federal dollars.

The ongoing and anticipated future cumulative effects are likely to continue to exert pressure on Tonto Creek's flow, aquatic species, and quality of riparian habitat for listed species critical habitat. Flycatcher, cuckoo, gartersnake, and spikedace critical habitat PCEs and PBFs focus on water, elevated groundwater, stream function, stream flow, plant species, plant growth, and increased native aquatic species (and reduced nonnative predatory aquatic species). The cumulative effects from local communities over time will likely continue to exert pressure on these essential critical habitat elements.

JEOPARDY AND ADVERSE MODIFICATION ANALYSIS

Section 7(a)(2) of the Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. This is intra-Service biological opinion for Salt River Project's (SRP) Roosevelt Habitat Conservation Plan (RHCP) amendment is a combined section 10(a)(1)(B) and section 7 approach to compliance under the Act for implementation of covered activities for non-Federal (section 10) and Federal (section 7) participants.

Jeopardy Analysis Framework

Our jeopardy analysis relies on the following regulatory framework: "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). The following analysis relies on four components:

1. Status of the Species, which evaluates the range-wide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs;
2. Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species;
3. Effects of the Action (including those from conservation measures), which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and
4. Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species.

The jeopardy analysis in this biological opinion emphasizes the range-wide survival and recovery needs of the listed species and the role of the action area in providing for those needs. We evaluate the significance of the proposed Federal action within this context, taken together with cumulative effects, for the purpose of making the jeopardy determination.

Destruction/Adverse Modification Analysis Framework

The final rule revising the regulatory definition of "destruction or adverse modification of critical habitat" was amended in 2019 (84 FR 44976). Thedefinition states: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species."

Similar to our jeopardy analysis, our adverse modification analysis of critical habitat relies on the following four components:

1. Status of Critical Habitat, which evaluates the range-wide condition of designated critical habitat in terms of PCEs/PBFs, the factors responsible for that condition, and the

intended recovery function of the critical habitat overall;
2. Environmental Baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area;
3. Effects of the Action, which determine the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs/PBFs and how they will influence the recovery role of affected critical habitat units; and
4. Cumulative Effects, which evaluate the effects of future, non-federal activities in the action area on the PCEs/PBFs and how they will influence the recovery role of affected critical habitat units.

Conclusion

After reviewing the current status of the northern Mexican gartersnake, southwestern willow flycatcher, yellow-billed cuckoo and their designated critical habitat; the bald eagle, and spikedace critical habitat; the environmental baseline for the action area; the effects of the proposed RHCP amendment; and the cumulative effects; it is our biological opinion that the actions, as proposed, are not likely to jeopardize the continued existence of these species, and are not likely to destroy or adversely modify designated critical habitat. We base these conclusions on the following:

Northern Mexican Gartersnake

- Gartersnakes have persisted along lower Tonto Creek and its inflow to Roosevelt Lake under existing SRP conservation storage and flood control operations, without any mitigation or conservation measure implementation since at least 1995, and likely were present through the extensive modifications to the Tonto Creek/Salt River confluence when building Roosevelt Dam in the early 1900s, through dam modifications in the mid-1990s.
- Gartersnakes have persisted at lower Tonto Creek with the stocking of nonnative predatory sportfish at Roosevelt Lake and lower Tonto Creek.
- Normal flood control operations are infrequent and short duration, closely mimicking natural Tonto Creek stream flow.
- The planned deviation occurs over a small area between 2,151 and 2,156 feet in elevation amsl and the adverse effects of covering gartersnake habitat with water is limited to 3 seasons over 5 years.
- Despite periodic adverse effects to gartersnakes from the dynamic movement of Roosevelt Lake, dam operations can temporarily create gartersnake habitat. The creation of gartersnake habitat likely helps, in concert with Tonto Creek's intermittent flows, to maintain gartersnakes along lower Tonto Creek.
- Conservation/mitigation measures for conservation storage and flood control actions to suppress nonnative predatory sportfish and stock native fish and frogs along two lower Tonto Creek sections will minimize gartersnake predation and sportfish effects to gartersnake's native aquatic prey species. Reducing gartersnake predation and increasing prey diversity is likely to have the effect of improving reproduction, survivorship, and gartersnake occurrence along lower Tonto Creek.

- Conservation/mitigation measures to suppress nonnative predatory sportfish and stock native fish and frogs along lower Tonto Creek reduces the effect of long-term Roosevelt Dam conservation storage operations to gartersnake critical habitat. The long-term commitment to address the ongoing effects of water storage on lower Tonto Creek improves the essential PBFs focused on gartersnake prey quality.

Southwestern Willow Flycatcher

- The number of flycatcher territories rangewide has improved since its listing in 1995, from an estimated 500 to 1000 territories to an estimated 1,650 territories in 2012.
- In Arizona, the estimated number of flycatcher territories has increased from 145 in 1993 to 679 in 2012.
- Flycatcher territories at Roosevelt Lake can be one of the highest concentrations in Arizona, with over 200 territories in the CS and FCS. In 2020, biologists found 236 flycatcher territories within the Roosevelt Lake CS and FCS.
- The Roosevelt Management Unit has a recovery goal of 50 flycatcher territories, which flycatchers regularly surpass, even with the full operation of Modified Roosevelt Dam.
- Modified Roosevelt Dam conservation storage operations will temporarily adversely affect flycatchers and its habitat, but its dynamic operations also create flycatcher habitat.
- Normal flood control operations are infrequent and short duration, closely mimicking natural Tonto Creek stream flow and are likely to have an insignificant effect to flycatchers and its habitat.
- The planned deviation occurs over a small area between 2,151 and 2,156 feet in elevation amsl and the adverse effects to flycatchers and its habitat are limited to the 5-year planned deviation and any subsequent 3 to 4-year habitat recovery period.
- The temporary minor adverse effects to flycatchers and its habitat from the planned deviation will not surpass SRP's existing RHCP incidental take authorization, which SRP has fully mitigated through habitat acquisition, protection, creation, and management.
- The temporary minor adverse effects to flycatcher critical habitat from the planned deviation will occur over a relatively small area, and following the completion of the planned deviation, ongoing stream processes and habitat development can continue.

Western Yellow-billed Cuckoo

- We estimate the rangewide number of cuckoo territories at 1,300 territories.
- In Arizona, we estimate the number of cuckoo territories at 450 territories.
- Cuckoo territories at Roosevelt can fluctuate, with recently biologists detecting nine territories in the Roosevelt Lake CS and FCS in 2020, and two territories in the FCS in 2021.
- There are currently no cuckoo recovery plan or goals established for cuckoos rangewide, regionally, or locally at Roosevelt Lake.
- Modified Roosevelt Dam conservation storage operations will temporarily adversely affect cuckoos and its habitat, but its dynamic operations also create cuckoo habitat.
- Normal flood control operations are infrequent and short duration, closely mimicking natural Tonto Creek stream flow and are likely to have an insignificant effect to cuckoos and its habitat.

- The planned deviation occurs over a small area between 2,151 and 2,156 feet in elevation amsl and the adverse effects to cuckoos and its habitat are limited to the 5-year planned deviation and any subsequent 3 to 4-year habitat recovery period.
- The temporary minor adverse effects to cuckoos and its habitat from the planned deviation will not surpass SRP's existing RHCP incidental take authorization, which SRP has fully mitigated through habitat acquisition, protection, creation, and management.
- The temporary minor adverse effects to cuckoo critical habitat from the planned deviation will occur over a relatively small area, affect a small number of cuckoos, and following the completion of the planned deviation, ongoing stream processes and habitat development can continue.

Bald Eagle

- The bald eagle is currently a recovered species, and the Eagle Act is its primary Federal protection.
- There is no DPS for bald eagles in the Sonoran Desert Area of central Arizona.
- There are nearly 317,000 bald eagles across the country, 4.4 times more than in 2009.
- The number of Arizona bald eagle territories has increased from just under 30 in the late 1980s to 95 in 2022. Bald eagles now nest in the western, central, northeastern, eastern, and southern parts of Arizona from about 500 feet in elevation amsl along the lower Colorado River to about 8,000 feet in elevation amsl at Luna Lake in eastern Arizona.
- The number of bald eagles relying on Roosevelt Lake has increased from two territories in the late 1980s to six territories in 2022.
- Roosevelt Lake supports the most bald eagle territories than any other Arizona impounded water source.
- The number of productive bald eagle territories relying on Roosevelt Lake has increased since Roosevelt Dam modifications in the mid-1990s and RHCP implementation in 2003.
- Normal flood control operations are infrequent and short duration, closely mimicking natural Tonto Creek stream flow and in most circumstances are likely to have an insignificant effect to bald eagles and its habitat.
- The additional minor effects to bald eagles and their habitat from FCS operations are primarily from the planned deviation and limited to its five-year duration.
- Existing RHCP conservation measures, in particular the presence of Arizona bald eagle nestwatchers, provide the opportunity to rescue eggs and eaglets in life threatening situations from FCS operations.
- There is no designated bald eagle critical habitat.

Spikedace

- Large areas of the Salt River Sub-basin and Tonto Creek Unit are unsuitable for spikedace based upon topography, stream flow, impoundments, and abundance of predatory nonnative species.
- We anticipate that normal FCS operations and the planned deviation will have an insignificant effect to spikedace critical habitat largely due to the existing nonnative predatory sportfish baseline in lower Tonto Creek, infrequent and temporary use of the FCS, and the small intersection with the terminal end of designated segments.

- Long-term Modified Roosevelt Dam conservation storage operations create habitat for nonnative predatory sportfish at Roosevelt Lake, and when Tonto Creek flows are sufficient, predatory sportfish can move into lower Tonto Creek, adversely affecting spikedace designated critical habitat.
- Gartersnake conservation measures associated with the RHCP amendment over the the 30-year permit duration to suppress nonnative predatory sportfish in lower Tonto Creek and stock native fish will incrementally improve spikedace critical habitat.
- SRP's periodic adverse effects to critical habitat should not adversely modify spikedace critical habitat or inhibit spikedace recovery due to the existing environmental baseline in the Salt River and Tonto Creek and implementation of the RHCP's gartersnake conservation measures. The Salt River and Tonto Creek are currently unsuitable for spikedace, either because of topography, reservoirs, and other stream-channel alterations. SRP's implementation of gartersnake conservation measures should minimize the temporal adverse effects to spikedace critical habitat, and incrementally improve the spikedace environmental baseline in lower Tonto Creek by suppressing the persistence of nonnative predatory sportfish and improving the occurrence of native fish species.

We base the conclusions of this biological opinion on full implementation of the project as presented in the Description of the Proposed Action section of this document, including any Conservation Measures that SRP has incorporated into their project design.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined (50 CFR § 17.3) to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined (50 CFR § 17.3) as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. "Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the Act, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Since permit issuance for SRP's original RHCP (ERO 2002), we removed the bald eagle from the list of threatened and endangered species under the Act. Separate from listing under the Act, bald eagles are protected under the Eagle Act (16 U.S.C. §§ 668-668d), as amended. Following delisting, we defined "disturb" as set forth in the Eagle Act, 50 C.F.R. 22.6, and developed incidental take permits and criteria to comply with the Eagle Act. Our Eagle Act compliance is included in the NEPA EA for these proposed actions. A valid section 10(a)(1)(B) permit properly executed under the Act, replaces the need for applicants to seek a separate Eagle Act permit. For purposes of this biological opinion, we are addressing effects to the delisted bald eagle under the Act should it ever become listed as threatened or endangered in the future.

The RHCP amendment and this biological opinion is a combined section 10(a)(1)(B) and section 7 approach to compliance under the Act for implementation of covered activities for non-Federal (section 10) (SRP) and Federal (section 7) (Corps) participants. This intra-Service consultation addresses effects that may result from amending our incidental take permit in accordance with section 10(a)(1)(B) of the Act for SRP's Modified Roosevelt Dam and Lake operations. SRP has sought the Corps authorization to implement a planned deviation to Modified Roosevelt Dam's WCM, a Federal action. This biological opinion satisfies the Corps responsibility under section 7 for its decision whether the authorize the planned deviation and the planned deviation's effects are addressed by SRP under the RHCP amendment under section 10(a)(1)(B).

The measures described below are non-discretionary and must be undertaken by the FWS and Corps so that they become binding conditions of any grant or permit issued to any applicant, as appropriate, for the exemption in section 7(o)(2) to apply. We have a continuing duty to regulate the activity covered by this incidental take statement. If the permittee (1) fails to assume and implement the terms and conditions or (2) we fail to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. In order for FWS to monitor the impact of incidental take under the proposed RHCP amendment, SRP must report the progress of the action and its impact on the species to the FWS as specified in the incidental take statement [50 CFR § 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE

The FWS anticipates SRP's conservation and flood control operations at Roosevelt Lake will result in incidental take of gartersnakes, flycatchers, cuckoos, and bald eagles. We anticipate incidental take of gartersnakes in the form of kill, wound, and harm from Modified Roosevelt Dam's conservation storage and flood control activities, and the planned deviation with incidental take occurring in Roosevelt Lake's CS and FCS and lower Tonto Creek. We anticipate incidental take of flycatchers and cuckoos in the form of harm from the planned deviation in the FCS. We anticipate bald eagles will be incidentally taken in the form of kill or harm from normal flood control activities and the planned deviation in the FCS and CS. Incidental take attributed to the Corps decision to approve the planned deviation is authorized by this biological opinion and is accounted for in the overall incidental take statement for our 10(a)(1)(B) permit to SRP, and incidental take attributed to SRP's conservation and normal flood control actions is authorized solely through the 10(a)(1)(B) permit.

Northern Mexican Gartersnake

The FWS anticipates incidental take of gartersnakes will be difficult to detect because gartersnakes are a cryptic species, gartersnake populations will likely fluctuate within the permit area over time, and affected gartersnakes will be nearly impossible to detect. However, surrogate habitat metrics focusing on amount of gartersnake habitat ("acre-years") Roosevelt Lake covers and the "migration days" nonnative sportfish can access lower Tonto Creek can replace direct observations of effects. *See* 50 CFR 402.14(i)(1)(i). The two metrics directly relate to how Modified Roosevelt Dam's operations affects gartersnakes and its habitat in the CS and FCS, and the extent of when predatory fish can affect gartersnakes in lower Tonto Creek. The two metrics are needed to address the effects leading to incidental take that are particular to the CS, FCS, and

the lower Tonto Creek parts of the permit area (Table 4). The incidental take estimates are conservative in that they are based on the "worst case" 30-year periods of the Reservoir Planning Model or the historic Tonto Creek gage data and SRP includes an additional allowance for uncertainty based on the standard deviation of the mean estimates for all 30-year periods in these datasets.

Gartersnake Surrogate Metric for the Conservation and Flood Control Space

SRP determined that the proximity to visible surface water was the variable associated most strongly with telemetered, active-season gartersnake locations within the CS and FCS. SRP used high-resolution National Agriculture Imagery Program (NAIP) imagery from 2007, 2010, 2013, 2015, and 2017, as well as a set of images from USBR dating to 2000 and 2002, to map the location and extent of visible surface water in the CS and FCS over a 17-year period. Some of these images corresponded with the time of the gartersnake telemetry data reported in Nowak *et al.* (2019).

SWCA (2023a) identifies that a 308-foot area around visible surface water captures 95% of the area gartersnakes rely upon for breeding, feeding, and sheltering affected by Modified Roosevelt Dam conservation and flood control actions (including the planned deviation) in the CS and FCS based on the locations of telemetered snakes tracked during the active season. While snakes may use areas beyond 308 feet of visible surface water, the 308-foot distance from visible surface water is a reasonable approximation of the extent of gartersnake habitat in the CS and FCS affected by Modified Roosevelt Dam operations.

SRP created a model to quantify the amount of gartersnake habitat affected by CS and FCS operations to track gartersnake incidental take with a habitat surrogate described in "acre-years" (see below) (SWCA 2023a). SRP based its proposed incidental take metric for the CS and FCS on the amount, location, and temporal change to gartersnake habitat in these parts of the permit area. Because the gartersnake is associated with aquatic habitats for hunting prey, proximity to water is an important factor (Emmons and Nowak 2016, Nowak *et al*. 2019, and Sprague and Bateman 2018). Surface water (*i.e*., water identifiable in aerial imagery) is an environmental parameter that SRP can map for predicting and monitoring gartersnake habitat.

SRP estimates the amount of incidental take from its conservation and flood control activities in the CS and FCS in terms of the cumulative reductions to acres of available gartersnake habitat from the lake covering gartersnake habitat with water. SRP derived incidental take estimates from yearly and monthly data on lake elevations and stream flow and can summarize these effects as "acre-years" of reduced habitat availability. This time-specific metric addresses the dynamic nature of gartersnake habitat in the CS and FCS (and, by extension, the population of gartersnakes in the CS and FCS) arising from varied precipitation and stream inflow and Roosevelt Lake elevations. The acre-year approach is appropriate for the gartersnake and the covered activities because ecological conditions in the CS and FCS are not static from year to year. In any given year, the same acre of land (or water) may or may not be gartersnake habitat, depending on the amount and location of visible surface water.

We measure gartersnake incidental take in the form of kill, wound, and harm in the Roosevelt Lake CS and FCS from conservation storage and flood control operations (including the planned

deviation) by the cumulative acre-years of gartersnake habitat made unavailable in a given year, totaled over the remaining life of this permit (acre-years of reduced habitat availability). The amount of authorized incidental take in the CS and FCS at Roosevelt Dam and Lake over the permit duration shall not exceed 2,742.9 acre-years of reduced habitat availability for all conservation and flood control actions (Table 4). SRP will base incidental take exceedance upon cumulative year-to-year affected acres, rather than an annual limit. For the permit duration, we do not anticipate SRP will exceed incidental take, and it would likely take years for cumulative number of acre-years to approach exceedance limits. The cumulative total of 2,742.9 acre-years represents 2,507 acre-years from conservation storage action in the CS, 226.3 acre-years from normal flood control actions in the FCS, and 9.6 acre-years from the planned deviation in the FCS (Table 4).

Estimates of gartersnake incidental take in the CS and FCS rely on two field conditions: the Roosevelt Lake elevation and the location and extent of visible surface water along the Tonto Creek channel above the lake but below the 2,175-foot amsl elevation contour. Together, these field conditions generate estimates of available gartersnake habitat for a given year. To monitor changes in gartersnake habitat availability each year of the remaining permit term, SRP will perform the following to calculate annual acre-years of gartersnake habitat affected:

1. **Document the elevation of Roosevelt Lake on June 30 of each year**.
   The lake elevation on June 30 establishes the aquatic edge for lake fringe habitat in the CS. If the lake elevation exceeds 2,151 feet amsl on June 30, then SRP will document that flood control operations are in progress and use 2,151 feet amsl as the lake elevation for the purpose of estimating habitat availability in the CS that year.

2. **Document the maximum elevation of Roosevelt Lake in each month with flood control operations**.
   The maximum monthly lake elevation during flood control operations, whether under current procedures or under the planned deviation, determines how much gartersnake habitat in the FCS is temporarily unavailable for use due to inundation.

3. **Delineate the extent of visible surface water in the Tonto Arm above Roosevelt Lake each year between June 1 and June 30**.
   SRP may use publicly or commercially produced aerial imagery or produce its own aerial imagery for this purpose. The quality of the imagery should be comparable to or better than the 2017 NAIP imagery standards. SRP may use either visual image interpretation or software-aided processes to delineate visible surface water. SRP will delineate visible surface water between the elevation of the lake and the top of the FCS at 2,175 feet amsl. The specific methods used to delineate visible surface water may change over time as available and practical tools and data sources change.

4. **Estimate gartersnake habitat in the CS and FCS each year**.
   SRP will apply the 308-feet distance-to-water finding to the June 30 lake elevation contour (limited to the Tonto Arm) and the boundary of June visible surface water along Tonto Creek to estimate the amount of gartersnake habitat in the CS and FCS. SRP will extract from this estimate any areas that are unsuitable for use by gartersnakes. If the lake's elevation on June 30 is at or above 2,151 feet amsl, then SRP will assume that the

amount of available gartersnake habitat in the CS is 105.5 acres (the estimate of gartersnake habitat available when the lake is temporarily full). SRP does not apply the 308-foot distance-to-water to the lake elevation contour when it is at or above 2,151 feet amsl (*i.e.*, SRP estimates gartersnake habitat in the FCS from the visible surface water only because of the rapid evacuation of water from FCS).

5. **Determine the Year-to-Year Change in Habitat Availability in the CS**.
SRP will calculate the change in gartersnake habitat availability in the CS each year as compared to the prior year's calculation. A negative change (*i.e.*, a reduction) in habitat availability represents incidental take of the gartersnake in the CS from conservation storage operations.

6. **Determine the Monthly Reductions in Habitat Availability in the FCS**.
SRP will calculate how much gartersnake habitat in the FCS the lake inundates in each month with flood control operations. The amount of gartersnake habitat in the FCS that is below the monthly maximum lake elevation contour will determine how much of the gartersnake habitat is temporarily unavailable in a given month (*i.e.*, the metric for incidental take in the FCS). SRP will combine the monthly estimates of reduced habitat availability for a given year to produce an annual total and divide the annual total by 12 months to convert the total from acre-months to acre-years. This unit conversion facilitates consistent comparison with the accounting of take in the CS. For the purpose of this assessment, years will begin on July 1 to conform with the timeline for producing updated habitat estimates.

7. **Update the Take Ledger and Check for Changed Circumstances**.
SRP will update the take ledger each year to debit the acre-years of take observed in the CS and FCS during the prior year from the remaining total acre-years of take authorization. SRP will update the ledger based on years that begin on July 1 and run through June 30. SRP will confirm that the remaining balance of take authorization after each update remains below the threshold for Changed Circumstances or notify the FWS that there has been a Changed Circumstance triggering initiation of a new amendment process to increase the amount of take authorization.

8. **Include the Updated Take Ledger in the Roosevelt Lake HCP Annual Report**.
SRP will provide the FWS a copy of the updated take ledger each year with its annual report. SRP will also provide notice of a Changed Circumstance triggering initiation of a new amendment process with the annual report, if the exceedance threshold occurs.

<u>Gartersnake Surrogate Metric for Lower Tonto Creek</u>

The effects of SRP's conservation storage activities that lead to incidental take in the form of harm (predation, wounding, survivorship, and reproduction) to gartersnakes in lower Tonto Creek are the result of nonnative fish supported by Roosevelt Lake that move into the creek. Nonnative predatory sportfish have an adverse effect to gartersnakes from predation and wounding, and affecting prey resources that can reduce survivorship and reproduction. Biologists are not likely to observe these effects, because of the difficulty in tracking small cryptic gartersnakes and its occurrence over a large area in vegetated and aquatic areas. Therefore, we

are establishing a surrogate metric based upon the timing and frequency that nonnative sportfish are able to enter lower Tonto Creek, described as fish "migration days."

Fish "migration days" is the surrogate metric for estimating incidental take along the 14.4 miles of lower Tonto Creek within the permit area. We measure gartersnake incidental take along lower Tonto Creek by the number of fish "migration days" that nonnative predatory fish are able to leave the Roosevelt Lake CS and affect gartersnakes between 2,151 feet in elevation amsl and 14.4 miles upstream to the large culverts at East Del Chi Drive. The amount of authorized incidental take from long-term conservation storage's effects to gartersnakes along lower Tonto Creek shall not exceed 906 migration days. Similar to acre-years, fish migration days are a cumulative total over the permit's duration, rather than an annual limit. For the permit's duration, we do not anticipate SRP will exceed incidental take, and it would likely take years for cumulative amount of migration days to approach exceedance limits.

When Tonto Creek flows are between 200 and 1,100 cfs (as measured by the U.S Geological Survey gauge at the Gun Creek/Tonto Creek confluence), nonnative predatory sportfish supported by the lake can move upstream into Tonto Creek. After five consecutive fish migration days in a given year between February 1 and May 31, we assume that incidental take of gartersnakes along lower Tonto Creek is reasonably certain to occur.

Once in the creek, these nonnative fish can cause incidental take of gartersnakes. The spawning behaviors of nonnative fish make it more likely that these fish will seek habitat outside of the lake and move into stream habitats between February 1 and May 31 (ERO-GEI 2022a). These effects intensify once Tonto Creek stops flowing and nonnative fish become trapped in residual channel pools. These pools are important gartersnake habitat in lower Tonto Creek since they extend the availability of aquatic habitat and the aquatic edge/riparian resources gartersnakes rely on. The effects of nonnative fish on gartersnakes become intensified when and where the availability of aquatic habitat is more restricted. The presence and abundance of nonnative fish in lower Tonto Creek relate to the amount of time that the lake and the creek are connected. It is reasonable to conclude that the longer this connectivity occurs, the more nonnative fish will make the move from the lake into the creek.

SRP will record fish migration days by observations of stream flow measured at the Tonto Creek stream gage above Gun Creek. To monitor how much incidental take occurs annually, SRP will perform the following:

1. **Calculate the Average Daily Flow Rate for Each Day between February 1 and May 31**.
   SRP will obtain the stream gage data for Tonto Creek above Gun Creek (USGS stream gage station number 09499000) for the period between February 1 and May 31 each year of the permit's remaining term. SRP will calculate the average daily flow rate for each day in this period.

2. **Determine the Number of Migration Days Contributing to Incidental Take that Occur Each Year**.
   SRP will count the number of days between February 1 and May 31 when the average daily flow in Tonto Creek is between 200 cfs and 1,100 cfs (*i.e.,* days that meet the

definition of a migration day). When the number of consecutive migration days in a given year exceeds five, then SRP will count those five days and each migration day that follows for the remainder of the year (through May 31) as a day of take.

3. **Update the Take Ledger and Check for Changed Circumstances**.
SRP will update the take ledger each year to debit the number of migration days contributing to incidental take that occurred during the current year from the remaining total number of migration days of take authorization. SRP will update the take ledger for lower Tonto Creek after May 31 each year. SRP will confirm that the remaining balance of take authorization after each update remains below the threshold for Changed Circumstances or notify the FWS that there has been a Changed Circumstance triggering initiation of a new amendment process to increase the amount of take authorization.

4. **Include the Updated Take Ledger in the RHCP Annual Report**.
SRP will provide the FWS a copy of the updated take ledger each year with its annual report. SRP will also provide notice of a Changed Circumstance triggering initiation of a new amendment process with the annual report, if the exceedance threshold occurs.

Southwestern Willow Flycatcher and Yellow-Billed Cuckoo

We anticipate incidental take of flycatchers and cuckoos in the form of harm from the planned deviation in the FCS. SRP's existing RHCP incidental take coverage and surrogate metric for effects in the CS up to 2,151 feet in elevation amsl is robust enough to absorb the additional minor effects from the planned deviation. We will adjust our permit to expand the permit area to include the FCS up to 2,175 feet in elevation amsl.

Based upon the current flycatcher habitat and cuckoo habitat conditions, the planned deviation would diminish the availability of approximately 12 acres of flycatcher nesting habitat and 2.6 acres of cuckoo nesting habitat on the Tonto and Salt Arms. Also based on current conditions, SRP estimates adverse effects to 75.9 acres of suitable flycatcher breeding habitat and 43.0 acres of suitable cuckoo breeding habitat along the Salt and Tonto Arms. SRP will use the same surrogate metrics and methodology in the original RHCP (ERO 2002) and associated FWS biological opinion (USFWS 2003) to quantify flycatcher and cuckoo habitat annually, by using the flycatcher satellite habitat suitability model.

With the addition of RHCP amendment, SRP can incidentally take flycatchers and cuckoos in Modified Roosevelt Dam's CS and FCS in the form of harm. SRP may incidentally take flycatchers and cuckoo nestlings and eggs may because of nest trees falling or nestlings falling and drowning due to high reservoir levels or associated effects from nesting habitat modification, degradation, and desiccation from conservation storage and flood control operations. The annual amount of affected flycatcher habitat cannot exceed 750 acres annually (or up to 1,250 acres annually with adaptive management) and the annual amount of affected cuckoo habitat cannot exceed 313 acres annually (or up to 1,113 acres annually with adaptive management). These surrogate metrics are the same which we established in the original RHCP (ERO 2002).

Bald Eagle

We anticipate normal flood control activities, and the planned deviation will incidentally take bald eagles in the form of kill or harm in the FCS and CS up to 2,175 feet in elevation amsl.

After reviewing the original RHCP (ERO 2002), our biological opinion (USFWS 2003), and the status of the eagle at Roosevelt Lake, we recognized that our incidental take exceedance measures from the original RHCP could be more thorough, measurable, and better incorporate the eagle's changing distribution and abundance at Roosevelt Lake. Our exceedance metrics could better reflect the effects frequency of occurrence and anticipate the eagle's changing distribution and abundance. As a result, we are replacing the exceedance measures from the original RHCP for conservation storage actions with improved metrics that biologists can observe and measure, which also include the minor effects from normal FCS operations and the planned deviation (Table 5). SRP will track these effects directly, with likely assistance from Arizona Bald Eagle Nestwatchers, Forest Protection Officer, and AGFD's Bald Eagle Management Program.

SRP may kill no more than three fledgling bald eagles from drowning due to flood control activities in the FCS and CS. SRP will measure incidental take by the detection of a drowned fledgling bald eagle between March 15 and June 15 that biologists from SRP and FWS conclude have fledged from a nest within the CS or FCS at Roosevelt Lake.

SRP may kill or harm bald eagle adults, nestlings, and eggs, that are directly or indirectly attributable to the destruction of no more than 40 bald eagle nests or supporting nest trees/snags when the bald eagle nest is also destroyed within the CS or FCS at Roosevelt Dam and Lake, regardless of the mode of nest destruction or the specific breeding areas and nests that may be affected. We also include in this incidental take exceedance limit:

1. instances where bald eagle nests with viable eggs or nestlings are abandoned by the adult breeding pair, the nest fails due to abandonment, and the proximate and reasonably certain cause of the abandonment is high water under the nest, even if the nest itself is not ultimately destroyed; and,

2. instances where nest destruction resulting from SRP activities is imminent and any bald eagle eggs or nestlings are proactively salvage collected by other parties.

SRP may kill or harm, breeding bald eagles that rely upon Roosevelt Lake and their nestlings and eggs by reduced foraging opportunities within the Roosevelt Lake CS or FCS. Incidental take shall be limited to no more than four reduced foraging events, defined as any year in which both of the following conditions occur:

1. conservation storage at Roosevelt Dam and Lake is below elevation 2,100 feet amsl for either:
    a. at least 60 consecutive days between January 1 and March 31, or
    b. at least 90 total days between January 1 and June 30; and,

2. the combined productivity rate (number of fledged young/occupied breeding areas) (McCarty *et al.* 2022) of all monitored bald eagle breeding areas relying on Roosevelt Lake food resources at is less than 1.0.

The FWS will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. § 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. § 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

EFFECT OF THE TAKE

In this biological opinion, the FWS determines that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat for the reasons stated in the Conclusions section.

REASONABLE AND PRUDENT MEASURES AND TERMS AND CONDITIONS

SRP's RHCP amendment and associated 10(a)(1)(B) permit contains all measures necessary to minimize incidental take to the maximum extent practicable. Therefore, we conclude there is no need for reasonable and prudent measures or terms and conditions. SRP will collaborate with FWS throughout the year and report annually on the effects of their action and implementation of the RHCP amendment.

Disposition of Dead or Injured Listed Species

Upon locating a dead, injured, or sick listed species initial notification must be made to the FWS's Law Enforcement Office, 4901 Paseo del Norte NE, Suite D, Albuquerque, NM, 87113; 505-248-7889 or FWS's Law Enforcement Office, P.O. Box 6342, Chandler, AZ, 85246; 480-967-7900, 480-268-1153 within three working days of its finding. Written notification must be made within five calendar days and include the date, time, and location of the animal, a photograph if possible, and any other pertinent information. The notification shall be sent to the Law Enforcement Office with a copy to this office. Care must be taken in handling sick or injured animals to ensure effective treatment and care, and in handling dead specimens to preserve the biological material in the best possible state.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. We have no further conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation for the RHCP amendment. As provided in 50 CFR 402.16, reinitiation of consultation is required where discretionary Federal agency involvement or

control over the action has been retained or is authorized by law and if; (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion or written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

In keeping with our trust responsibilities to American Indian Tribes, we encourage continued coordination with the Bureau of Indian Affairs in the implementation of this consultation and, by copy of this biological opinion, are notifying 14 Tribes of its completion. We also encourage you to coordinate the review of this project with the Arizona Game and Fish Department.

Please refer to the consultation number, 2022-0048502-S7-001 in future correspondence concerning this project. Should you require further assistance or if you have any questions, please contact Greg Beatty (greg_beatty@fws.gov), Shaula Hedwall (shaula_hedwall@fws.gov) or Mary Fugate (mary_fugate@fws.gov).

cc (electronic):

Jody Clifford, Chief, Planning Division, Los Angeles Districut, Army Corps of Engineers, Los Angeles, CA (Attn. E. Lester)
Jeremy Plain, District Ranger, Tonto Basin Ranger District, Tonto National Forest, Tonto Basin, AZ
Mike Martinez, Tonto National Forest Supervisors Office, Tonto National Forest, Phoenix, AZ (Attn. D. Ulberg)
Sean Heath, Environmental Division, Bureau of Reclamation, Phoenix, AZ (Attn. N. Olsker)
Charles Lewis, Environmental Protection Specialist, Bureau of Indian Affairs, Western Regional Office, Phoenix, AZ
Marty Tuegel, U.S. Fish and Wildlife Service, Southwest Region 2, Albuquerque, NM (Attn. M. Durflinger, K. McDonnell)
Julie McIntyre, Assistant Field Supervisor, Arizona Ecological Services, Tucson, AZ (Attn. J. Servoss, M. Conway)
Mary Fugate, Assistant Field Supervisor, Arizona Ecological Services, Phoenix, AZ (Attn. S. Hedwall, N. Engelmann, L. Stewart)

Luke Thompson, Chief, Habitat Branch, Arizona Game and Fish Department, Phoenix, AZ (Attn. T. Jones)
Leslie Myers, Chief Water Executive and Associate General Manager of Water Resources, Salt River Project, Phoenix, AZ (Attn. C. Paradzick, M. Wicke)
Robert Miguel, Chairman, Ak-Chin Indian Community, Maricopa, AZ
Arden Kucate, Governor, Pueblo of Zuni, Zuni, NM
Robert Ogo, President, Yavapai-Prescott Indian Tribe, Prescott, AZ
Tanya Lewis, Chairwoman, Yavapai-Apache Nation, Camp Verde, AZ
Kasey Velasquez, Chairman, White Mountain Apache Tribe, Whiteriver, AZ
Calvin Johnson, Chairman, Tonto Apache Tribe, Payson, AZ

Ned Norris, Jr., Chairman, Tohono O'odham Nation, Sells, AZ
Ted Rambler, Chairman, San Carlos Apache Tribe, San Carlos, AZ
Martin Havier, President, Salt River Pima Maricopa Indian Community, Scottsdale, AZ
Buu Nygren, President, The Navajo Nation, Window Rock, AZ
Eddie Martinez, President, Mescalero Apache Tribe, Mescalero, NM
Timothy L. Nuvangyaoma, Chairman, Hopi Tribe, Kykotsmovi, AZ
Steven Roe Lewis, Governor, Gila River Indian Community, Sacaton, AZ
Sandra Pattea, President, Fort McDowell Yavapai Nation, Fountain Hills, AZ

LITERATURE CITED

General

Arizona Game and Fish Department (AGFD). 2019. Roosevelt Lake Fisheries Management Plan, 2019–2029. Phoenix: Arizona Game and Fish Department.

_____. 2022. Fisheries Management. Available at: https://www.azgfd.com/fishing/fisheriesmanagement/. Accessed January 2022.

Army Corps of Engineers (ACOE). 2023. Biological Assessment for Planned Deviation from the Water Control Manual for Modified Roosevelt Dam in Maricopa and Gila Counties, Arizona. U.S. Army Corps of Engineers, Los Angeles District, Los Angeles, CA.

Bailey, R.M., and C.L. Hubbs. 1949. The black basses (*Micropterus*) of Florida, with description of a new species. Occasional Papers of the Museum of Zoology, University of Michigan 516:1–40.

Bureau of Land Management (BLM). 2022. Biological Evaluation for the SPRNCA Grazing Lease and Renewal and Integrated Vegetation Management. Bureau of Land Management, Tucson Field Office, Tucson, AZ.

Cayan, D.R., T. Das, D.W. Pierce, T.P. Barnett, M. Tyree, and A. Gershunov. 2010. Future dryness in the southwest US and the hydrology of the early 21st century drought. PNAS 107(50):21271-21276.

Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner. 2017. Precipitation change in the United States. Pages 207-230 In: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (Eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 10.7930/J0H993CC.

ERO Resources Corporation (ERO). 2002. Roosevelt Lake Habitat Conservation Plan, Gila and Maricopa Counties, Arizona. Prepared for Salt River Project and Submitted to U.S. Fish and Wildlife Service, Albuquerque, NM.

Frankson, R., K. Kunkel, L. Stevens, and D. Easterling. 2017: New Mexico State climate summary. NOAA Technical Report NESDIS 149-NM, May 2019 Revision. 4 pp.

Garfin, G., G. Franco, H. Blanco, A. Comrie, P. Gonzalez, T. Piechota, R. Smyth, and R. Waskom. 2014. Chapter 20: Southwest. Climate change impacts in the United States: The Third National Climate Assessment. J. M. Melillo, Terese (T.C.) Richmond, and G.W. Yohe (Eds.). U.S. Global Change Research Program.

Hagman, R.K., P.F. Hessburg, S.J. Prichard, N.A. Povak, P.M. Brown, P.Z. Fulé, R.E. Keane, E.E. Knapp, J.M. Lydersen, K.L. Metlen, M.J. Reilly, A.J. Sánchez Meador, S.L. Stephens, J.T. Stevens, A.H. Taylor, L.L. Yocum, M.A. Battaglia, D.J. Churchill, L.D. Daniels, D.A. Falk, P. Henson, J.D. Johnston, M.A. Krawchuk, C.R. Levine, G.W. Meigs, A.G. Merschel, M.P. North, H.D. Safford, T.W. Swetnam, and A.E.M. Waltz. 2021. Evidence for widespread changes in the structure, composition, and fire regimes of western North American forests. Ecological Applications 31(8):34 pp.

Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for policy makers In Climate Change 2007: The physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

[Solomon, S., D. Quin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (Eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA.

_____. 2014. Climate change 2014: AR5 synthesis report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Pachauri, R.K. and L.A. Meyer (Eds.). IPCC, Geneva, Switzerland. 151 pp.

Jaeger, K.L., J.D. Olden, and N.A. Pelland. 2014. Climate change poised to threaten hydrologic connectivity and endemic fishes in dryland streams. PNAS 111(38):13894–13899.

Jamison, L.R. and C. van Riper III. 2018. Population Dynamics of the Northern Tamarisk Beetle (*Diorhabda carinulata*) in the Colorado River Basin. Open-file Report 2018-1070. Reston, Virginia: U.S. Geological Survey. Available at https://pubs.usgs.gov/of/2018/1070/ofr20181070.pdf. Accessed April 19, 2022.

Markovchick, L. 2021. Personal communication, L. Markovchick, Graduate Researcher, Northern Arizona University, with M.A. McLeod, Senior Biologist, SWCA Environmental Consultants, December 1, 2021.

Parmesan, C., and H. Galbraith. 2004. Observed impacts of global climate change in the U.S. Prepared for the Pew Center on Global Climate Change, November 2004. 67 pp.

RiversEdge West. 2022a. 2021 Interactive ArcGIS Online Beetle Data Map. Web map. Available at https://riversedgewest.org/events tamarisk-beetle-maps. Accessed April 19, 2022.

_____. 2022b. Tamarisk Beetle. Available at https://riversedgewest.org/services/tamariskbeetle#ecosystem. Accessed April 19, 2022.

Seager, R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi, H.P. Huang, N. Harnik, A. Leetmaa, N.C. Lau, C. Li, J. Velez, and N. Naik. 2007. Model projections of an imminent transition to a more arid climate in Southwestern North America. Science 316:1181-1184.

Robles, M.D., J.C. Hammond, S.K. Kampf, J.A. Biederman, and E.M.C. Demaria. 2021. Winter Inputs Buffer Streamflow Sensitivity to Snowpack Losses in the Salt River Watershed in the Lower Colorado River Basin. *Water* 13, 3. Available at: https://doi.org/10.3390/w13010003. Accessed March 2023.

Salt River Project (SRP). 2003. Roosevelt Habitat Conservation Plan, Annual Report, 2003. Prepared for U.S. Fish and Wildlife Service. Phoenix, Arizona: Salt River Project.

_____. 2004. Roosevelt Habitat Conservation Plan, Annual Report, 2004. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.

_____. 2005. Roosevelt Habitat Conservation Plan, Annual Report, 2005. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.

_____. 2006. Roosevelt Habitat Conservation Plan, Annual Report, 2006. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.

_____. 2007. Roosevelt Habitat Conservation Plan, Annual Report, 2007. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.

_____. 2008. Roosevelt Habitat Conservation Plan, Annual Report, 2008. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.

_____. 2009. Roosevelt Habitat Conservation Plan, Annual Report, 2009. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.

_____. 2010. Roosevelt Habitat Conservation Plan, Annual Report, 2010. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.

_____. 2011. Roosevelt Habitat Conservation Plan, Annual Report, 2011. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2012. Roosevelt Habitat Conservation Plan, Annual Report, 2012. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2013. Roosevelt Habitat Conservation Plan, Annual Report, 2013. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2014. Roosevelt Habitat Conservation Plan, Annual Report, 2014. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2015. Roosevelt Habitat Conservation Plan, Annual Report, 2015. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2016. Roosevelt Habitat Conservation Plan, Annual Report, 2016. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2017. Roosevelt Habitat Conservation Plan, Annual Report, 2017. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2018. Roosevelt Habitat Conservation Plan, Annual Report, 2018. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2019. Roosevelt Habitat Conservation Plan, Annual Report, 2019. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2020. Roosevelt Habitat Conservation Plan, Annual Report, 2020. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2021. Roosevelt Habitat Conservation Plan, Annual Report, 2021. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.
_____. 2022. Roosevelt Habitat Conservation Plan, Annual Report, 2022. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, Salt River Project, Phoenix, AZ.

SWCA, Inc. 2023a. Addendum to the Roosevelt Lake Habitat Conservation Plan, Gila and Maricopa Counties, Arizona. Prepared for Salt River Project Agricultural Improvement and Power District, Phoenix, AZ, and Submitted to U.S. Fish and Wildlife Service, Albuquerque, NM.

_____. 2023b. Draft Environmental Assessment for the Roosevelt Lake Habitat Conservation Plan Addendum and Planned Deviation to the Modified Roosevelt Dam Water Control Manual. Prepared for U.S. Fish and Wildlife Service, Phoenix, AZ, and Army Corps of Engineers, Los Angeles, CA.

Trenberth, K.E. 2007. Warmer oceans, stronger hurricanes. Scientific American 297(1):45-51.

U.S. Bureau of Reclamation (USBR). 1989. Biological Assessment of the Possible Impacts of CAP Plan 6 and Safety of Dams Activities on the Bald Eagles at Roosevelt Lake. Phoenix Area Office, Phoenix, AZ.

———. 1992. Biological Assessment of the Possible Impacts of CAP Plan 6 and Safety of Dams Activities on the Tonto Creek Bald Eagle Territory, Roosevelt Lake. Phoenix Area Office, Phoenix, AZ.

_____. 1996. Modified Theodore Roosevelt Dam Water Control Manual Final Environmental Assessment. Prepared for U.S. Army Corps of Engineers. August. Phoenix Area Office, Phoenix, AZ.

U.S. Fish and Wildlife Service (USFWS). 1990. Biological Opinion on Central Arizona Water Control Project, Roosevelt Dam Element of Plan 6 (2-21-83-F-10). March 30, 1990. Phoenix: Arizona Ecological Services Field Office, Phoenix, AZ.

_____. 1993. Biological Opinion for A-Cross Road, Indian Point Recreation Site, Tonto Creek Riparian Unit, and Roosevelt Lake Operating Levels. January 21, 1993. Phoenix: Arizona Ecological Services Field Office, Phoenix, AZ.

_____. 1996. Final Biological Opinion for the Modified Roosevelt Dam and Its Effects on the Endangered S.W. Willow Flycatcher (*Empidonax traillii extimus*) and Response to Reclamation's Comments on Draft Biological Opinion. Phoenix: Arizona Ecological Services Field Office, Phoenix, AZ.

_____. 2002b. Final Environmental Impact Statement for the Roosevelt Habitat Conservation Plan, Gila and Maricopa Counties, Arizona. U.S. Fish and Wildlife Service, Arizona Ecological Services, Phoenix, AZ.

_____. 2003. Intra-Service Biological and Conference Opinion – Issuance of a Section 10(a)(1)(B) permit to Salt River Project for Operation of Roosevelt Lake. Phoenix: Arizona Ecological Services Field Office, Phoenix, AZ.

_____. 2011. Biological and Conference Opinion for Wildlife and Sport Fish Restoration Funding of Arizona Game and Fish Department's Statewide and Urban Fisheries Stocking Program for 2011-2021. Albuquerque, New Mexico: U.S. Fish and Wildlife Service, Wildlife and Sport Fish Restoration Program.

_____. 2019a. Intra-Service Formal Consultation on the Proposed Issuance of a Section 10(a)(1)(A) Recovery Permit for the Northern Mexican Gartersnake for Proposed Scientific and/or Enhancement of Propagation or Survival Activities. Project # 02EAAZ00-2019-F-0868, Arizona Ecological Services Office, U.S. Fish and Wildlife Service, Phoenix, AZ

_____. 2021a. Intra-Service Formal Consultation Reinitiation for the Issuance of a Salt River Project's Amended Section 10(a)(1)(A) Scientific and/or Enhancement of Survival Recovery Permit for the Northern Mexican Gartersnake (2021-2023). Project # 02EAAZ00-2019-F-0868-R001, Arizona Ecological Services Office, U.S. Fish and Wildlife Service, Phoenix, AZ.

_____. 2021d. Biological and Conference Opinion (BCO) for Wildlife and Sport Fish Restoration Funding of Arizona Game and Fish Department's Statewide and Urban Fisheries Stocking Program for 2021–2031. Phoenix: U.S. Fish and Wildlife Service, Arizona Ecological Services Office, Phoenix, AZ.

_____. 2022. Biological Opinion for the San Pedro Riparian National Conservation Area (SPRNCA) Grazing Lease Renewal and Integrated Vegetation Management, Cochise County, Project #2022-0011144, Arizona Ecological Services Office, U.S. Fish and Wildlife Service, Phoenix, AZ.

Northern Mexican Gartersnake

Altemus, M.M. 2020. Northern Mexican Gartersnake Survey Summary Report. Mesa, Arizona: EcoPlan Associates, Inc.

Baker, S.J., R.P. O'Donnell, and M.F. Ingraldi. 2019. Surveys for the Threatened Northern Mexican Gartersnake on Salt River Project Owned Properties of the Lower San Pedro and Salt Rivers. Phoenix: Arizona Game and Fish Department, Wildlife Contracts Branch.

Bauder, J. 2022. 2022 Annual report for U.S. Fish and Wildlife Service native threatened species recovery permit (#ESPER0033846). Unpublished report to the Arizona Ecological Services Suboffice. Tucson, Arizona. 8 pp.

Boyarski, V.L., M.E. Young, and T.B. Cotton. 2015. Home range and habitat use of northern Mexican gartersnakes (Thamnophis eques megalops) in a highly modified habitat. Unpublished technical report #291. Nongame Wildlife Branch, Wildlife Management Division, Arizona Game and Fish Department. Phoenix, AZ. 27 pp.

Boyarski, V.L., M.J. Ryan, and T.B. Cotton. 2019. Population Ecology of Northern Mexican Gartersnakes (*Thamnophis eques megalops*) at Bubbling Ponds Hatchery Complex. Nongame and Endangered Wildlife Program Technical Report 317. Arizona Game and Fish Department, Phoenix, AZ.

Brennan, T.C., and A.T. Holycross. 2006. A Field Guide to Amphibians and Reptiles in Arizona. Arizona Game and Fish Department, Phoenix, AZ. 150 pp.

Brennan, T.C., P.C. Rosen, and L. Hellekson. 2009. Diadophis punctatus regalis (regal ring-necked snake) diet. Sonoran Herpetologist 22(11):123.

Burger. B. 2010. Email correspondence from Bill Burger, Nongame Specialist, Arizona Game and Fish Department, to Tom Jones, Arizona Game and Fish Department, Valerie Boyarski, Arizona Game and Fish Department, Jeff Servoss, U.S. Fish and Wildlife Service, and Andrew Holycross, Arizona State University. July 12, 2010; 1556 hours.

Cobbold, S. 2018. Personal communication via Facebook Messenger regarding the observation of a Northern Mexican Gartersnake in a parking lot in Punkin Center, AZ (June 12, 2018; 1057 hours).

Cogan, R. 2015. E-mail correspondence from Roger Cogan, Conservation Coordinator at Appleton-Whitten Research Ranch, National Audubon Society (April 7, 2015; 1117 hours).

Cotton, T.B., J.D. Miller, and D.D. Grandmaison. 2013. Geographic distribution: *Thamnophis eques* (Mexican gartersnake). Herpetological Review 44(1):111.

Degenhardt, W.G., C.W. Painter, and A.H. Price. 1996. Amphibians and Reptiles of New Mexico. University of New Mexico Press, Albuquerque, NM. 431 pp.

d'Orgeix, C., T. Mathies, B. Ellison, K. Johnson, I. Monagan, and T. Young. 2013. Northern Mexican gartersnakes, *Thamnophis eques megalops*, feeding on *Spea multiplicata* in an ephemeral pond. Herpetological Review 44(2):213-215.

Drummond, H., and C. Marcías-García. 1989. Limitations of a generalist: a field comparison of foraging snakes. *Behaviour* 108(1/2):23-43.

Emmons, I. 2017. Ecology of federally threatened northern Mexican gartersnakes in north-central Arizona. Master's Thesis, Northern Arizona University, Flagstaff, AZ. 173 pp.

Emmons, I.D., and E. Nowak. 2013. Northern Mexican gartersnake surveys 2012: interim report. Colorado Plateau Research Station, Northern Arizona University. Flagstaff, AZ. 20 pp.

Emmons, I.D., and E.M. Nowak. 2016. Monitoring Surveys and Radio Telemetry of Northern Mexican Gartersnakes (*Thamnophis eques megalops*) in the Verde Valley, Arizona. Unpublished final report to Arizona Game and Fish Department Heritage Fund IIAPM Program in fulfillment of grant #I12028. Flagstaff: Colorado Plateau Research Station, Northern Arizona University.

Emmons, I.D., E.M. Nowak, and K.K. Lauger. 2016. Prey availability and foraging events of the northern Mexican gartersnake (*Thamnophis eques megalops*) in north-central Arizona. Herpetological Review 47(4):555-561.

ERO-GEI (ERO Resources Corporation and GEI Consultants, Inc.). 2022a. Movement of Nonnative Fish into Tonto Creek, Above A-Cross Road, Gila County, Arizona. Denver, Colorado. January 21.

_____. 2022b. Salt River Project Northern Mexican Gartersnake Study 4: Nonnative Fish Survey Report Gila County, Arizona. Denver, Colorado. January 21.

Fitzgerald, L.A. 1986. A preliminary status survey of *Thamnophis rufipunctatus* and *Thamnophis eques* in New Mexico. Unpubl. Report to New Mexico Department of Game and Fish, Albuquerque, NM.

Gawlik, D.E. 2002. The effects of prey availability on the numerical response of wading birds. Ecological Monographs 72(3):329–346.

Grimsley-Padron, A.A., R.P. O'Donnell, S.J. Baker, and M.F. Ingraldi. 2020. Surveys for the Northern Mexican Gartersnake (Thamnophis eques megalops) on Salt River Project Owned Properties of the Salt and Gila Rivers in Arizona. Phoenix: Arizona Game and Fish Department, Wildlife Contracts Branch.

Harrow, R.L., A. Duran-Granillo, and M.J. Ryan. 2022. *Thamnophis eques* (Mexican Gartersnake). Foraging Behavior. Herpetological Review 53(4):703–704.

Holycross, A.T., W.P. Burger, E.J. Nigro, and T C. Brennan. 2006. Surveys for *Thamnophis eques* and *Thamnophis rufipunctatus* along the Mogollon Rim and New Mexico. A Report Submitted to the Arizona Game and Fish Department, Phoenix, AZ. 94 pp.

Jenney, C.J, Z.C. Nemec, L.N. Lee and S.A. Bonar. 2022. Increased juvenile native fish abundance following a major flood in an Arizona river, Journal of Freshwater Ecology, 37:1, 1-14, DOI: 10.1080/02705060.2021.2002734

Jones, T.R. 2017. E-mail correspondence from Thomas R. Jones, Amphibians and Reptiles Program Manager, Arizona Game and Fish Department. (August 2, 2017; 1355 hrs.).

Jones, T.R., M.J. Ryan, T.B. Cotton, and J.M. Servoss. 2020. *Thamnophis eques*, Mexican gartersnake. Pages 418-432 *In:* A.T. Holycross and J.C. Mitchell (Eds.), Snakes of Arizona, ECO Publishing, Rodeo, NM.

Lashway, S. 2012. Santa Cruz River northern Mexican gartersnake survey: San Rafael State Natural Area. Unpublished report. Arizona Game and Fish Department, Region V Fish Program. 13 pp.

_____. 2014. Santa Cruz River northern Mexican gartersnake survey: San Rafael State Natural Area, August 2014. Arizona Game and Fish Department. Unpublished report. 18 pp.

_____. 2015. Santa Cruz River northern Mexican gartersnake survey: San Rafael State Natural Area, August 2014. Arizona Game and Fish Department. Unpublished report. 18 pp.

Madara, A. 2012. Email correspondence from Amy Madara, Tonto Basin Ranger District, Tonto National Forest to Bill Burger, Arizona Game and Fish Department. July 5, 2012; 1650 hours.

Manjarrez, J., C. Macías García, and H. Drummond. 2013. Variation in the diet of the Mexican black-bellied barter snake *Thamnophis melanogaster:* Importance of prey availability and snake body size. Journal of Herpetology 47:413–420.

Manjarrez, J., M. Pacheco-Tinoco, and C.S. Venegas-Barrera. 2017. PeerJ. Open Access Journal.

Myrand, J. 2019. Inundation effects on the ecology of the northern Mexican gartersnake (*Thamnophis eques megalops*). Unpublished M.S. thesis, Northern Arizona University, Flagstaff.

Myrand, J., E. Nowak, R. Bergamini, and I. Emmons. 2017. 2016 surveys and telemetry of northern Mexican gartersnakes of lower Tonto Creek: Report to the Salt River Project.

Unpublished report from the USGS Colorado Plateau Research Station at Northern Arizona University. Flagstaff, AZ. 36 pp.

Nowak, E.M. and V.L. Boyarski. 2012. *Thamnophis eques megalops* (Northern Mexican Gartersnake). Reproduction: Litter size. Herpetological Review 43(2):351-352.

Nowak, E., R. Bergamini, and I. Emmons. 2015. 2014 Surveys for the Northern Mexican Gartersnakes in Lower Tonto Creek. Unpublished report for the Salt River Project. Colorado Plateau Research Station, Northern Arizona University, Flagstaff.

Nowak, E., I. Emmons, J. Myrand, C. Klovanish, and R. Bergamini. 2019. 2015–2017 Surveys and Telemetry of Northern Mexican Gartersnakes in Lower Tonto Creek. Prepared for the Salt River Project. Colorado Plateau Research Station, Northern Arizona University, Flagstaff. Originally dated April 2018. Rev. May 2019.

Owens, M.D., E.L. Federman, D.E. Sanchez, M. Wicke, J. Black, R.A. Valencia, E. Nowak, and F.M. Walker. 2023. Detection of the Threatened Northern Mexican Gartersnake Through Fecal and eDNA. The Wildlife Society AZ/NM Joint Annual Meeting, Farmington, New Mexico, February 2–4. Poster presentation.

Price, A.H. 1980. Geographic Distribution Notes: *Thamnophis eques megalops*. Herpetological Review 11(2):39.

Rosen, P.C., and C.R. Schwalbe. 1988. Status of the Mexican and narrow-headed garter snakes (*Thamnophis eques megalops* and *Thamnophis rufipunctatus rufipunctatus*) in Arizona. Unpubl. Report from Arizona Game and Fish Dept. (Phoenix, Arizona) to U.S. Fish and Wildlife Service, Albuquerque, NM. iv + 50 pp + appendices.

_____. 1997. Status of Native and Introduced Species of Aquatic Herpetofauna at San Bernardino National Wildlife Refuge. Tucson: Department of Ecology and Evolutionary Biology and Biological Resources Division, Cooperative Park Studies Unit, U.S. Geological Survey, University of Arizona.

Rosen, P.C., J.E. Wallace, and C.R. Schwalbe. 2001. Resurvey of the Mexican gartersnake (*Thamnophis eques*) in southeastern Arizona. In Conservation of Wetland Herpetofauna in Southeastern Arizona, edited by P.C. Rosen and C.R. Schwalbe, p. 167. Tucson: School of Renewable Natural Resources, U.S. Geological Survey Sonoran Desert Field Station, University of Arizona.

Rossman, D.A., N.B. Ford, and R.A. Seigel. 1996. The Garter Snakes. University of Oklahoma Press: Norman, OK. 332 pp.

Simms, J. 2016. Aquatic species conservation work in the BLM Tucson Field Office: update 2016. Unpublished report. 9 pp.

Sprague, T. 2017. Microhabitat and Movement Assessment for Northern Mexican Gartersnakes (*Thamnophis eques megalops*) at Bubbling Ponds Hatchery, Arizona. Master's thesis, Northern Arizona University, Flagstaff.

Sprague, T.A., and H.L. Bateman. 2018. Influence of seasonality and gestation on habitat selection by northern Mexican gartersnakes (*Thamnophis eques megalops*).

Stingelin, A. M., S. T. Blackman, R. M. Mixan, and M. F. Ingraldi. 2009. Post-fire vegetation monitoring, invasive species mapping, and sensitive species inventory, and monitoring on the San Rafael State Natural Area. Progress report submitted to Resources Management Section, Arizona State Parks. Final Report. 63 pp.

SWCA Environmental Consultants (SWCA). 2022. Assessment of Northern Mexican Gartersnake Occupancy and Habitat within the Roosevelt Lake Permit Area. Tucson, Arizona: SWCA Environmental Consultants.

U.S. Fish and Wildlife Service (USFWS). 2014a. Endangered and threatened wildlife and plants; threatened status for the northern Mexican gartersnake and narrow-headed gartersnake, Final rule. Federal Register 79(130) 38678-38746.

_____. 2021b. Endangered and threatened wildlife and plants; Designation of critical habitat for the northern Mexican gartersnake; Final rule. *Federal Register* 86(80):22518–22580.

Southwestern Willow Flycatcher

Animal and Plant Health Inspection Services (APHIS). 2010. Biological Assessment for APHIS PPQ Permitting and Program for Redistribution in 13 States of *Diorhabda* species for Biological Control of Salt Cedar (*Tamarix* spp.). U.S. Department of Agriculture, Animal and Plant Health Inspection Services, Riverdale, MD.

Browning, M.R. 1993. Comments on the taxonomy of *Empidonax traillii* (willow flycatcher). Western Birds 24:241-257.

Busch, D.E. 1995. Effects of Fire on Southwestern Riparian Communities. Southwestern Naturalist 40 (3):259-267.

Cardinal S.N. and E. H. Paxton. 2005. Home range, movement, and habitat use of the southwestern willow flycatcher at Roosevelt Lake, AZ – 2004. U.S. Geological Survey Report to the U.S. Bureau of Reclamation, Phoenix, AZ.

DeLoach, C.J. 1991. Biological control of weeds in the United States. Natural Areas Journal 11:129-142.

Drost, C.A., M.K. Sogge, and E. Paxton. 1998. Preliminary Diet Study of the Endangered Southwestern Willow Flycatcher. Report to U.S. Bureau of Reclamation. U.S.G.S. Biological Resources Division/Colorado Plateau Res. Station/N. Arizona University. 26 pp.

Durst, S.L. 2004. Southwestern willow flycatcher potential prey base and diet in native and exotic habitat. Masters Thesis. Northern Arizona University, Flagstaff, AZ.

_____. 2017. Southwestern willow flycatcher breeding site and territory summary – 2012. San Juan River Basin Recovery Implementation Program, U.S Fish and Wildlife Service, New Mexico Ecological Services Field Office, Albuquerque, NM.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2005. Southwestern willow flycatcher breeding site and territory summary- 2004. U.S. Geological Survey, Colorado Plateau Research Station, Flagstaff, AZ.

Durst, S.L., M.K. Sogge, H.C. English, S.O. Williams, B.E. Kus, and S.J. Sferra. 2006. Southwestern willow flycatcher breeding site and territory summary- 2005. U.S. Geological Survey, Colorado Plateau Research Station, Flagstaff, AZ.

Durst, S.L., M.K. Sogge, S.D. Stump, S.O. Williams, B.E. Kus, and S.J. Sferra. 2007. Southwestern willow flycatcher breeding site and territory summary- 2006. U.S. Geological Survey, Colorado Plateau Research Station, Flagstaff, AZ.

Durst, S.L, M.K. Sogge, H.C. English, H.A. Walker, B.E. Kus, and S.J. Sferra. 2008. Southwestern willow flycatcher breeding site and territory summary – 2007. U.S. Geological Survey, Colorado Plateau Research Station, Flagstaff, AZ.

Ellis, L.A., D.M. Weddle, S.D. Stump, H.C. English, and A.E. Graber. 2008. Southwestern Willow Flycatchers Final Survey and Monitoring Report. Research Technical Guidance Bulletin #10. Arizona Game and Fish Department, Phoenix, AZ.

Finch, D.M. and S.H. Stoleson, eds. 2000. Status, ecology, and conservation of the southwestern willow flycatcher. Gen. Tech. Rep. RMRS-GTR-60. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 131 p.

Gladwin, D.N., and J.E. Roelle. 1998. Survival of plains cottonwood (*Populus deltoides* subsp. *monilifera*) and tamarisk (*Tamarix ramosissima*) seedlings in response to flooding. Wetlands 18:669–674.

Hatten, J.R., and C.E. Paradzick. 2003. A multiscaled model of southwestern willow flycatcher breeding habitat. Journal of Wildlife Management 67(4):774–788.

Howell, S.N.G. and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York, New York. 851 pp.

Hubbard, J.P. 1987. The Status of the Willow Flycatcher in New Mexico. Endangered Species Program, New Mexico Department of Game and Fish, Sante Fe, New Mexico. 29 pp.

Johnson, M. 2021. Personal communication, M. Johnson, Avian Ecologist, Colorado Plateau Research Station, with M.A. McLeod, Senior Biologist, SWCA Environmental Consultants, August 25, 2021.

Johnson, M., Z. Ozsoy, A. Stahlke, L. Jamison, C. Calvo, R. Gillespie, and R. Winton. 2021. Tamarisk leaf beetle species distribution, tamarisk phenology and tamarisk leaf beetle molecular identification within the Lower Colorado River, Hassayampa River, Centennial Wash Gila River, AZ/NM, Little Colorado River, Salt River, San Pedro River, Tonto Creek, Verde River and Rio Grande River, NM Watersheds. Presented at RiversEdge West Changing River Conference, February. Flagstaff, Arizona: EcoPlateau Research.

Liknes, E.T., and T.C. Ashbeck. 2021. Southwestern Willow Flycatcher and Western Yellow-billed Cuckoo Surveys along the Tonto Creek and Salt River Inlets at Roosevelt Lake, Arizona: 2020 Summary Report. Prepared for Salt River Project. Mesa, Arizona: EcoPlan Associates, Inc.

_____. 2022. Southwestern Willow Flycatcher and Western Yellow-billed Cuckoo Surveys along the Tonto Creek and Salt River Inlets at Roosevelt Lake, Arizona: 2021 Summary Report. Prepared for Salt River Project. Mesa, Arizona: EcoPlan Associates, Inc.

McCarthey, T.D., C.E. Paradzick, J.W. Rourke, M.W. Sumner, and R.F. Davidson. 1998 Arizona Partners in Flight southwestern willow flycatcher 1997 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 130. Arizona Game and Fish Department, Phoenix, Arizona. 81 pp.

McLeod, M.A., T.J. Koronkiewicz, B.T. Brown, and S.W. Carothers. 2005. Southwestern willow flycatcher surveys, demography, and ecology along the lower Colorado River and tributaries. Annual report submitted U.S. Bureau of Reclamation, Boulder City, NV, by SWCA Environmental Consultants, Flagstaff, AZ.

Owen, J.C. and M.K. Sogge. 2002. Physiological condition of southwestern willow flycatchers in native and saltcedar habitats. U.S. Geological Survey report to the Arizona Department of Transportation.

Paxton, E., J. Owen and M.K. Sogge. 1996. Southwestern willow flycatcher response to catastrophic habitat loss. U.S.G.S. Colorado Plateau Research Station/Northern Arizona University report. 12 pp.

Paxton, E.H., M.K. Sogge, S.L. Durst, T.C. Theimer, and J.R. Hatten. 2007. The Ecology of the Southwestern Willow Flycatcher in Central Arizona—a 10-year Synthesis Report.

U.S. Geological Survey Open-File Report 2007-1381. Available at: https://pubs.er.usgs.gov/publication/ofr20071381.

Paxton, E., K. Day, T Olson, P. Wheeler, M. MacLeod, T. Koronkiewicz, and S. O'Meara. 2010. Tamarisk biocontrol impacts occupied breeding habitat of the endangered southwestern willow flycatcher. Poster presentation at Tamarisk Coalition annual conference. Reno, NV.

Peterson, R.T. 1990. A field guide to western birds. Third edition. Houghton Mifflin Company, Boston, Massachusetts. 432 pp.

Phillips, A.R. 1948. Geographic variation in *Empidonax traillii*. *The Auk* 65:507-514.

Phillips, A.R., J. Marshall, and G. Monson. 1964. The Birds of Arizona. University of Arizona Press, Tucson, Arizona. 212 pp.

Poff, L.N., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks and J.C. Stromberg. 1997. The Natural Flow Regime. BioScience, Vol. 47, No. 11 (Dec., 1997), pp. 769-784.

Ridgely, R.S. and G. Tudor. 1994. The Birds of South America: Suboscine Passerines. University of Texas Press, Austin, Texas.

Smith, A.B., C.E. Paradzick, A.A. Woodward, P.E.T. Dockens, and T.D. McCarthey. 2002. Southwestern willow flycatcher 2001 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report #191. Arizona Game and Fish Department, Phoenix, Arizona.

Sogge, M.K., R. M. Marshall, S. J. Sferra, and T. J. Tibbitts. 1997. A southwestern willow flycatcher survey protocol and breeding ecology summary. National Park Service/Colorado Plateau Res. Station/N. Arizona University, Tech. Rept. NRTR-97/12. 37 pp.

Sogge, M.K., E.H. Paxton, and A.A Tudor. 2005. Saltcedar and southwestern willow flycatchers: lessons from long-term studies in central Arizona. As published on CD ROM in: Aguirre-Bravo, Celedonio, and others. Eds. 2005. Monitoring science and technology symposium: unifying knowledge for sustainability in the Western Hemisphere. 2004 September 20-24; Denver, CO. Proceedings RMRS-P037CD. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

Sogge, M.K., D. Ahlers, and S.J. Sferra. 2010. A Natural History Summary and Survey Protocol for the Southwestern Willow Flycatcher: U.S. Geological Survey Techniques and Methods 2A-10, 38 p.

Stevens, L.E. and G.L. Waring. 1986. Effects of postdam flooding on riparian substrates, vegetation, and invertebrate populations in the Colorado River corridor in Grand Canyon, Arizona. Glen Canyon Environmental Studies Tech Report 19/87, U.S. Bureau of Reclamation, Upper Colorado Region, Salt Lake City, UT.

Stiles, F. G., and A. F. Skutch. 1989. A guide to the birds of Costa Rica. Comstock, Ithaca, New York. 364 pp.

Stromberg, J.C. 1997. Growth and survivorship of Fremont cottonwood, Goodding willow, and salt cedar seedlings after large floods in central Arizona. Great Basin Naturalist 57:198–208.

Stromberg, J.C., B.D. Richter, D.T. Patten, and L.G. Wolden. 1993. Response of a Sonoran riparian forest to a 10-year return flood. Great Basin Naturalist 53(2):118–130.

Unitt, P. 1987. *Empidonax traillii extimus*: An endangered subspecies. Western Birds 18:137-162.

U.S. Fish and Wildlife Service (USFWS). 1995a. Final rule determining endangered status for the southwestern willow flycatcher. Federal Register 60:10694-10715.
_____. 1997a. Final determination of critical habitat for the southwestern willow flycatcher. *Federal Register* 62(140):39129-39146.
_____. 1997b. Correction; final determination of critical habitat for the southwestern willow flycatcher. Federal Register 62 (161): 44228.
_____. 2002a. Southwestern Willow Flycatcher Recovery Plan, Region 2, Albuquerque, NM.
_____. 2005. Biological opinion on the Forest Service's continued implementation of the land, resource, and management plans for the 11 southwestern region national forests and grasslands, R2/ES-TE, 02-21-03-F-0366. U.S. Fish and Wildlife Service, Region 2, Albuquerque, New Mexico.
_____. 2013. Final Revised Southwestern Willow Flycatcher Critical Habitat Designation. *Federal Register* 78 (2): 344.
_____. 2017. Notice of 12 Month Finding on Petition to Remove the Southwestern Willow Flycatcher from the List of Threatened and Endangered Species and 5 Year Review. Federal Register 82 (249): 61725.
Valencia, R.A. 2022. Personal communication, email, to SWCA Environmental Consultants, July 5, 2022.
Warren, D.K. and R.M Turner. 1975. Saltcedar seed production, seedling establishment, and response to inundation. Journal of the Arizona Academy of Science. Oct. 1975, Vol. 10, No. 3. Arizona-Nevada Academy of Sciences.

Western Yellow-billed Cuckoo

American Ornithologists Union (AOU). 1998. The A.O.U. Checklist of North American Birds. 7th ed. Washington, D.C.: American Ornithologists' Union.
Corman T.E. and R.T Magill. 2000. Western Yellow-billed Cuckoo in Arizona: 1998 and 1999 Survey Report. Phoenix, AZ: Arizona Game and Fish Department Report No.: 150.
Corman T.E. and C. Wise-Gervais, editors. 2005. Arizona Breeding Bird Atlas. University of New Mexico Press.
Corson C. 2018. Yellow-billed Cuckoo Survey at Buenos Aires National Wildlife Refuge, Arizona, 2018. Sasabe, AZ: USFWS, Buenos Aires National Wildlife Refuge.
Cresswell K.A., W.H. Satterthwaite., and G.A Sword. 2011. Understanding the evolution of migration through empirical examples. In: Milner-Gulland E.J., Fryxell J.M., Sinclair A.R.E., editors. Animal Migration. Oxford University Press. p. 6–16.
Dettling M.D. and C.A. Howell. 2011. Status of the Yellow-billed Cuckoo along the Sacramento River in 2010. PRBO Conservation Science Report No.: PRBO Contribution # 1794.
Dillon K.G. and D. Moore. 2020. Yellow-billed Cuckoo Breeding Habitat Use: Radio Telemetry on the Middle Rio Grande, New Mexico 2019. Denver, CO: Bureau of Reclamation Technical Service Center Report No.: Report # ENV-2020-016.
Dillon K.G., D. Ahlers, and D. Moore. 2018. Yellow-billed Cuckoo Study Results – 2017 Middle Rio Grande from Los Lunas to Elephant Butte Reservoir, New Mexico. Denver, CO: U.S. Bureau of Reclamation, Technical Service Center, Fisheries and Wildlife Resources.

Dockens P.E.T. and T.C. Ashbeck. 2011a. Southwestern willow flycatcher and yellow-billed cuckoo surveys on the Horseshoe Reservoir study area, Arizona, 2011. Mesa, AZ: EcoPlan Associates, Inc. Report No.: EcoPlan Number 09-281004.

_____. 2011b. Southwestern willow flycatcher and yellow-billed cuckoo surveys at the SRP-managed properties along the San Pedro River, Pinal County, Arizona. Mesa, AZ: EcoPlan Associates, Inc. Report No.: EcoPlan Number 09-281003.

Erfani E. and D. Mitchell. 2014. A partial mechanistic understanding of the North American monsoon. Journal of Geophysical Research.:13096–13115. doi:doi:10.1002/2014JD022038.

Gaines D. 1974. Distribution, density and habitat requirements of the California Yellow-billed Cuckoo in the Sacramento Valley: 1972-73. The State of California Department of Fish and Game.

Gaines D. and S.A. Laymon. 1984. Decline, Status and Preservation of the Yellow-Billed Cuckoo in California. Western Birds. 15(2):49–80.

Griffin D.J. 2015. Surveys for Yellow-billed Cuckoos at Buenos Aires National Wildlife Refuge, Pima County, Arizona. Sasabe, AZ: Griffin Biological Services.

Groschupf K. 1987. Status of the yellow-billed cuckoo (*Coccyzus americanus occidentallis*) in Arizona and West Texas.

Halterman M.D. 2001. Population status of the yellow-billed cuckoo at the Bill Williams River NWR and Alamo Dam, Arizona, and southern Nevada: Summer 2000. Weldon, CA: Southern Sierra Research Station.

_____. 2002. Surveys and life history studies of the yellow-billed cuckoo: Summer 2001. Weldon, CA: Southern Sierra Research Station.

_____. 2009. Sexual Dimorphism, Detection Probability, Home Range, and Parental Care in the Yellow-billed Cuckoo [PhD Dissertation]. [Reno, NV]: University of Nevada.

Holmes J.A., C. Calvo, M.J. Johnson, and T.R. Arundel. 2008. Yellow-billed cuckoo distribution, abundance, habitat use, and breeding ecology in the Verde River watershed of Arizona, 2004–2005. Arizona Game and Fish Department.

Hughes J.M. 2015. Yellow-billed Cuckoo (*Coccyzus americanus*). In: Rodewald PG, editor. The Birds of North America Online. Ithaca, NY: Cornell Lab of Ornithology. [accessed 2021 Aug 24]. https://birdsoftheworld.org/bow/historic/bna/yebcuc/2.0/introduction.

Jarnevich C.S., P. Evangelista, T.J. Stohlgren., and J. Morisette. 2011. Improving National-Scale Invasion Maps: Tamarisk in the Western United States. Western North American Naturalist. 71(2):164–175. doi:10.3398/064.071.0204.

Kagan R.A., T.C. Viner, P.W. Trail, and E.O. Espinoza. 2014. Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Report. National Fish and Wildlife Forensics Laboratory.

Kingsley K.J. 1985. The pecan orchard as a riparian ecosystem.

Laymon S.A. 1980. Feeding and Nesting Behavior of the Yellow-billed Cuckoo in the Sacramento Valley. State of California Department of Fish and Game.

_____. 1998. Yellow-billed Cuckoo (*Coccycus americanus*). In: The Riparian Bird Conservation Plan: A Strategy for Reversing the Decline of Riparian-associated Birds in California. California Partners in Flight. http://www.prbo.org/calpif/htmldocs/riparian_v-2.html.

Laymon S.A. and M.D. Halterman. 1985. Yellow-billed Cuckoos in the Kern River Valley: 1985 Population, Habitat Use, and Management Recommendations. Kern River Preserve, The Nature Conservancy.

_____. 1989. A Proposed Habitat Management Plan for Yellow-billed Cuckoos in California. Pacific Southwest Forest and Range Experiment Station Report No.: PSW-110.

Laymon S.A., P.L.Williams, and M.D. Halterman. 1997. Breeding Status of the Yellow-billed Cuckoo on the South Fork Kern River Valley, Kern County, California: Summary Report 1985-1997. USDA Forest Service Sequoia National Forest Report No.: Cost Share Grant 92-5-13.

Leenhouts J.M., J.C. Stromberg, and R. Scott. 2006. Hydrologic Requirements of and Consumptive Groundwater Use by Riparian Vegetation along the San Pedro River, Arizona. U.S. Geological Survey Fact Sheet Report No.: 2005–5163. https://pubs.usgs.gov/sir/2005/5163/.

Longcore R.T. and S.A. Gauthreaux Jr. 2005. Scientific Basis to Establish Policy Regulating Communications Towers To Protect Migratory Birds: response to Avatar Environmental, LLC., report regarding migratory bird collisions with communications towers, WT Docket No. 03–187. Federal Communications Commission Notice of Inquiry. Los Angeles, CA: Land Protection Partners.

MacFarland J. and J. Horst 2015. Yellow-billed Cuckoo Surveys on the Coronado National Forest within Eight Sky Island Mountain Ranges in Southeast Arizona. Tucson Audubon Society.

_____. 2016. Yellow-billed Cuckoo Surveys on the Coronado National Forest within Five Sky Island Mountain Ranges in Southeast Arizona in 2016. Tucson Audubon Society.

_____. 2017. Yellow-billed Cuckoo Surveys on the Coronado National Forest within Five Sky Island Mountain Ranges in Southeast Arizona in 2017. Tucson Audubon Society.

_____. 2019. Yellow-billed Cuckoo Surveys on the Coronado National Forest within Three Sky Island Mountain Ranges in Southeast Arizona in 2018. Tucson, AZ: Tucson Audubon Society.

McNeil S.E., T.D. Stanek, and C.D. Capello. 2015. Loop migration by a western yellow-billed cuckoo wintering in the Gran Chaco. Western Birds. 46:24–215.

McNeil S.E., T.D, Stanek, J.R. Stanek, and Southern Sierra Research Station. 2013. Yellow-billed Cuckoo Distribution, Abundance, and Habitat Use on the Lower Colorado River and Tributaries 2008-2012 Summary Report. Boulder City, NV: Lower Colorado River Multi-Species Conservation Program, U.S. Bureau of Reclamation.

Parametrix, Inc. and Southern Sierra Research Station. 2019. Yellow-billed Cuckoo Surveys on the Lower Colorado River and Tributaries, 2014 to 2018 Summary Report. Boulder City, Nevada: by S.E. McNeil, D. Tracy, J. Lisignoli, and J.R. Stanek Report No.: Reclamation contract No. R14PD0004.

Phillips A, J. Marshall, and G. Monson. 1964. The Birds of Arizona. Tucson, AZ: University of Arizona Press.

Pulido F, T. Coppack, and P. Berthold. 2001. Genetic variation and phenotypic plasticity may explain adaptive changes in the timing of Autumn migration. The Ring. 23:149–158.

Sechrist J., V. Johanson, D. Ahlers. 2009. Western yellow-billed cuckoo radio telemetry study results middle Rio Grande, New Mexico: 2007–2008. Denver, CO: U.S. Bureau of Reclamaiton, Technical Service Center.

Sechrist J.D., E.H. Paxton, D. Ahlers, R.H. Doster, and V.M. Ryan. 2012. One Year of Migration Data for a Western Yellow-billed Cuckoo. Western Birds. 43(1):2–11.

Sechrist J., D. Ahlers, K.P. Zehfuss, R.H. Doster, E.H. Paxton, and V.M. Ryan. 2013. Home Range and Use of Habitat of Western Yellow-billed Cuckoos On the Middle Rio Grande,

New Mexico. The Southwestern Naturalist. 58(4):411–419. doi:10.1894/0038-4909-58.4.411.

Sferra S.J., C. Drost, T.C. Theimer, and N. Beauregard. 2019. Investigating Western Yellow-billed Cuckoo Breeding Status in the Mountains of Southeastern Arizona; Implications for Recovery Annual report, 2018. Flagstaff, AZ.

Sogge M.K., S.J. Sferra, and E.H. Paxton. 2008. Tamarix as Habitat for Birds: Implications for Riparian Restoration in the Southwestern United States. Restor Ecology. 16(1):146–154. doi:10.1111/j.1526-100X.2008.00357.x.

Stanek J.E., S.E. McNeil, D. Tracy, J.R Stanek., J.A. Manning, and M.D. Halterman. 2021. Western Yellow-billed Cuckoo Nest-Site Selection and Success in Restored and Natural Riparian Forests. Jour Wild Mgmt. 85(4):782–793. doi:10.1002/jwmg.22020.

U.S. Fish and Wildlife Service (USFWS). 2014b. Endangered and Threatened Wildlife and Plants: Determination of Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*); Final rule. Federal Register: 79:59992; October 3, 2014.

_____. 2019b. Historical and current status of the western yellow-billed cuckoo (YBCU) excerpted from October 2013 proposed listing rule and updated by the YBCU Core Team.

_____. 2020a. Endangered and Threatened Wildlife and Plants: Findings on a Petition to Delist the Distinct Population Segment of the Yellow-billed Cuckoo; Notification of Findings. Federal Register: 85:57816; September 16, 2020.

_____. 2021c. Endangered and Threatened Wildlife and Plants: Designation of Critical Habitat for the Western Distinct Population Segment of the Yellow-billed Cuckoo; Final rule. Federal Register: 86:20798; April 21, 2021.

Villarreal M.L., C. van Riper III, and R.E. Petrakis. 2014. Conflation and aggregation of spatial data improve predictive models for species with limited habitats: A case of the threatened yellow-billed cuckoo in Arizona, USA. Applied Geography. 47:57–69. doi:10.1016/j.apgeog.2013.12.003.

Wallace C.S.A., M.L. Villarreal, and C. van Riper III. 2013. Influence of monsoon-related riparian phenology on yellow-billed cuckoo habitat selection in Arizona. Pearson R, editor. J Biogeogr. 40(11):2094–2107. doi:10.1111/jbi.12167.

White M.C., K.G. Dillon, and D. Moore. 2018. Lower Rio Grande Yellow-billed Cuckoo Survey Results - 2017: Selected sites within the Lower Rio Grande Basin from Elephant Butte Dam, NM to El Paso, TX. Denver, CO: U.S. Department of the Interior, Bureau of Reclamation, Technical Service Center.

Wohner P.J., S.A. Laymon., J.E. Stanek, S.L. King, and R.J. Cooper. 2021. Early successional riparian vegetation is important for western Yellow-billed Cuckoo nesting habitat. Restor Ecol. 29(5). doi:10.1111/rec.13376.

Bald Eagle

Driscoll, J.T., K.V. Jacobson, G.L. Beatty, J.S. Canaca, and J.G. Koloszar. 2006. Conservation assessment and strategy for the bald eagle in Arizona. Nongame and Endangered Wildlife Program Technical Report 173. Arizona Game and Fish Department, Phoenix, Arizona.

Hunt, W.G., D.E. Driscoll, E.W. Bianchi, and R.E. Jackman. 1992. Ecology of Bald Eagles in Arizona. Report to U.S. Bureau of Reclamation, Contract 6-CS-30-04470. BioSystems Analysis Incorporated, Santa Cruz, CA.

McCarty, K.M, J.K. Presler, and K.V. Jacobson. 2022. Arizona bald eagle management program 2022 summary report. Nongame and Endangered Wildlife Program Technical Report 355. Arizona Game and Fish Department, Phoenix, AZ.

Stalmaster, M.V. 1987. The bald eagle. Universe Books, New York, New York.

U.S. Fish and Wildlife Service (USFWS). 1995b. Endangered and threatened species: bald eagle reclassification; final rule. Federal Register. 60(133):36000-10. Department of the Interior, Washington, D.C.

_____. 2007. Endangered and threatened wildlife and plants; removing the bald eagle in the lower 48 states from the list of endangered and threatened wildlife; final rule. Federal Register. 72(130):37346-37372. Department of the Interior, Washington, D.C.

_____. 2010a. Endangered and threatened wildlife and plants; 12-month finding on a petition to list the Sonoran Desert population of the bald eagle as a threatened or endangered distinct population segment. Federal Register. 75(37):8601-8621. Department of the Interior, Washington, D.C.

_____. 2011. Endangered and threatened wildlife and plants; bald eagles nesting in Sonoran Desert Area of central Arizona removed from the list of endangered and threatened wildlife. Federal Register. 76(171):54711-54713. Department of the Interior, Washington, D.C.

_____. 2020b. Final Report: Bald Eagle Population Size: 2020 Update. U.S. Fish and Wildlife Service, Division of Migratory Birds Management, Washington, D.C.

Spikedace

Andereck, K.L. 1993. The impacts of tourism on natural resources. Parks and Recreation 28(6):26-32. Available online at http://www.thefreelibrary.com/The+impacts+of+tourism+on+natural+ resources-a013952796. Accessed August 2, 2010.

Anderson, R.M. 1978. The distribution and aspects of the life history of Meda fulgida in New Mexico. MS Thesis. New Mexico State University, Las Cruces. 62 pp.

Anderson, A.A. and D.A. Hendrickson. 1994. Geographic variation in the morphology of spikedace, *Meda fulgida*, in Arizona and New Mexico. The Southwestern Naturalist 39(2):148-155.

Arizona State University (ASU). 1994. Fishery surveys of the Apache-Sitgreaves National Forests. First through fourth trip reports for the Blue River and selected tributaries between May 24 and August 13, 1994. Tempe, Arizona.

_____. 1995. Fishery surveys of the Apache-Sitgreaves National Forests. Fifth through ninth trip reports for the Blue River and selected tributaries between April 22 and September 16, 1995. Tempe, Arizona.

_____. 2002. Lower Colorado Basin fish database. Produced for the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service by Arizona State University, Tempe, Arizona.

_____. 2008. Eagle Creek trip reports from Arizona State University personnel from 1989 through 2008. Tempe, Arizona.

Armour, C.L., D.A. Duff, and W. Elmore. 1991. The effects of livestock grazing on riparian and stream ecosystems. Fisheries 16(1):7-11.

Bahm, J. and A. Robinson. 2009a. Spikedace and loach minnow survey in Eagle Creek, Greenlee and Graham counties, July – August 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 7 pages.

_____. 2009b. Spikedace survey of the upper Verde River, Granite Creek and Perkinsville areas, June 25 – July 3, 2008. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 5 pages.

Barber, W.E. and W.L. Minckley. 1983. Feeding ecology of a southwestern Cyprinid fish, the spikedace, *Meda fulgida*. The Southwestern Naturalist 28(1):33-40.

_____. 1983. Feeding ecology of a southwestern Cyprinid fish, the spikedace, *Meda fulgida* Girard. The Southwestern Naturalist 28(1):33-40.

Barber, W.E., D.C. Williams, and W.L. Minckley. 1970. Biology of the Gila spikedace, *Meda fulgida*, in Arizona. Copeia 1970(1):9-18.

Barlow, P.M. and S.A. Leake. 2012. Streamflow depletion by wells – understanding and managing the effects of groundwater pumping on streamflow. U.S. Geological Survey circular 1376. Reston, Virginia. 84 pages.

Bonar, S.A., L.L. Leslie, and C.E. Velez. 2004. Influence of species, size class, environment, and season on introduced fish predation on native fishes in the Verde River system, Arizona. Arizona Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, University of Arizona. Tucson, Arizona. 108 pages.

Briggs, M.K. 1996. Riparian ecosystem recovery in arid lands. University of Arizona Press, Tucson, Arizona. 159 pages.

Brouder, M. 2002. July 25, 2002 e-mail to Marianne Meding from Mark Brouder re: Verde River survey info.

Brown, M. and P. Froemke. 2012. Nationwide assessment of nonpoint source threats to water quality. BioScience 62(2):136-146.

Clark, A. 2001. Region III fisheries survey of the Verde River-Stillman Lake, September 25, 2001. Arizona Game and Fish Department, Kingman, Arizona.

Clarkson, R.W., P.C. Marsh, J.A. Stefferud, and B.R. Kesner. 2008. Fishery survey of lower Blue River, Greenlee County, Arizona, May 19-22, 2008. 5 pages.

Clarkson, R.W., P.C. Marsh, S.E. Stefferud, and J.A. Stefferud. 2005. Conflicts between native fish and nonnative sport fish management in the southwestern United States. Fisheries 30(9):20-27.

Courtenay, W.R., Jr. and G.K. Meffe. 1989. Small fishes in strange places: a review of introduced Poeciliids. Pages 319 - 331 In G.K. Meffe and F.F. Snelson, Jr. (Editors) Ecology and evolution of livebearing fishes (Poeceliidae). Prentice Hall, Englewood Cliffs, New Jersey.

Deacon, J.E., C. Hubbs, and B.J. Zahuranec. 1964. Some effects of introduced fishes on the native fish fauna of southern Nevada. Copeia 1964 (2):384-388.

Dorn, N.J. and G.G. Mittelbach. 2004. Effects of a native crayfish (Orconectes virilis) on the reproductive success and nesting behavior of sunfish (Lepomis spp.). Canadian Journal of Fisheries and Aquatic Sciences 61:2135-2143.

Douglas, M.E., P.C. Marsh, and W.L. Minckley.1994. Indigenous fishes of western North America and the hypothesis of competitive displacement: *Meda fulgida* (Cyprinidae) as a case study. Copeia 1994(1):9-19.

Hanson, J.M., P.A. Chambers, and E.E. Prepas. 1990. Selective foraging by the crayfish Orconectes virilis and its impact on macroinvertebrates. Freshwater Biology 24:69-80.

Hickerson, B.T., E.R. Grube, K.R. Mosher, and A.T. Robinson. 2021. Successful repatriation of a native fish assemblage in the Blue River, Arizona. North American Journal of Fisheries Management 41:746-756.

Jahrke, E. and D.A. Clark. 1999. Razorback sucker and Colorado pikeminnow reintroduction and monitoring in the Salt and Verde rivers. Technical Report 147, Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix, Arizona. 18 pages.

Jakle, M. 1992. Memo February 26, 1992 - Summary of fish and water quality sampling along the San Pedro River from Dudleyville to Hughes Ranch near Cascabel, October 24 and 25, 1992, and the Gila River from Coolidge Dam to Ashurst/Hayden Diversion Dam, October 28 - 31, 1991. U.S. Bureau of Reclamation, Phoenix, Arizona. 11 pp.

_____. 1995. Memorandum dated May 11, 1995 to PXAO-150 Files through B.D. Ellis re: Summary of fish and water quality sampling on the Gila River from Coolidge Dam to Ashurst/Hayden Diversion Dam, October 26 – 28, 1993, and the San Pedro River from Dudleyville to Hughes Ranch near Cascabel, Arizona, December 1 and 2, 1993, and an analysis of data collected during the fall fish counts 1991 – 1993.

Lachner, E.A., C.R. Robins, and W.R. Courtenay, Jr. 1970. Exotic fishes and other aquatic organisms introduced into North America. Smithsonian Contributions to Ecology 59:1-29.

Ligon, F.K., W.E. Dietrich, and W.J. Trush. 1995. Downstream ecological effects of dams. BioScience 45 (3):183-192.

Lodge, D.M., C.A. Taylor, D.M. Holdich, and J. Skurdal. 2000. Nonindigenous crayfishes threaten North American freshwater biodiversity: lessons from Europe. Fisheries 25(8):7-20.Marsh, P.C. 1996. 1996 monitoring and status of fishes in Eagle Creek, Arizona. U.S. Bureau of Reclamation, Phoenix, Arizona. 15 pages.

Marsh, P.C. 1996. 1996 monitoring and status of fishes in Eagle Creek, Arizona. U.S. Bureau of Reclamation, Phoenix, Arizona. 15 pages.

Marsh, P.C., F.J. Abarca, M.E. Douglas, and W.L. Minckley. 1989. Spikedace (*Meda fulgida*) and loach minnow (*Tiaroga cobitis*) relative to introduced red shiner (*Cyprinella lutrensis*). Arizona Game and Fish Department, Phoenix, Arizona. 116 pp.

Marsh, P.C., J.E. Brooks, D.A. Hendrickson, and W.L. Minckley. 1990. Fishes of Eagle Creek, Arizona, with records for threatened spikedace and loach minnow (Cyprinidae). Journal of the Arizona-Nevada Academy of Science 23(2):107-116.

Marsh, P.C., B.E. Bagley, G.W. Knowles, G. Schiffmiller, and P.A. Sowka. 2003. New and rediscovered populations of loach minnow, Tiaroga cobitis (Cyprinidae) in Arizona. The Southwestern Naturalist 48(4):666-669.

Meffe, G.K. 1985. Predation and species replacement in American southwestern fishes: A case study. The Southwestern Naturalist 30:173-187.

Miller, R.R. 1961. Man and the changing fish fauna of the American southwest. Papers of the Michigan Academy of Science, Arts, and Letters XLVI:365-404.

Minckley, W.L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, Arizona. 293 pp.

_____. 1985. Native fishes and natural aquatic habitats in U.S. Fish and Wildlife Service Region II west of the continental divide. Final Report for U.S. Fish and Wildlife Service, Albuquerque, NM. Arizona State University, Tempe, Arizona. 150 pages.

_____. 1987. Fishes and aquatic habitats of the upper San Pedro River system, Arizona and Sonora. Final Report, Purchase Order Number YA-558-CT7-001, U.S. Bureau of Land Management, Denver, Colorado. 81 pages.

_____. 1993. A review of fishes of the Coconino National Forest Region, Arizona. U.S. Forest Service, Flagstaff, Arizona. 43 pages.

Minckley, W.L. and J.E. Deacon. 1968. Southwestern fishes and the enigma of "Endangered species." Science 159:1424-1432.

Minckley, W.L. and J.E. Deacon (Editors). 1991. Battle against extinction: native fish management in the American West. The University of Arizona Press, Tucson, Arizona.

Minckley, W.L. and P.C. Marsh. 2009. Inland fishes of the greater southwest. Chronicle of a vanishing biota. The University of Arizona Press, Tucson, Arizona. 426 pages.

Minckley, W.L. and G.K. Meffe. 1987. Differential selection by flooding in stream fish communities of the arid American southwest. Pages 93 - 104 In W.J. Matthews and D.C. Heins (Editors) Community and evolutionary ecology of North American stream fishes. University of Oklahoma Press, Norman, Oklahoma.

Monz, C.A., D.N. Cole, Y. Leung, and J.L. Marion. 2010. Sustaining visitor use in protected areas: future opportunities in recreation ecology research based on the USA Experience. Environmental Management 45:551-562.

Moyle, P.B. 1986. Fish introductions into North America: patterns and ecological impact. Pages 27-43 *In* H.A. Mooney and J.A. Drake, Editors. Ecology of biological invasions of North America and Hawaii. Springer Verlag, New York.

Moyle, P.B., H.W. Li, and B.A. Barton. 1986. The Frankenstein effect: impact of introduced fishes on native fishes in North America. Pages 415-425 *In* R.H Stroud (Editor). Fish culture in fisheries management. American Fisheries Society, Bethesda, Maryland.

Nico, L.G. and P.L. Fuller. 1999. Spatial and temporal patterns of nonindigenous fish introductions in the United States. Fisheries 24(1):16-27.

Northern Arizona University (NAU). 2005. Fossil Creek state of the watershed report. Current condition of the Fossil Creek Watershed prior to return of full flows and other decommissioning activities. Flagstaff, Arizona. 288 pages.

New Mexico Department of Game and Fish (NMDGF). 2008. Gila rare species collections database. Provided by Y. Paroz, New Mexico Department of Game and Fish to M. Richardson, U.S. Fish and Wildlife Service.

Olden, J.D. and N.L. Poff. 2005. Long-term trends of native and nonnative fish faunas in the American Southwest. Animal Biodiversity and Conservation 28:75-89.

Ono, R.D., J.D. Williams, and A. Wagner. 1983. Vanishing fishes of North America. Stone Wall Press, Washington, D.C. 257 pages.

Papoulias, D., D. Valenciano, and D. Hendrickson. 1989. A fish and riparian survey of the Clifton Ranger District. Arizona Game and Fish Department. Phoenix, Arizona. 84 pages.

Paroz, Y.M., D.L. Propst, and J.A. Stefferud. 2006. Long-term monitoring of fish assemblages in the Gila River drainage, New Mexico. New Mexico Department of Game and Fish, Santa Fe, NM. 74 pages.

Paroz, Y. J. Monzingo, and D. Propst. 2009. Inventory of the East, Middle, and West Forks of the Gila River. Submitted to the U.S. Bureau of Reclamation and the U.S. Fish and Wildlife Service. New Mexico Department of Game and Fish and the Gila National Forest. 29 pages.

Pilger, T.J., K.B. Gido, and D.L. Propst. 2010. Diet and trophic niche overlap of native and nonnative fishes in the Gila River, USA: Implications for native fish conservation. Ecology of Freshwater Fish 19:300-321.

Platts, W.S. 1990. Managing fisheries and wildlife on rangelands grazed by livestock. A guidance and reference document for biologists. Nevada Department of Wildlife. Reno, Nevada.

Propst, D.L. 2002. Systematic investigations of warmwater fish communities. FW-17-RD Completion Report, 1 July 1997 – 30 June 2002. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 18 pages.

Propst, D.L. 2005. Systematic investigations of warmwater fish communities. FW-17-R-32 Performance Report, 1 July 2004 – 30 June 2005. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 43 pages.

Propst, D.L. 2007. Systematic investigations of warm water fish communities. Performance Report FW-17-R-34, 1 July 2006 – 30 June 2007. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 27 pages.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1986. Distribution, status, biology, and conservation of the spikedace (*Meda fulgida*) in New Mexico. Endangered Species Report No. 15. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 93 pp.

Propst, D.L., K.R. Bestgen, and C.W. Painter. 1988. Distribution, status, biology, and conservation of the loach minoow (*Tiaroga cobitis*) in New Mexico. Endangered Species Report No. 17. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 75 pp.

Propst, D.L., Y.M. Paroz, S.M. Carman, and N.D. Zymonas. 2009. Systematic investigations of warm water fish communities. Performance Report FW-17-R-36, 1 July 2008 – 30 June 2009. New Mexico Department of Game and Fish, Santa Fe, New Mexico. 6 pages.

Reinthal, P. 2022. October 15, 2022, email transmission from P. Reinthal, University of Arizona to H. Blasius, Bureau of Land Management and others re: Revised Fall 20122.

Rinne, J.N. 1985. Physical habitat evaluation of small stream fishes: point vs. transect, observation vs. capture methodologies. Journal of Freshwater Ecology 3(1):121-131.

_____. 1991. Habitat use by spikedace, *Meda fulgida* (Pisces: Cyprinidae) in southwestern streams with reference to probable habitat competition by red shiner, *Notropis lutrensis* (Pisces: Cyprinidae). The Southwestern Naturalist 36(1):7-13.

_____. 2004. Changes in fish assemblages in the Verde River, Arizona 1974 – 2003. American Fisheries Society Symposium 45:115-126.

Rinne, J.N., and E. Kroeger. 1988. Physical habitat use by spikedace, *Meda fulgida*, in Aravaipa Creek, Arizona. Proceedings of the Western Association of Fish and Wildlife Agencies Agenda 68:1-10.

Rinne, J.N. and J.A. Stefferud. 1997. Factors contributing to collapse yet maintenance of a native fish community in the desert southwest (USA). Pages 157 - 162 In D.A. Hancock, D.C. Smith, A. Grant, and J.P. Beaumer (Editors) Developing and sustaining world fisheries resources: the state of science and management. Second World Fish Congress, Brisbane, Australia. July 28-August 2, 1996 (refereed).

Rinne, J.N., C. Carter, and A. Sillas. 2005. Fish assemblages in the upper Verde River: species abundance and interactions with river hydrology, 1994-2005. Flagstaff, Arizona.

Robinson, A. and C. Crowder. 2009. Spikedace survey of the Upper Verde River, June 2009. Arizona Game and Fish Department, Research Branch. Phoenix, Arizona. 5 pages.

Robinson, A., C.D. Crowder, and D.B. Pearson. 2014. Repatriation of native fishes to Fossil Creek: summary of monitoring and stocking during 2013. A Gila River Basin Fishes Conservation Program progress report for task 3-751, U.S. Fish and Wildlife Service Cooperative Agreement No. F09AC00084. Arizona Game and Fish Department, Phoenix, Arizona.

Schreiber, D.C. 1978. Feeding interrelationships of fishes of Aravaipa Creek, Arizona. Arizona State University, Tempe, Arizona. 312 pp.

Schreiber, D.C. and W.L. Minckley. 1981. Feeding interrelations of native fishes in a Sonoran Desert stream. Great Basin Naturalist 41(4):409-426.

Shollenberger, K.R., B.R. Kesner, and P.C. Marsh. 2021. Gila River Basin native fish monitoring. 2020 annual report submitted to Bureau of Reclamation in behalf of Reclamation Contract number R17PC00108. Phoenix, Arizona. 74 pages.

Springer, C.L. 1995. Fishery survey of the Gila River within the Gila Wilderness area, Gila National Forest, New Mexico, June and August 1994. U.S. Fish and Wildlife Service, Albuquerque, New Mexico. 11 pages.

Stefferud, S.E. and P.N. Reinthal. 2005. Fishes of Aravaipa Creek, Graham and Pinal Counties, Arizona. Literature review and history of research and monitoring. Report to U.S. Bureau of Land Management, Safford, Arizona. Cooperative Agreement AAA000011, Task Order AAF030025. University of Arizona, Tucson, Arizona. 80 pages.

Stefferud, J.A. and J.N. Rinne. 1996. Sustainability of fishes in desert river: preliminary observations on the roles of stream flow and introduced fishes In Baker, M.B., Jr. and C.C. Avery (Editors) Hydrology and water resources in Arizona and the Southwest 22-25:26-31.

Stefferud, J.A., K.B. Gido, and D.L. Propst. 2011. Spatially variable response of native fish assemblages to discharge, predators and habitat characteristics in an arid-land river. Freshwater Biology 56(7):1403-1416.

Taylor, C.A., M.L. Warren, Jr., J.F. Fitzpatrick, Jr., H.H. Hobbs, III, R.F. Jezerinac, W.L. Pflieger, and H.W. Robison. 1996. Conservation status of crayfishes in the United States and Canada. Fisheries 21(4):25-38.

Tellman, B. R.Yarde, and M.G. Wallace. 1997. Arizona's changing rivers: how people have affected the rivers. University of Arizona, Tucson, Arizona. 198 pages.

Tibbets, C.A. 1992. Allozyme variation in populations of the spikedace *Meda fulgida* and the loach minnow *Tiaroga cobitis*. Proceedings of the Desert Fishes Council 24:37.

_____. 1993. Patterns of genetic variation in three cyprinid fishes native to the American southwest. MS Thesis. Arizona State University, Tempe, Arizona. 127 pp.

U.S. Fish and Wildlife Service (USFWS). 1991. Spikedace Recovery Plan. Albuquerque, New Mexico. 38 pages.

_____. 1997c. Biological opinion on Blue River road best management practices, normal repair, and maintenance. Section 7 consultation number 02-21-94-F-243. June 16, 1997. Phoenix, Arizona. Available online at http://www.fws.gov/southwest/es/arizona/Biological.htm.

_____. 2010b. Endangered and threatened wildlife and plants; Endangered status and designation of critical habitat for spikedace and loach minnow; Proposed rule. Federal Register 75(208):66482–66552.

_____. 2012. Endangered and threatened wildlife and plants; endangered status and designations of critical habitat for spikedace and loach minnow. Final Rule. Federal Register 77(36):10810-10932.

U.S. Forest Service (USFS). 2008. Pecos Canyon Recreation Use Capacity Assessment. Prepared by USDA Forest Service TEAMS Enterprise Unit for the New Mexico Department of Game and Fish, Santa Fe, New Mexico. Available online at http://www.wildlife.state.nm.us/ documents/Pecos7-2-08.pdf. Accessed November 27, 2011.

U.S. Geological Survey (USGS). 2009. Nonindigenous aquatic species – Orconectes virilis. Available online at http://nas.er.usgs.gov/queries/CollectionInfo.aspx?SpeciesID=215&State=AZ. Accessed November 27, 2011.

_____. 2010. Possible effects of groundwater pumping on surface water in the Verde Valley, Arizona. Fact Sheet 2010-3108.

_____. 2013. Understanding and managing the effects of groundwater pumping on streamflow. Fact Sheet 2013-3001. 3 pages.

Williams, J.E., D.B. Bowman, J.E. Brooks, A.A. Echelle, R.J. Edwards, D.A. Hendrickson, and J.J. Landye. 1985. Endangered aquatic ecosystems in North American deserts with a list of vanishing fishes of the region. Journal of the Arizona Nevada Academy of Science 20(1):1-62.

Wyman, S., D. Bailey, M. Borman, S. Cote, J. Eisner, W. Elmore, B. Leinard, S. Leonard, F. Reed, S. Swanson, L. Van Riper, T. Westfall, R. Wiley, and A. Winward. 2006. Riparian area management: grazing management processes and strategies for riparian-wetland areas. Technical Reference 1737-20. BLM/ST/ST-06/002+1737. U.S. Department of the Interior, Bureau of Land Management, National Science and Technology Center, Denver, Colorado. 105 pages.

APPENDIX A: CONCURRENCES

This appendix contains our concurrence for the "may affect, not likely to adversely affect" determination for the threatened narrow-headed gartersnake (*Thamnophis rufipunctatus*) and its critical habitat.

- We anticipate it is unlikely that narrow-headed gartersnakes occur along lower Tonto Creek where conservation and mitigation actions occur. These lower Tonto Creek stream segments are broader with flatter floodplains, less characteristic of the narrower and steeper streams where narrow-headed gartersnakes typically occur. The most recent narrow-headed gartersnake record was three miles upstream of the Town of Gisela in 2005 (USFWS 2014a), where Tonto Creek is steeper and narrower.
- Because we think it is unlikely narrow-headed gartersnakes occur in the conservation and mitigation areas, any short-term effects from suppression nonnative predatory sportfish and replacing them with native fish is likely insignificant to narrow-headed gartersnakes. These conservation and mitigation actions will likely overall improve narrow-headed gartersnake habitat.
- Because it is unlikely narrow-headed gartersnakes occur within the conservation and mitigation areas on lower Tonto Creek, it is unlikely electrofishing nonnative predatory sportfish will injure or kill narrow-headed gartersnakes.
- We expect the nonnative predatory sportfish suppression and native fish stocking will have an insignificant effect to narrow-headed gartersnake PBFs focusing on prey species and predation. Only 73.3 acres of narrow-headed gartersnake critical habitat occurs within the project area, at the perimeter of the critical habitat segment near the Town of Gisela. Any effects from suppressing nonnative predatory and stocking native fish will be insignificant because of its short duration and reduction in nonnative predatory sportfish. Reducing nonnative sportfish and stocking native fish is likely to improve narrow-headed gartersnake critical habitat.
- Conservation and mitigation fish management efforts will have no effects to narrow-headed gartersnake focusing on habitat function, hydrology, or stream quality PBFs.

APPENDIX B: TABLES AND FIGURES

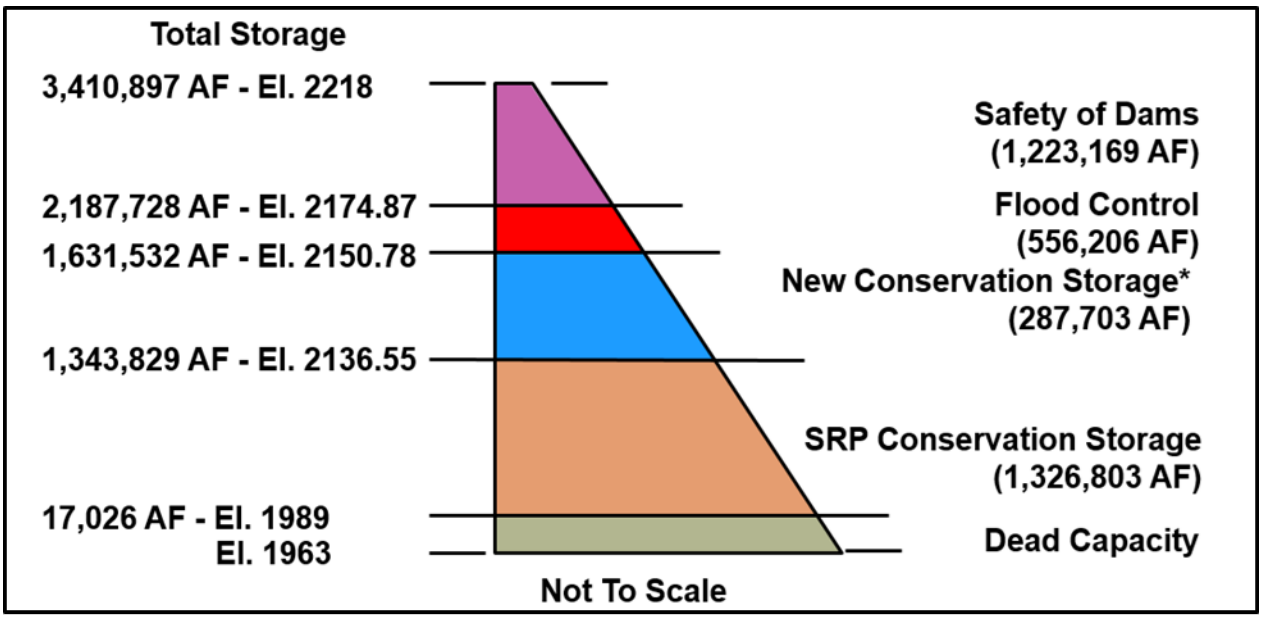

Figure 1. Modified Roosevelt Dam Representation and Areas of Operation.

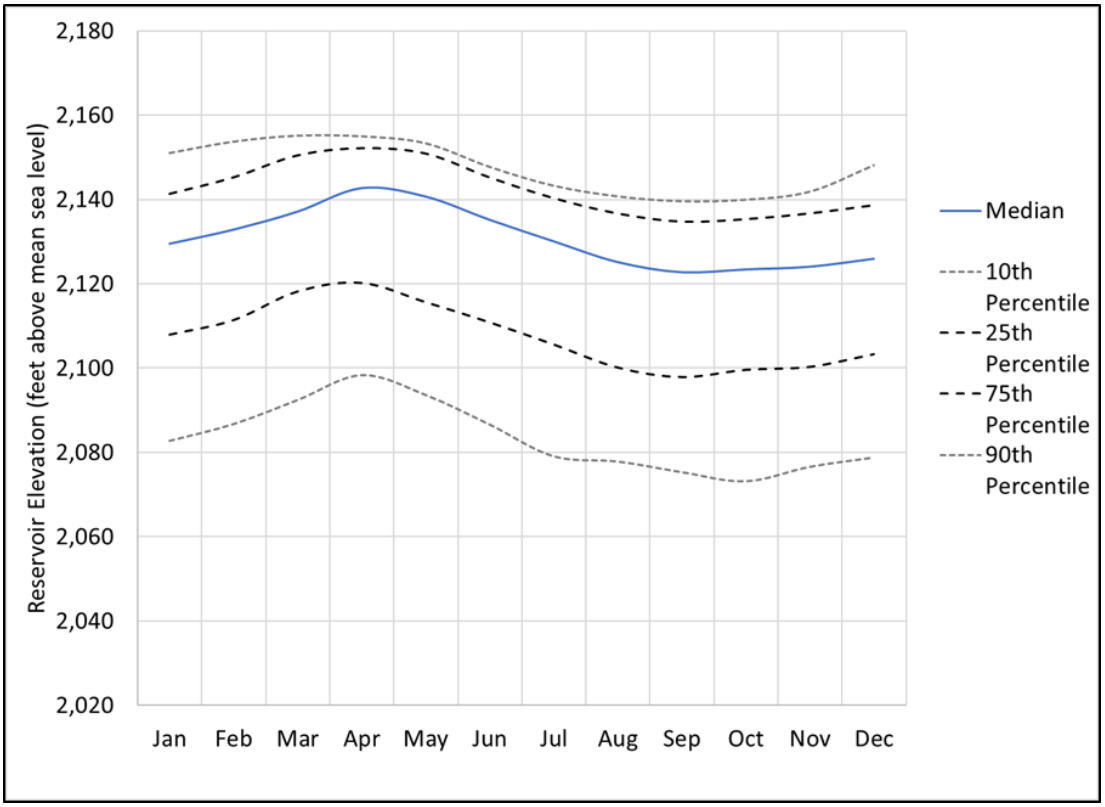

Figure 2. Estimated Range of Intra-Annual Roosevelt Lake Elevation Changes by Month.

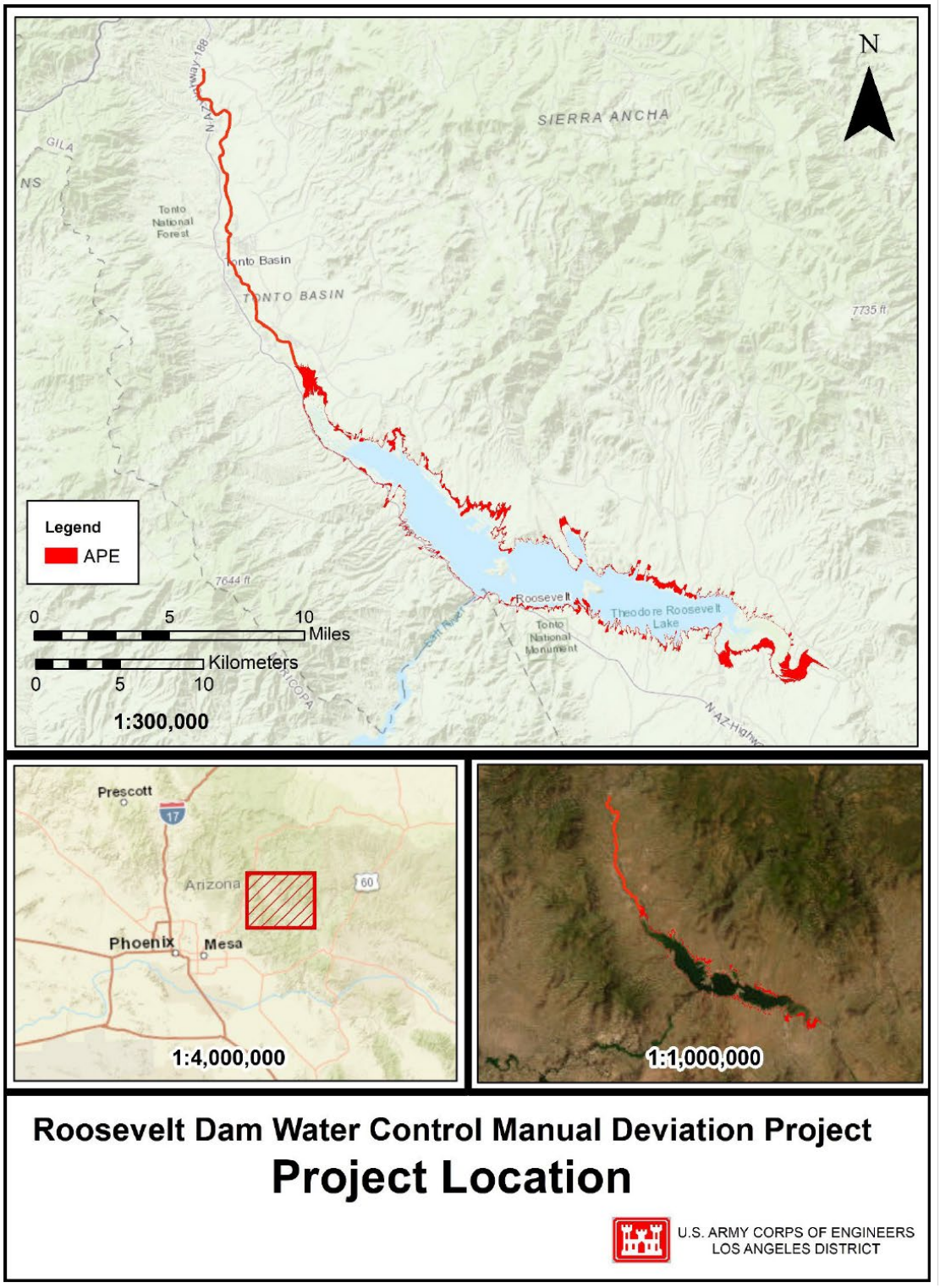

Figure 3. Modified Roosevelt Dam and Lake Location and Roosevelt HCP Amendment Permit Area (Flood Control Space and Lower Tonto Creek).

Figure 4. Roosevelt HCP Amendment - Permit Area at Tonto Creek (Flood Control Space and Lower Tonto Creek).

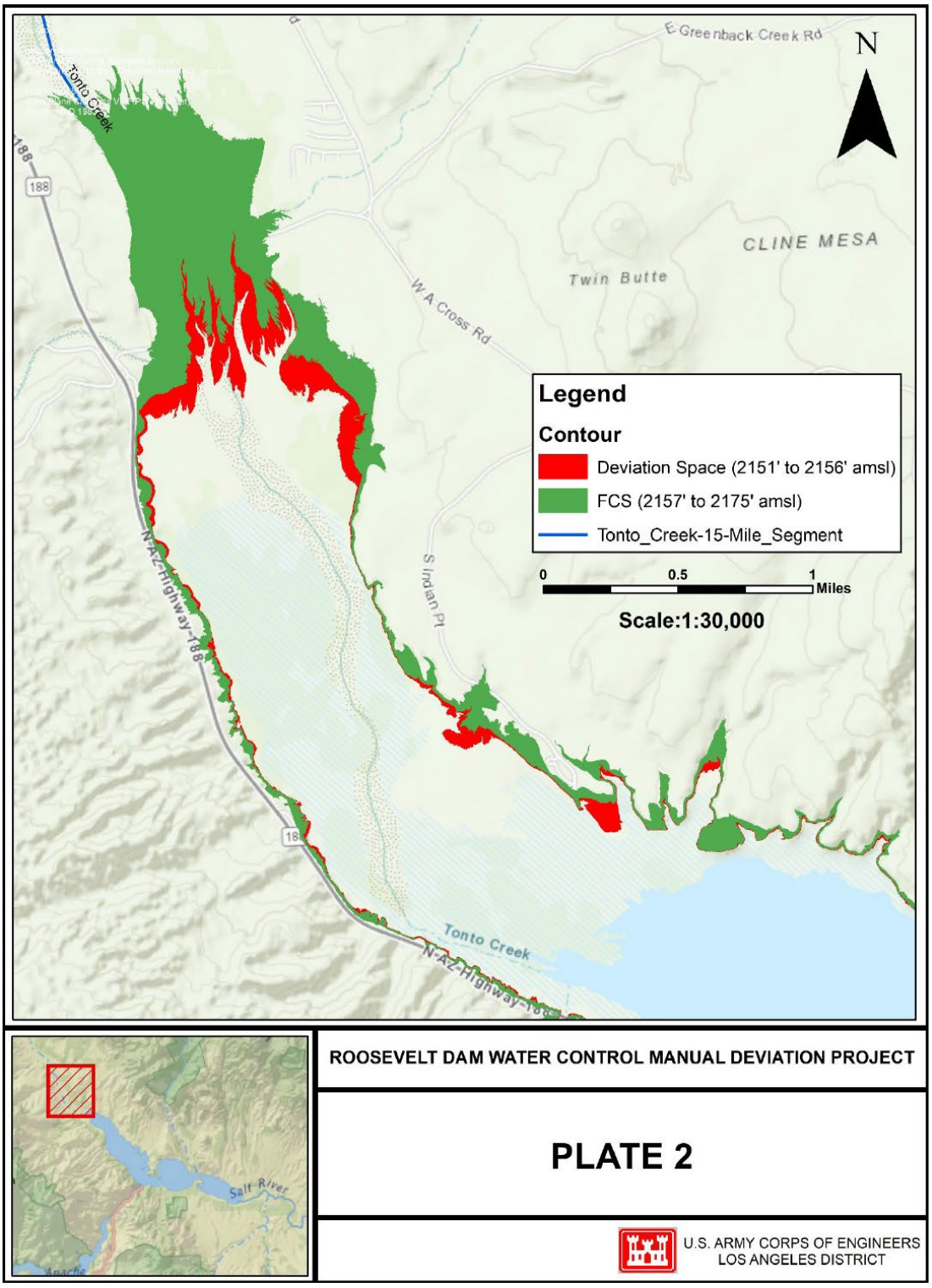

Figure 5. Roosevelt HCP Amendment - Permit Area at Tonto Creek Arm (Flood Control Space and Planned Deviation).

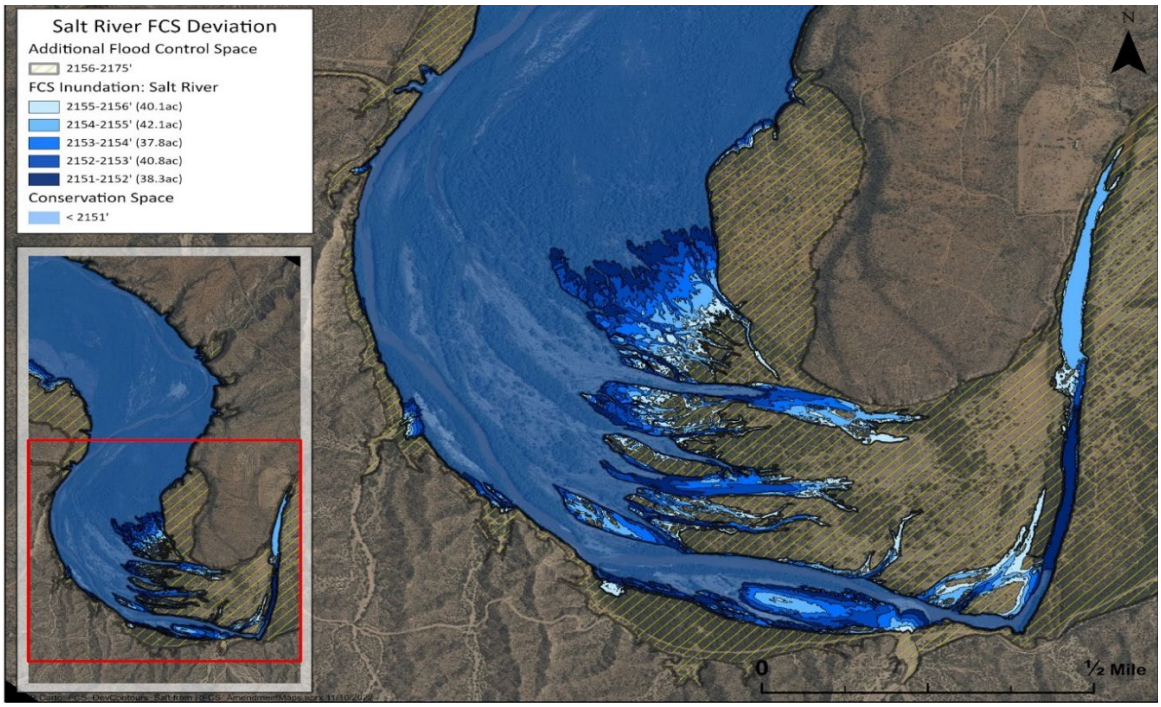

Figure 6. Roosevelt HCP Amendment – Salt River Arm, Planned Deviation Area.

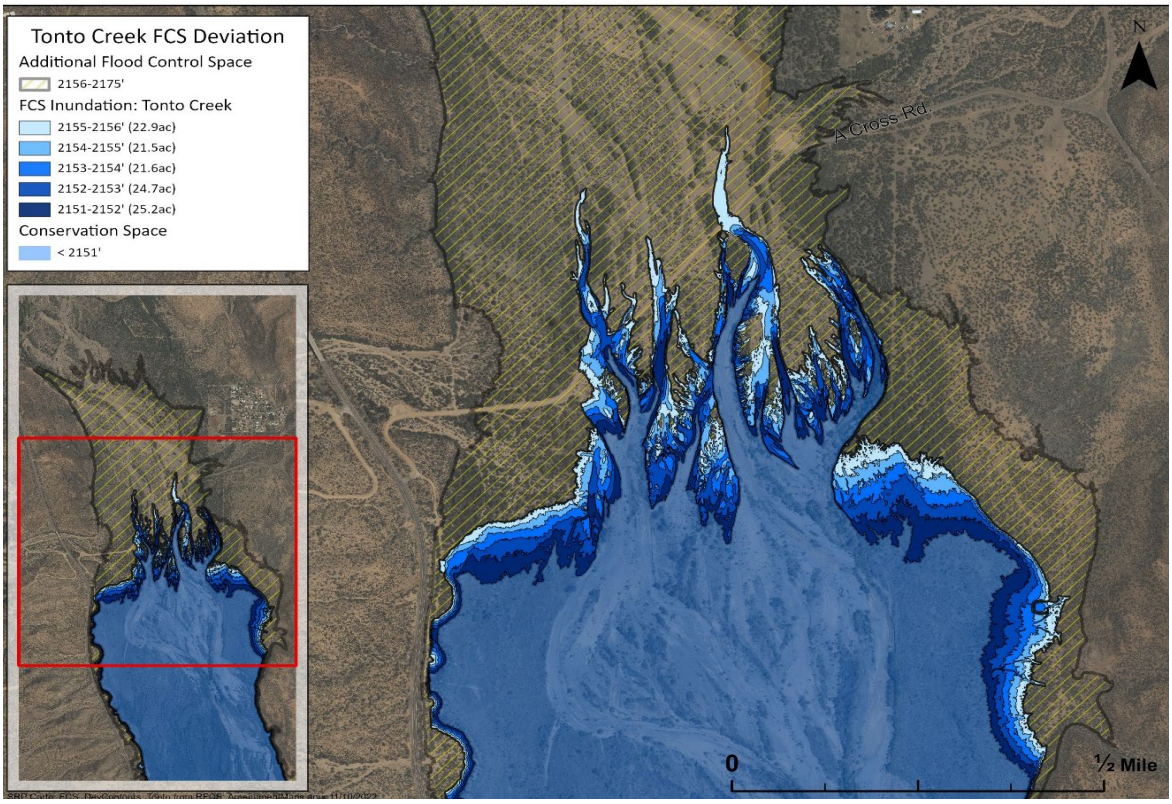

Figure 1. Roosevelt HCP Amendment – Tonto Creek Arm, Planned Deviation Area.

Figure 8. Northern Mexican Gartersnake Detections in the Roosevelt HCP Amendment Permit Area, Lower Tonto Creek and Tonto Creek Arm of Roosevelt Lake.

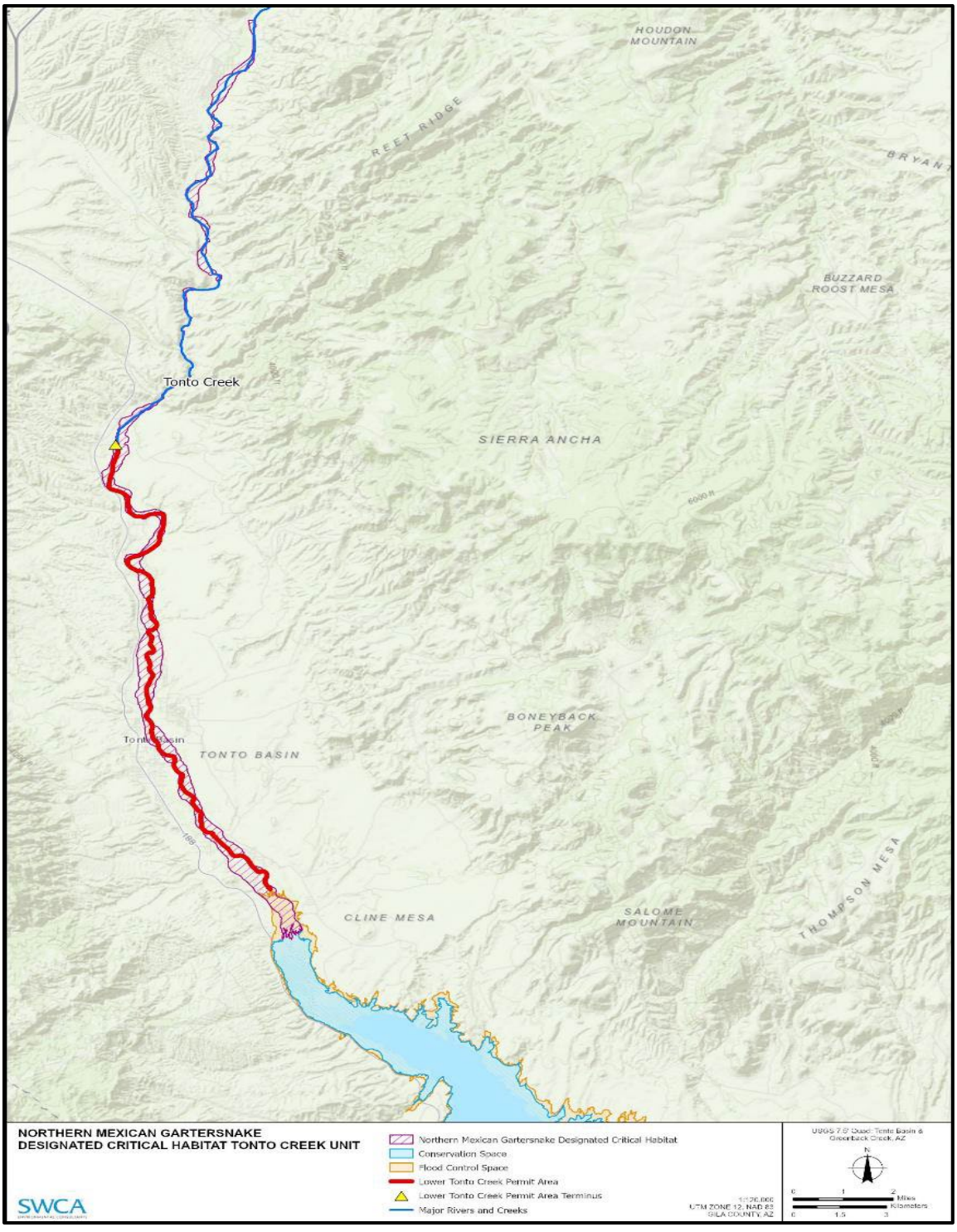

Figure 9. Northern Mexican Gartersnake Critical Habitat in the Roosevelt HCP Amendment Permit Area, Lower Tonto Creek.

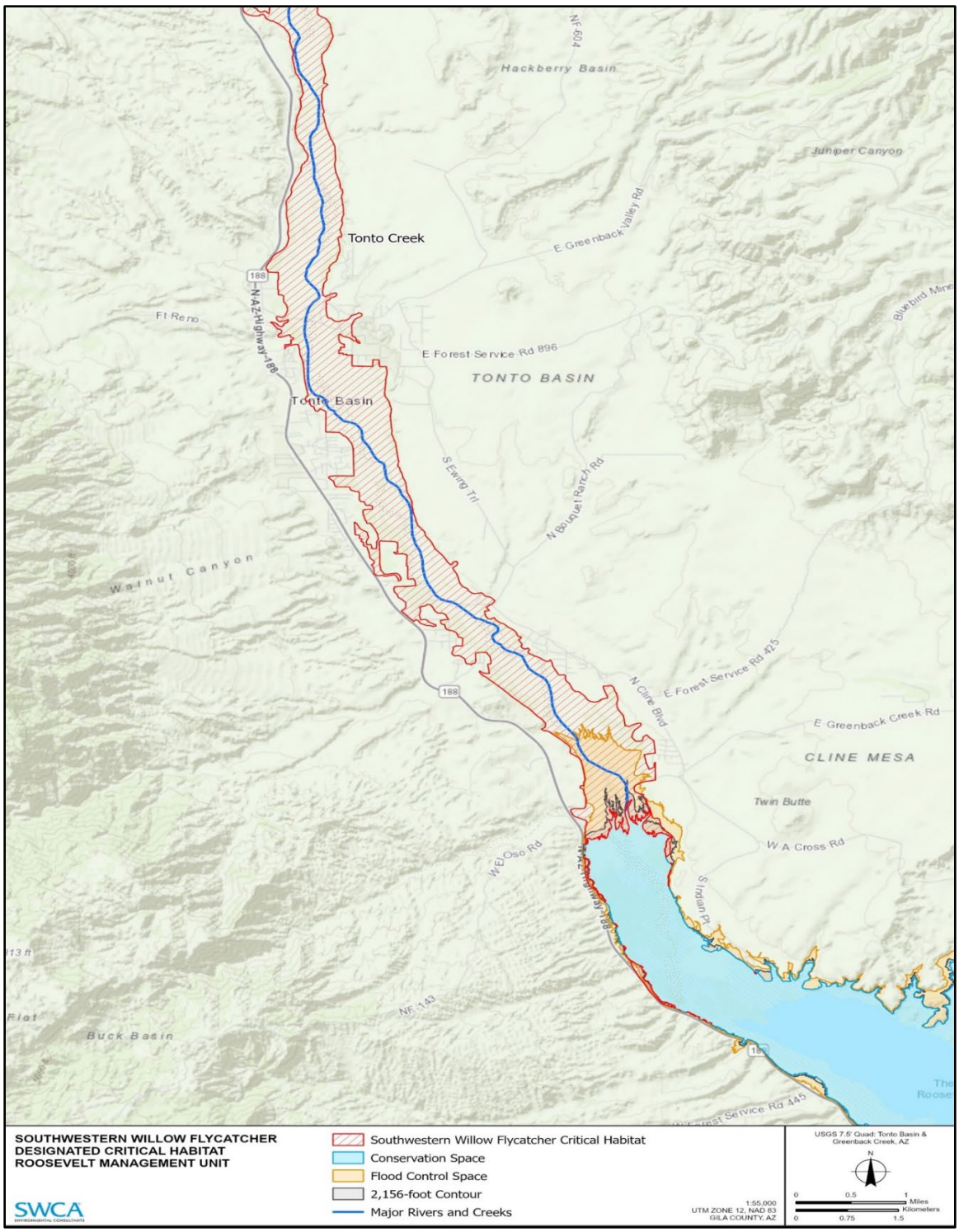

Figure 10. Southwestern Willow Flycatcher Critical Habitat in the Roosevelt HCP Amendment Permit Area, Tonto Creek.

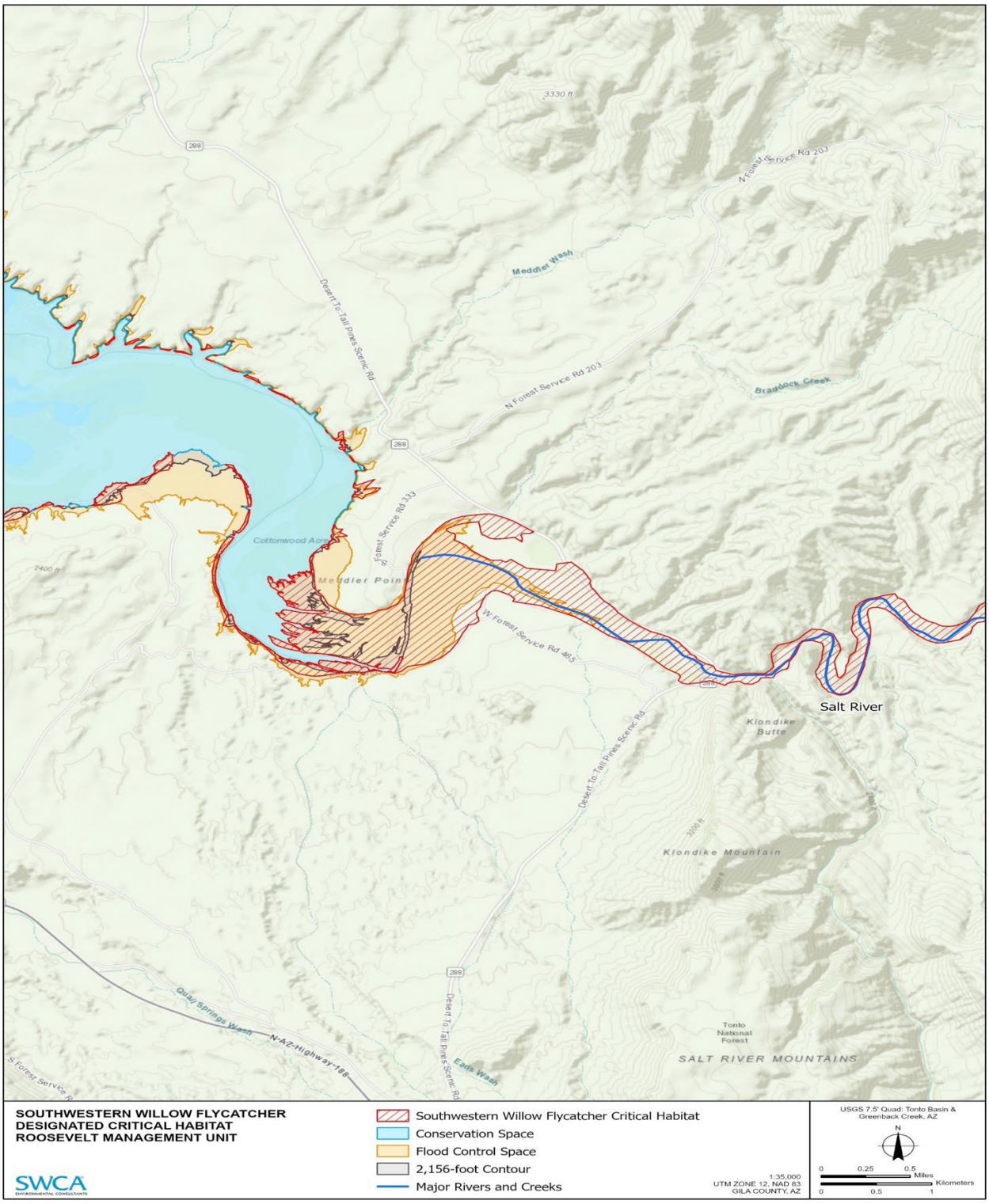

Figure 11. Southwestern Willow Flycatcher Critical Habitat in the Roosevelt HCP Amendment Permit Area, Salt River.

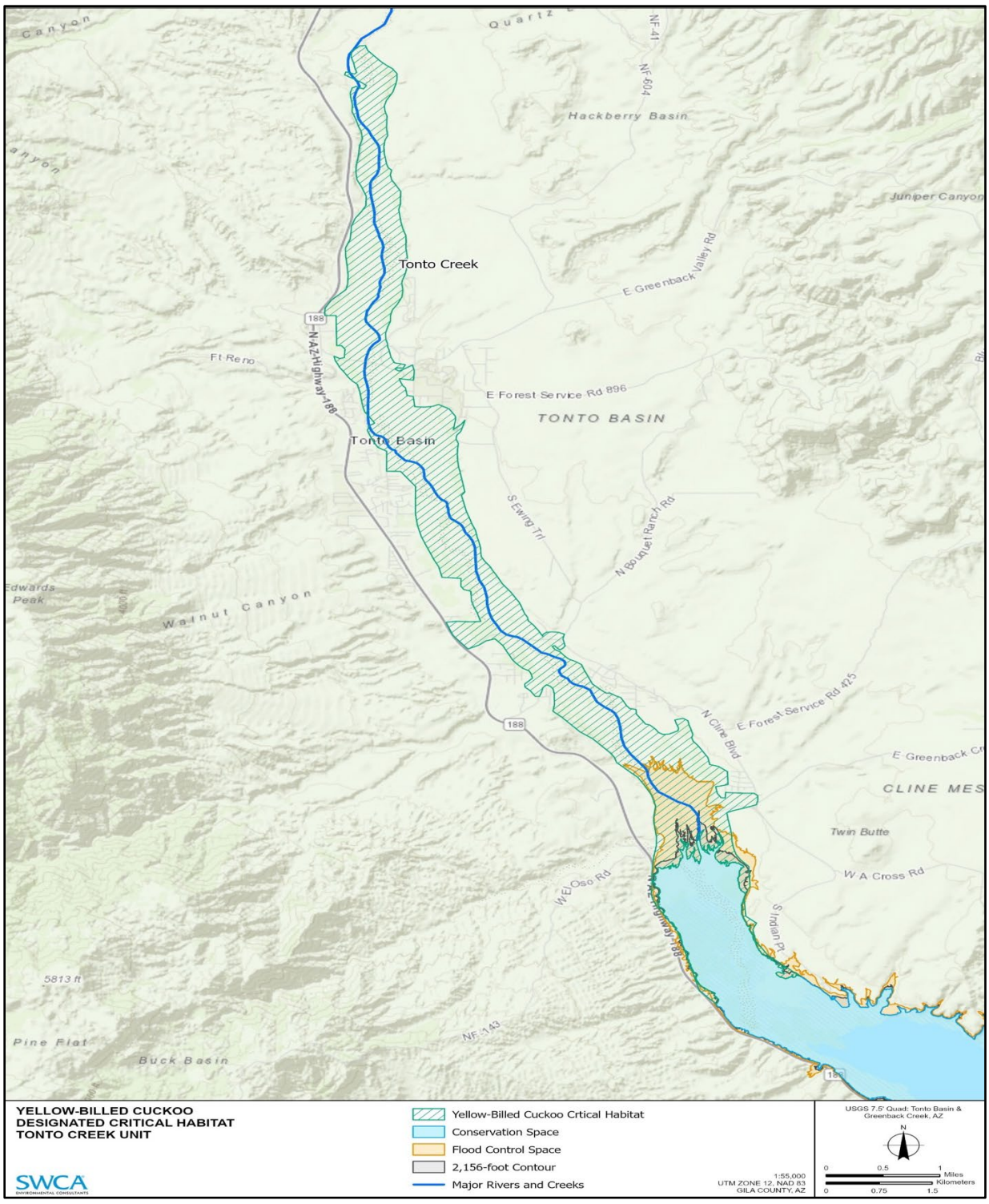

Figure 12. Yellow-Billed Cuckoo Critical Habitat in the Roosevelt HCP Amendment Permit Area, Tonto Creek.

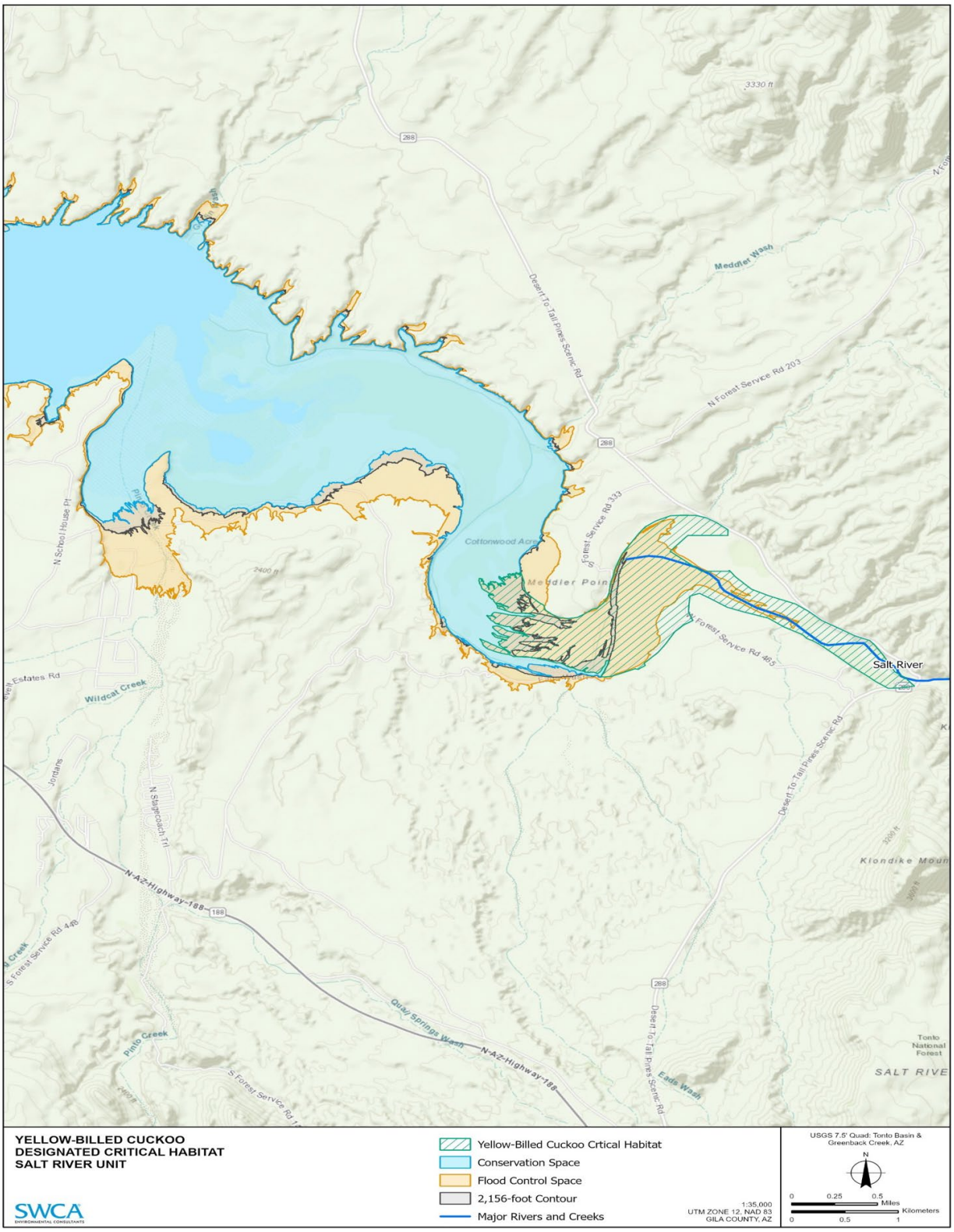

Figure 13. Yellow-Billed Cuckoo Critical Habitat in the Roosevelt HCP Amendment Permit Area, Tonto Creek.

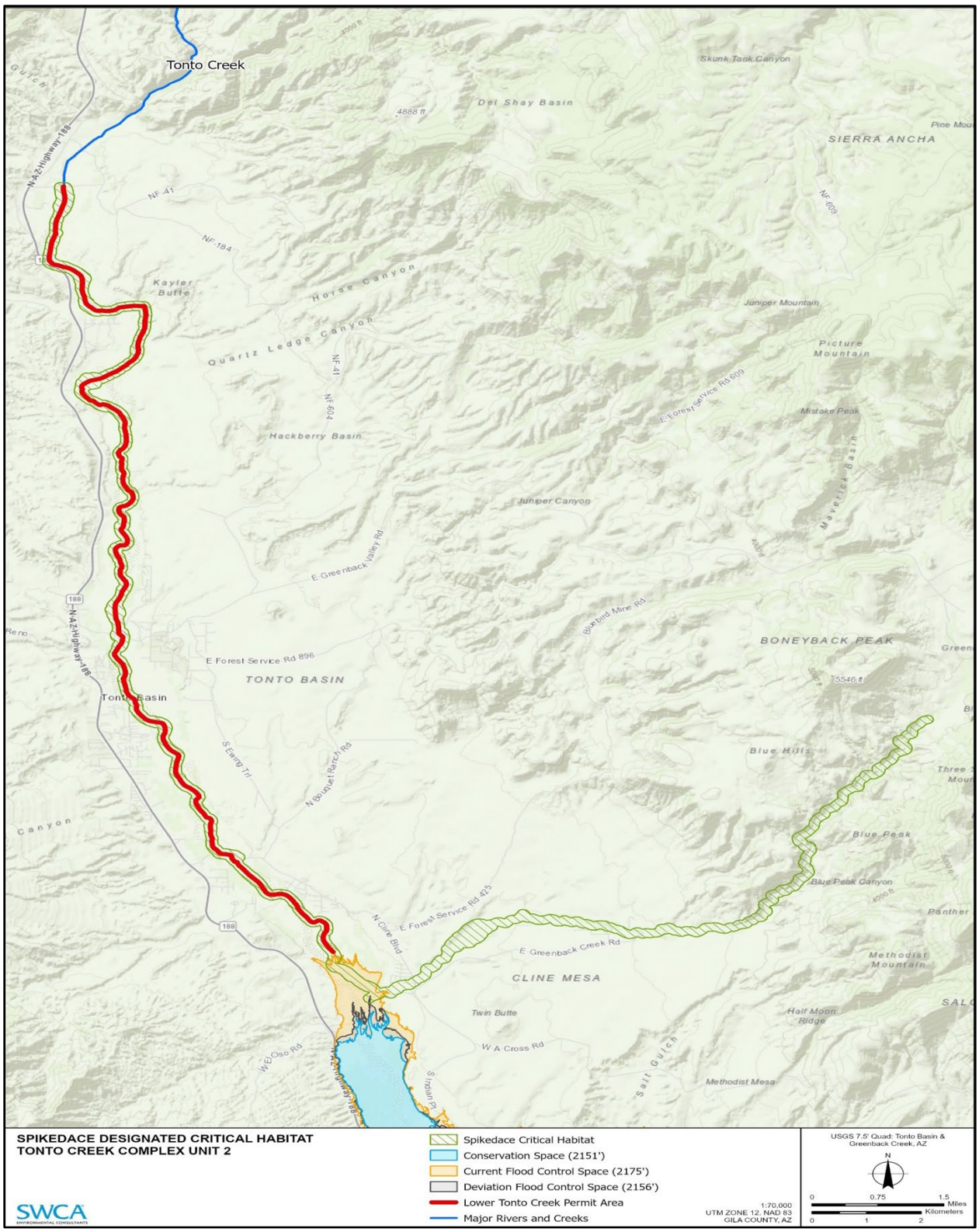

Figure 14. Spikedace Critical Habitat in the Roosevelt HCP Amendment Permit Area, Tonto and Greenback Creeks.

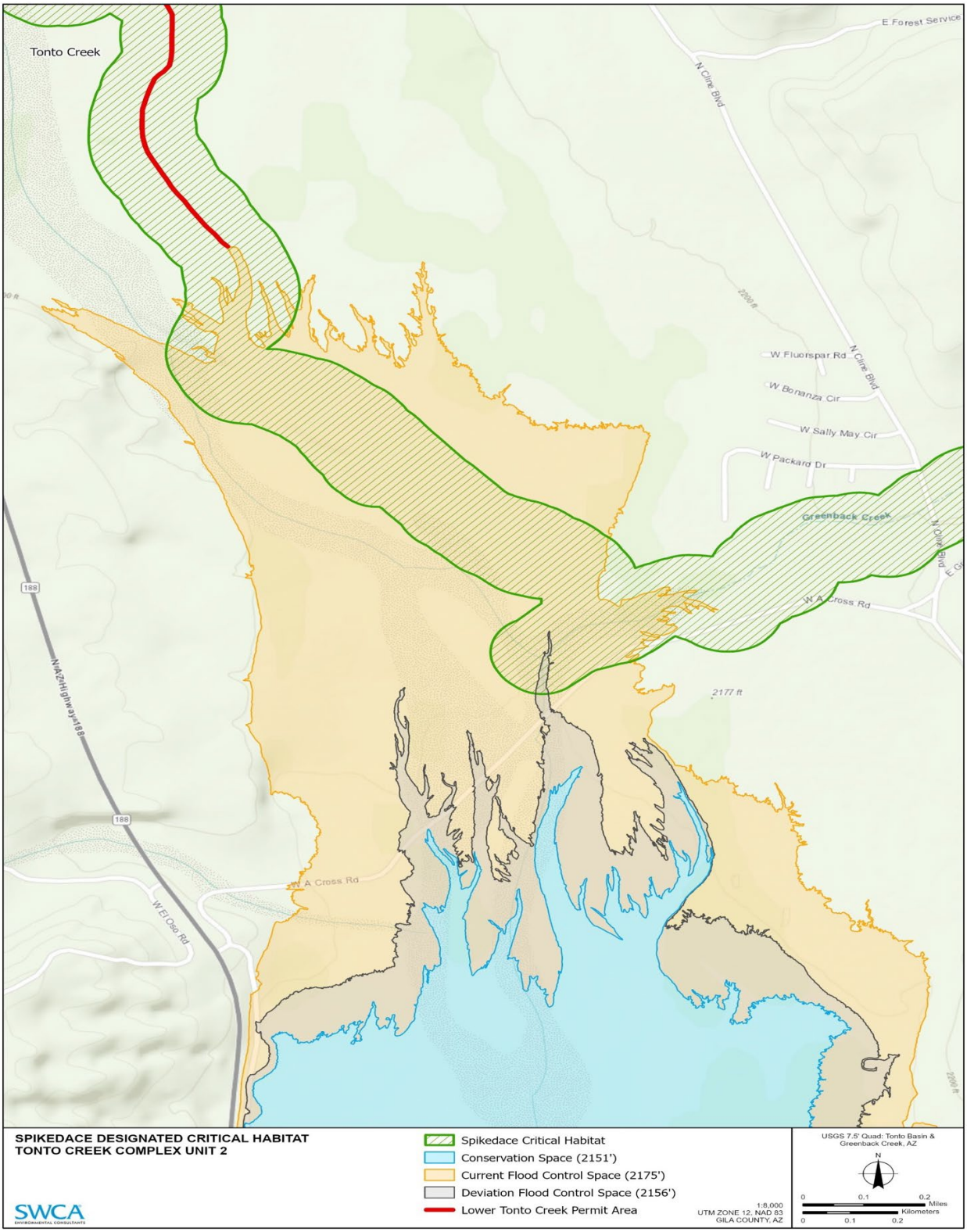

Figure 15. Spikedace Critical Habitat, Detailed View - Roosevelt HCP Amendment Flood Control Space Permit Area, Tonto and Greenback Creeks.

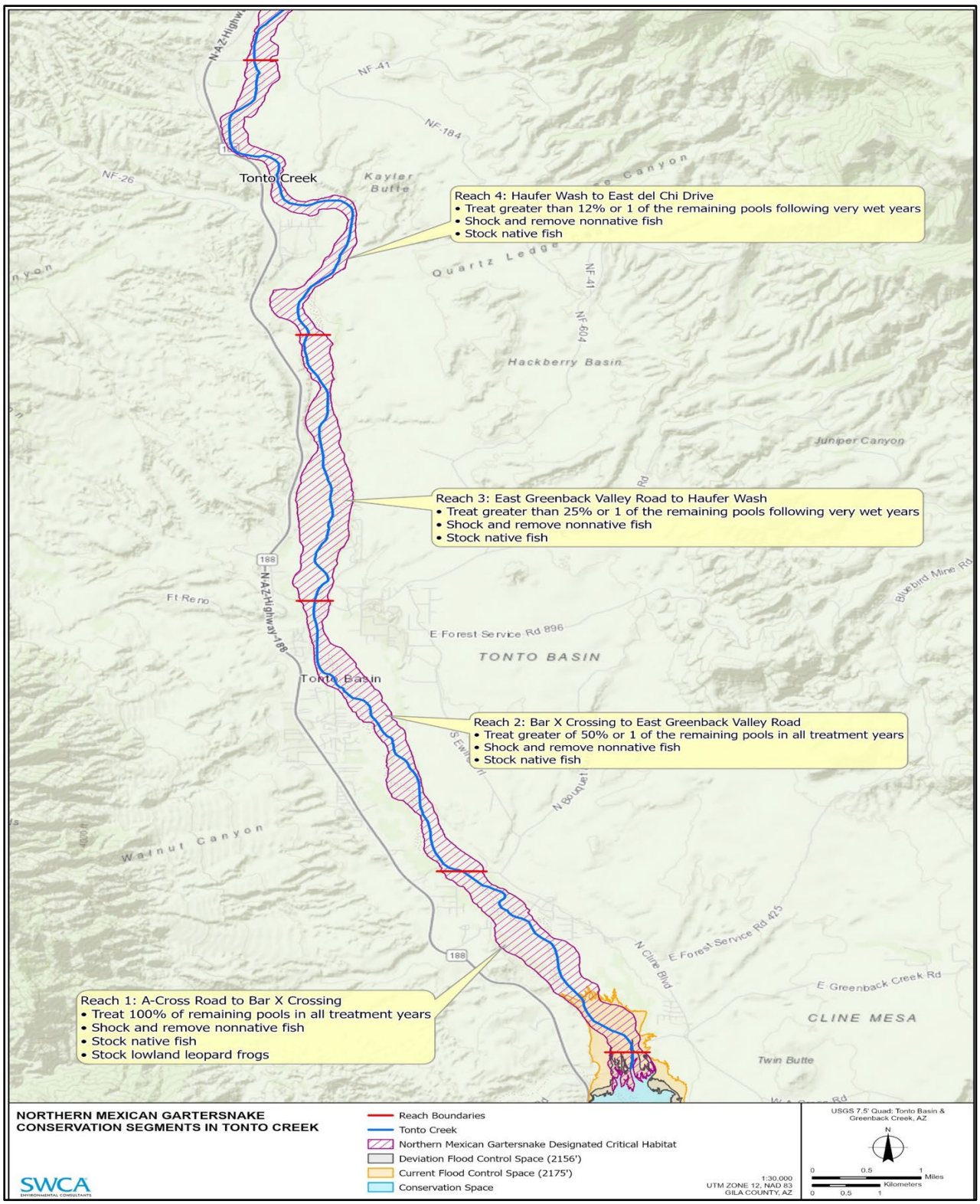

Figure 16. Northern Mexican Gartersnake Conservation Actions in the Roosevelt HCP Amendment Permit Area, Lower Tonto Creek.

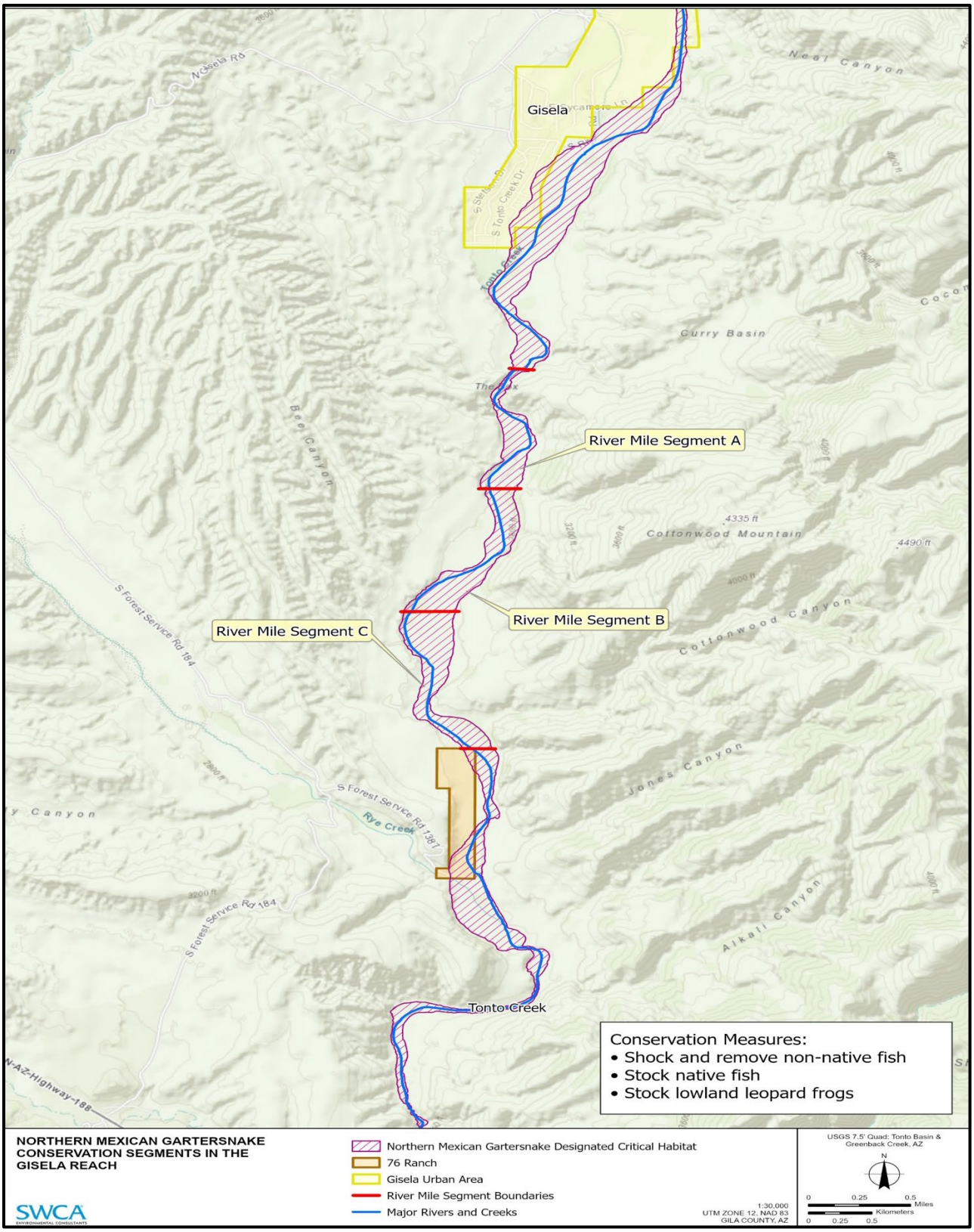

Figure 17. Northern Mexican Gartersnake Mitigation Area, Roosevelt HCP Amendment, Gisela Reach, Tonto Creek.

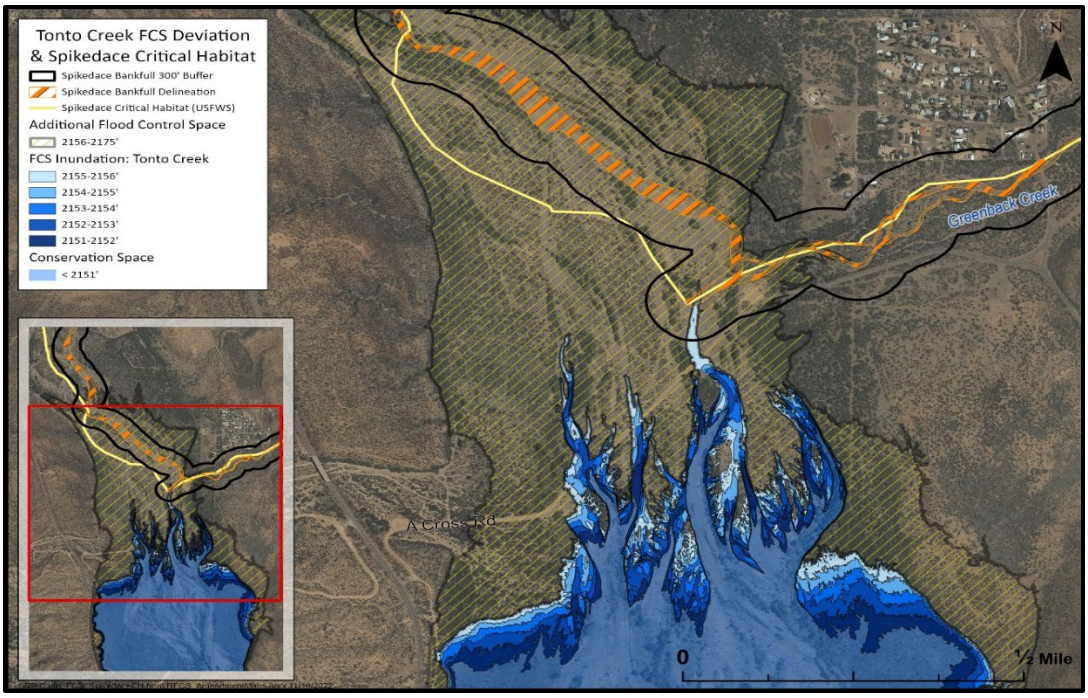

Figure 18. Inundation of Spikedace Critical Habitat on the Tonto Arm during Planned Deviation Operations, Roosevelt HCP Amendment.

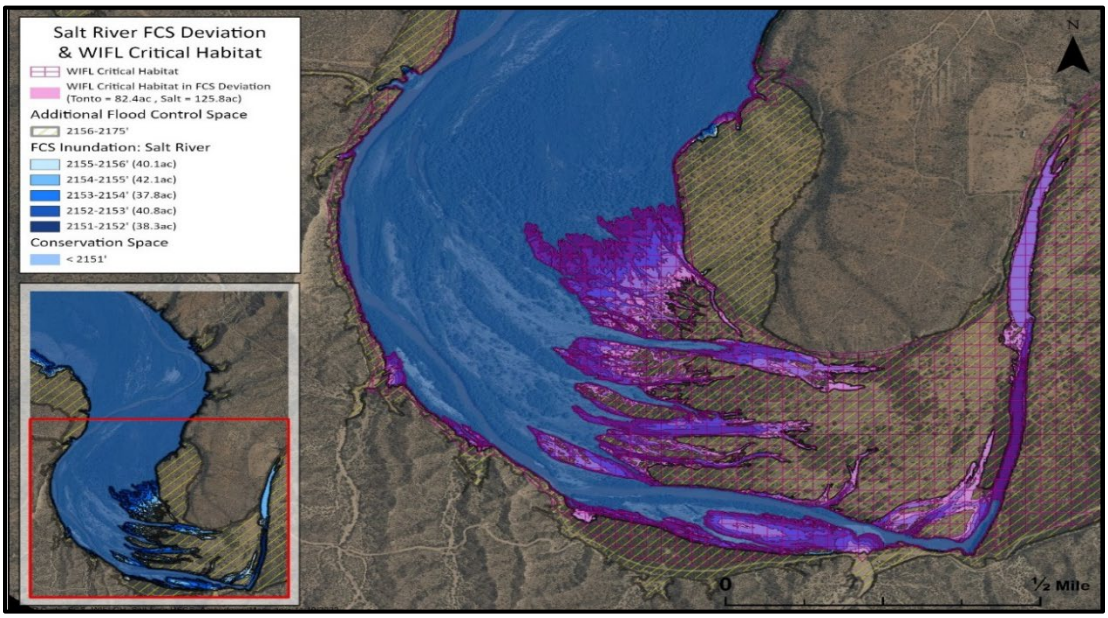

Figure 19. Inundation of Southwestern Willow Flycatcher Critical Habitat on the Salt Arm during Planned Deviation Operations, Roosevelt HCP Amendment.

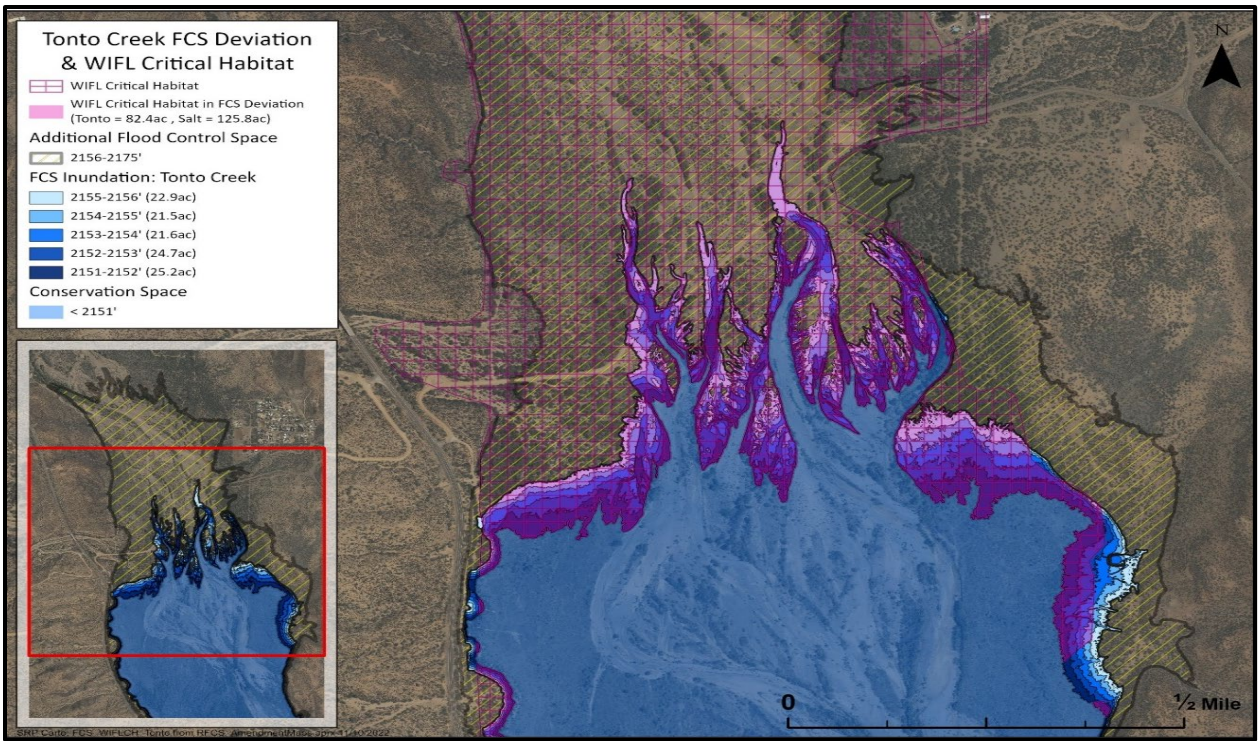

Figure 20. Inundation of Southwestern Flycatcher Critical Habitat on the Tonto Arm during Planned Deviation Operations, Roosevelt HCP Amendment.

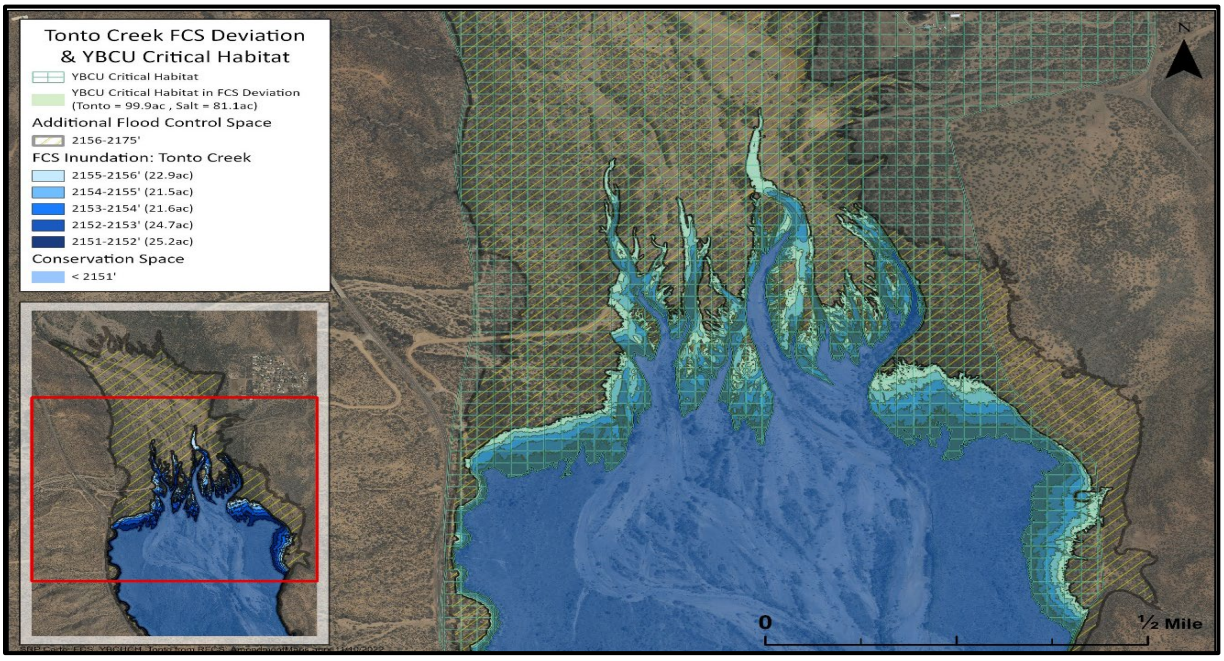

Figure 21. Inundation of Yellow-Billed Cuckoo Critical Habitat on the Tonto Arm during Planned Deviation Operations, Roosevelt HCP Amendment.

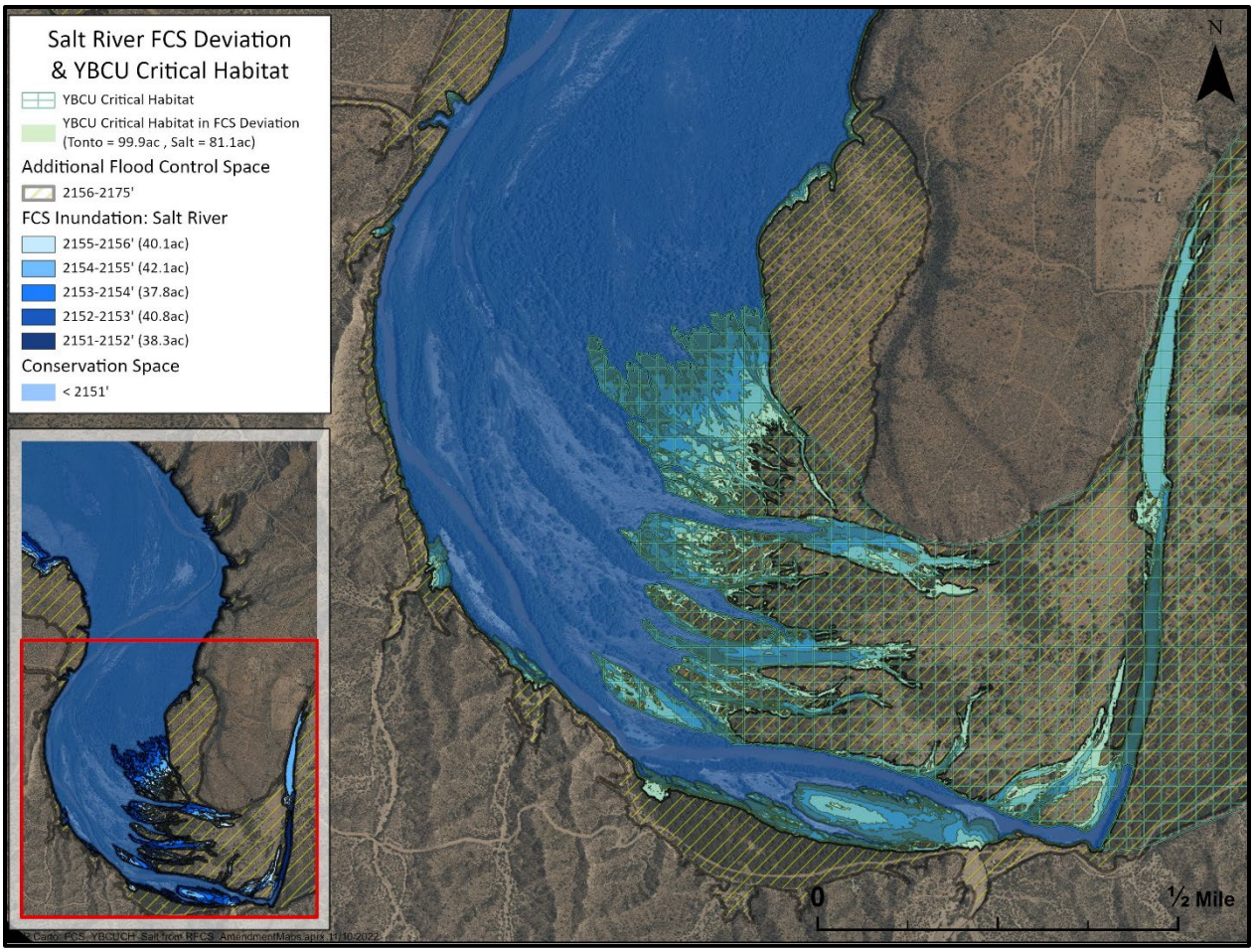

Figure 22. Inundation of Yellow-Billed Cuckoo Critical Habitat on the Salt Arm during Planned Deviation Operations, Roosevelt HCP Amendment.

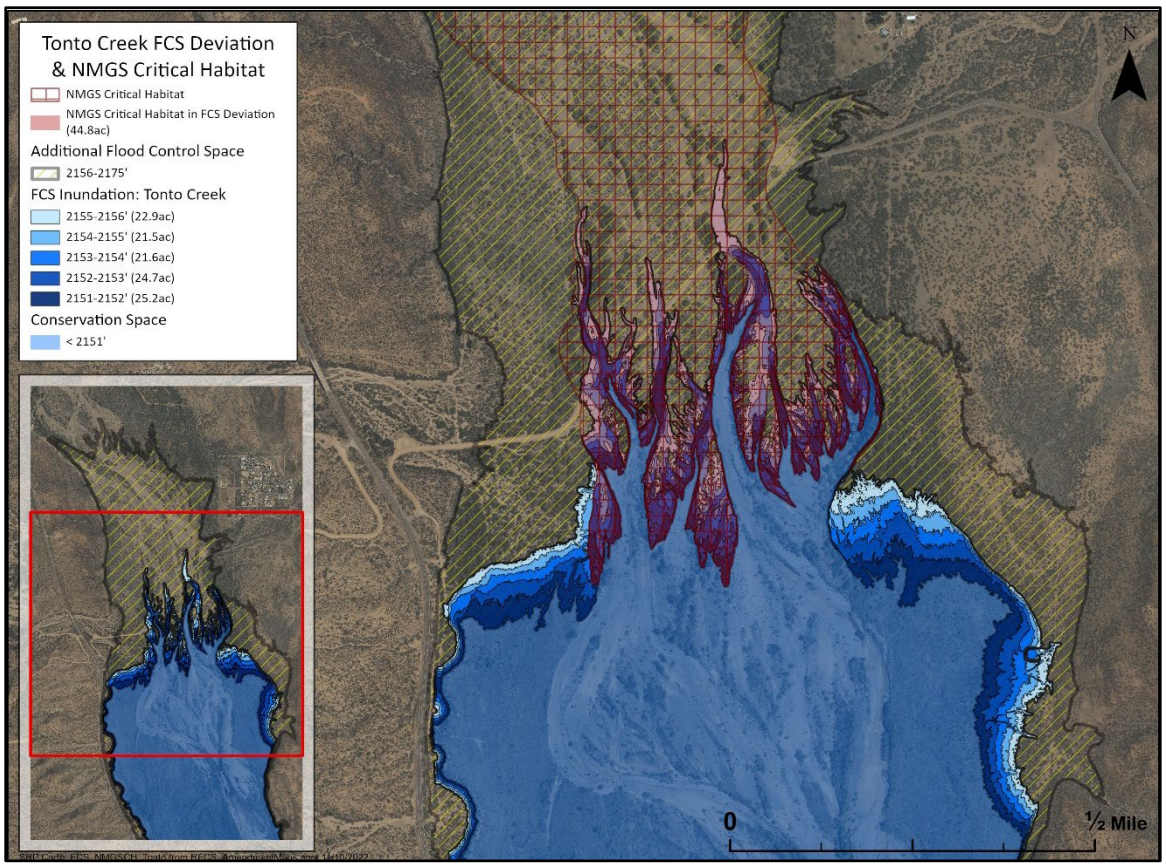

Figure 23. Inundation of Northern Mexican Gartersnake Critical Habitat on the Tonto Arm during Planned Deviation Operations, Roosevelt HCP Amendment.

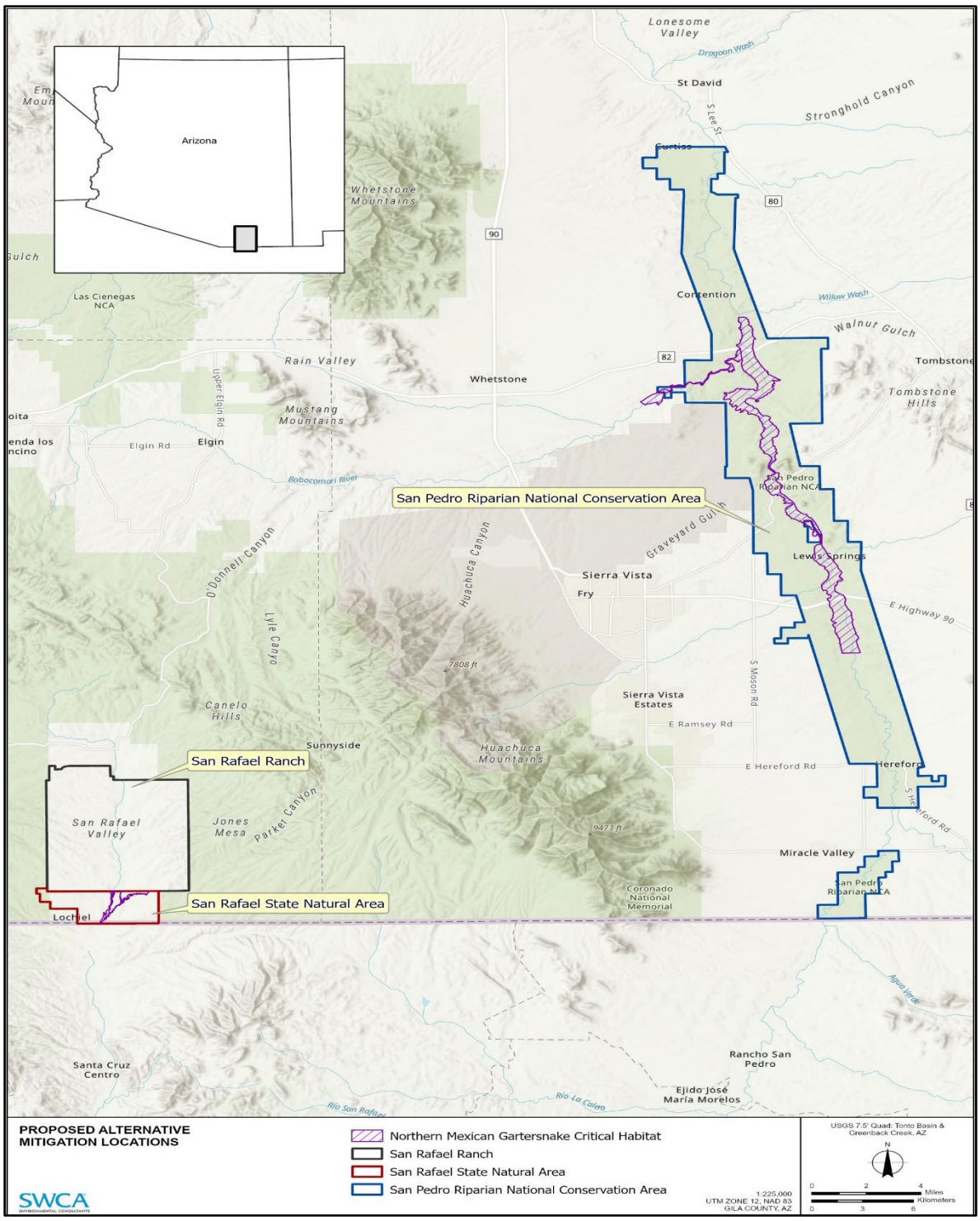

Figure 24. Alternative Northern Mexican Gartersnake Mitigation Areas on San Pedro and Babocomari Rivers at San Pedro National Conservation Area and Santa Cruz River on San Rafael State Natural Area.

Table 1. Summary of Covered Activities and Corresponding Northern Mexican Gartersnake Conservation/Mitigation Measures, Roosevelt HCP Amendment.

Covered Activity	**Form of Incidental Take**	**Location of Incidental Take**	**Mitigation/Conservation Measure**	**Metric**	Mitigation/Conservation **Location**
Long-term Conservation Storage	Harm via habitat modification through the adverse effects of nonnative predatory fish	CS or FCS	Suppression of nonnative predatory fish; stocking native fishes; stocking lowland leopard frogs*; support for lowland leopard frog breeding facility*	Acre-years of conservation credit from a menu of options	Gisela Reach of Tonto Creek; lowland leopard frog breeding facility would be outside of the permit area
Long-term Conservation Storage	Harm via habitat modification through the adverse effects of nonnative predatory fish	Lower Tonto Creek	Suppression of nonnative predatory fish; stocking native fishes in coordination with other parties	Specified level of effort, by reach, based on Tonto Creek flow conditions	Reaches 1–4 of the Lower Tonto Creek portion of the permit area; stocking focused on Reach 1 above the FCS or Reach 2
Conservation Storage Operations	Kill, wound, or harm via habitat modification through changes in habitat availability, habitat location, and habitat quality (including the adverse effects of nonnative predatory fish)	CS	Suppression of nonnative predatory fish; stocking native fishes; stocking lowland leopard frogs*; support for lowland leopard frog breeding facility*	Acre-years of conservation credit from a menu of options	Gisela Reach of Tonto Creek; lowland leopard frog breeding facility would be outside of the permit area
Current Flood Control Operations	Kill, wound, or harm via habitat modification through changes in habitat availability, habitat location, and habitat quality (including the adverse effects of nonnative predatory fish)	FCS	Suppression of nonnative predatory fish; stocking native fishes; stocking lowland leopard frogs*; support for lowland leopard frog breeding facility*	Acre-years of conservation credit from a menu of options	Gisela Reach of Tonto Creek; lowland leopard frog breeding facility would be outside of the permit area
Flood Control Planned Deviation	Kill, wound, or harm via habitat modification through changes in habitat availability, habitat location, and habitat quality (including the adverse effects of nonnative predatory fish)	Planned deviation space	Stocking native fishes	Acre-years of conservation credit from a menu of options	FCS

* This activity is subject to the availability of stock, need for conservation credit generation, and coordination with FWS.

Table 2. Estimated Credit for the Conservation/Mitigation Measures Proposed by SRP to Offset Impacts of Incidental Take to Northern Mexican Gartersnakes in the CS and FCS, Roosevelt HCP Amendment.

Location	**Conservation/ Mitigation Measure**	**Acres**	**Relative Conservation Value**	**Duration and Estimated Frequency**	**Estimated Credit Generated (acre-years)**
Gisela Reach	Suppression of predatory nonnative fish	73.8 acres critical habitat (average)	1.0	Duration of benefit is 1 year for each application. The measure is applied in 20 of 30 years = 20 years credit	1,476
Gisela Reach	Stocking native fishes	73.8 acres critical habitat (average)	1.0	Duration of benefit is 1 year for each application. The measure is applied in 20 of 30 years = 20 years credit	1,476
Gisela Reach	Stocking lowland leopard frogs*	73.8 acres critical habitat (average)	1.0	Duration of benefit is 1 year for each application. The measure is applied in up to 17† of 30 years = up to 17 years credit	Up to 1,254.6
Roosevelt Lake FCS	Stocking native fishes	192.2 acres modeled habitat	0.5	Duration of benefit is 1 year for each application. The measure is applied in an estimated 23 of 30 years = 23 years credit estimated	2,210 estimated
Roosevelt Lake FCS	Stocking lowland leopard frogs*	192.2 acres modeled habitat	1.0	Duration of benefit is 1 year for each application. Application of this measure is not currently planned for this location = minimum 0 years credit	0 minimum
Lowland leopard frog breeding facility	Funding up to $625,000 (subject to further investigation)*	192.2 + 221.4 = 413.6 total	1.0	4 years	1,654.4
Total					Up to 8,071.0

***** In lieu of this activity, SRP may instead perform nonnative fish suppression and native fish stocking more frequently or in additional river mile segments of the Gisela Reach.

† This is equivalent to stocking in 2 out of 3 years after an initial 4 years to establish the breeding facility and begin propagation.

Table 3. Sources of Uncertainty and Information Needs Related to the Northern Mexican Gartersnakes in the Roosevelt HCP Amendment Permit Area and the Covered Activities.

Information Category	**Information Needs**
Current distribution/status of species	Presence/absence surveys within the permit area
Predator/Competitors	Monitoring of nonnative fish in Tonto Arm pools
Prey community	Continue gartersnake diet studies (include areas where native species are stocked, do gartersnakes shift diet?)
Predator/Competitors	Study impacts of nonnative predators using quantitative approaches, such as fecal DNA analysis (see Owens *et al.* 2023)
Habitat	Study impacts of nonnative vegetation removal and/or supplemental planting of native vegetation on herpetofauna community
Habitat	Study of artificial brumation sites (do snakes use artificial brumation sites provided when natural brumation sites are inundated?)
Habitat	Study of artificial aquatic refugia created for snakes (assuming these are located where snakes are present, do snakes and/or aquatic prey [lowland leopard frog] start using these artificial ponds/pools/wetlands?)

Table 4. Summary of Northern Mexican Gartersnakes Incidental Take and Impacts of Take, Roosevelt HCP Amendment.

Covered Activity and Permit Area Location	**Estimated Take**	**Estimated Impact of Take**	**Average Annual Impact of Take over 30 Years**	**Overall Ratio of Impact to Take***
Conservation storage operations in the CS	2,507.0 acre-years	4,935.1 acre-years	164.5 acres	2.0
Current flood control operations in the FCS	226.3 acre-years	241.3 acre-years	8.0 acres	1.1
Planned deviation of flood control operations in the FCS	9.6 acre-years	10.6 acre-years	0.4 acres	1.1
Long-term storage in the CS and related impacts in lower Tonto Creek	906 migration days	See qualitative discussion in RHCP amendment Subchapter 4.B.iii.2	N/A	N/A
Total	2,742.9 acre-years and 906 migration days	5,187.0 acre-years plus the nominal additional impact of take for lower Tonto Creek	172.9 acres	1.9

* Ratio of impact to take is calculated using only the estimates for the CS and FCS. The take and impacts associated with effects along lower Tonto Creek are in a different metric and are not comparable to the acre-year estimates.

Table 5. Amount of Bald Eagle Incidental Take from SRP Covered Activities for the Remainder of the Permit Term.

Surrogate Metric	**Amount of Take**	**Measurement or Exceedance Criteria**
Number of drowned fledglings	3 drowned fledglings	Detection of a drowned juvenile bald eagle at Roosevelt Lake that is: 1) reported between March 15 and June 15; and 2) reasonably believed to have fledged from a nest that is located in the CS or FCS.
Number of destroyed nests	40 destroyed nests	Destroyed nests meet one or more of the following conditions: A. Detection of a bald eagle nest (active or alternate) in the CS or FCS: 1) that is damaged to the point where it is or would be unusable for nesting activities; and 2) where the cause of the destruction is wholly or substantially related to direct inundation by the lake or to a nest tree falling or breaking after a period of extended inundation or desiccation; B. Detection of a tree or snag supporting a bald eagle nest (active or alternate) in the CS or FCS: 1) that is damaged such that the nest is intact but unusable (e.g., the nest is intact on the ground,or the nest is intact but not upright); and 2) where the cause of the destruction is wholly or substantially related to inundation by the lake; C. Detection of a bald eagle nest with viable eggs or nestlings that are abandoned by the adult breeding pair, the nest fails due to abandonment, and the proximate and reasonably certain cause of the abandonment is high water under the nest, even if the nest itself is not ultimately destroyed; and/or A bald eagle nest in the CS or FCS where eggs or nestlings have been salvage collected by other authorized parties based on a determination that inundation (and subsequent destruction) of the nest is imminent (see RHCP amendment Subchapter 3.E.i).
Number of reduced foraging events	4 reduced lake elevation events	A year in which 1) the lake elevation is at or below 2,100 feet amsl for a substantial portion of the bald eagle breeding season *(i.e.*, at least 60 consecutive days between January 1 and March 31 or at least 90 total days between January 1 and June 30), and 2) the combined productivity rate of monitored bald eagle breeding areas relying on Roosevelt Lake is less than 1.0.