U.S. Fish & Wildlife Service

Recovery Plan

for the Santa Ana Sucker
(*Catostomus santaanae*)

Christine Medak, USFWS

Recovery Plan
for the
Santa Ana Sucker
(*Catostomus santaanae*)

Region 8
U.S. Fish and Wildlife Service
Sacramento, California

Approved: ______________________________

Regional Director, Pacific Southwest Region (Region 8),
U.S. Fish and Wildlife Service

Date: 2-28-17

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Carlsbad Fish and Wildlife Office
2177 Salk Avenue, Suite 250
Carlsbad, CA 92008
Office phone: 760–431–9440

Acknowledgements

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We also thank our partners who have played an active role in Santa Ana sucker conservation. Numerous agencies provided information through surveys and research, and helped to restore habitat and to implement recovery actions. Their support over the years has contributed to a better understanding of this species, which has subsequently helped to develop this Recovery Plan. We appreciate these efforts and look forward to continued cooperation with our external partners as we continue to refine methodologies and implement actions that support recovery of the Santa Ana sucker.

Executive Summary

Current Species Status

We, the U.S. Fish and Wildlife Service (USFWS or Service), listed the Santa Ana sucker (*Catostomus santaanae*) as a threatened species on April 12, 2000 (USFWS 2000, entire), under the Endangered Species Act of 1973 (Act), as amended. At that time, we considered the range of the listed entity to include the Los Angeles River, San Gabriel River, and Santa Ana River basins (watersheds). Critical habitat was designated for this species on December 14, 2010 (USFWS 2010). The Santa Ana sucker is one of only a few native freshwater fishes currently extant in southern California.

Threats

The primary threat to the Santa Ana sucker includes past and ongoing habitat loss through hydrological modifications throughout the range of the species. The loss and degradation of available habitat (caused by dams, changes in water allocations, and other hydrological modifications) combined with other increasing threats (such as degraded water quality, recreational pressures, and potential effects of nonnative vegetation and predation) have a cumulative effect on Santa Ana sucker and its habitat. Additionally, impassable barriers or areas of unsuitable habitat limit gene flow, thus increasing the vulnerability of small populations to a range of environmental stochastic factors and inbreeding depression.

Recovery Strategy

Past and ongoing large-scale hydrological modifications throughout the range of the Santa Ana sucker have resulted in a decrease of occupied, suitable habitat. This decrease, in turn, has reduced the species' resiliency and redundancy. Additionally, a reduced level of representation is a concern because (1) the species is geographically restricted to three, now-separate populations in three watersheds, and (2) each watershed supports a now-reduced population that, to varying degrees, consists of smaller subpopulations separated by barriers or areas of unsuitable habitat. Therefore, the highest priority for the recovery of Santa Ana sucker is to increase the amount of occupied, high-quality habitat that allows for feeding, breeding, and sheltering for all of the species' life stages in each of the three watersheds, which we designate as separate recovery units (RUs).

To do this, we believe it will require active management on two fronts: (1) providing additional areas of high-quality habitat in each of the watersheds through habitat restoration and, if necessary, habitat creation, and (2) reestablishing Santa Ana suckers in areas of unoccupied high-quality habitat (whether currently existing, restored, or created) through removal of existing barriers to fish passage (to allow natural recolonization) or, if necessary and where appropriate, through active reintroduction. Increasing the amount of occupied habitat through active management of habitat and populations, as called for above, will maintain or improve the representation, resiliency, and redundancy of the Santa Ana sucker in each of the watersheds. This will also help to reduce the relative magnitude of many of the other threats facing the species.

In all, we expect increasing the amount and extent of occupied habitat with the two-prong approach mentioned above will eliminate or reduce the threats facing the Santa Ana sucker and allow populations in each of the three watersheds to increase, thereby bringing this threatened species to a point at which the measures provided by the Act are no longer necessary.

To ensure that these management actions will be effective, studies are needed that will lead to a thorough understanding of the factors that contribute to improving the quality of Santa Ana sucker habitat, including (1) the current and future ramifications of past and ongoing hydrological modifications throughout the range of the species; (2) the effectiveness of controlling invasive, nonnative species (predators and plants); (3) the effectiveness of actions to taken to minimize impacts from recreational pressures; and (4) the tolerance of Santa Ana suckers to water quality variables and levels of contaminants. Lastly, stakeholders and partners will be critical to this process because we will not be able to implement the actions called for in this plan without their cooperation and participation.

Recovery Goal and Objectives

The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required.

We have identified four recovery objectives based on the recovery strategy and current threats to the species:

1. Develop and implement a rangewide monitoring protocol to accurately and consistently document (a) populations (quantitatively and qualitatively), (b) occupied habitat, and (c) threats.
2. Conduct research projects specifically designed to inform management actions and Santa Ana sucker recovery.
3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat.
4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.

Delisting Criteria

Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

A.1 Adequate amounts of high-quality Santa Ana sucker habitat are restored, protected, and managed in perpetuity, thereby expanding the range of the species (within its historical range) and improving its distribution (including increased within-RU connectivity), such that the population of each RU is viable.

Factor B: Overutilization for commercial, recreational, scientific, or educational purposes

No substantial threats have been identified under this Factor; therefore, no delisting criteria are included under this topic.

Factor C: Predation

C.1 Management is developed and implemented to reduce predation by nonnative species to levels determined to be necessary for the maintenance of viable Santa Ana sucker populations.

Factor D: the inadequacy of existing regulatory mechanisms

No substantial threats have been identified under this Factor; therefore, no delisting criteria are included under this topic.

Factor E: Other natural or manmade factors affecting its continued existence

E.1 The population of each RU is expanded through modification or removal of existing barriers, restoration of suitable habitat, and/or reintroduction of the species to areas within its historical range in a configuration that ensures, with reasonable certainty that (a) the genetic makeup of the species has been adequately preserved, and (b) the population within each RU can withstand catastrophic and environmental stochastic events.

E.2. Adequate movement of individual Santa Ana suckers is maintained between occupied areas of each RU, through natural processes or management, to ensure population viability and genetic exchange.

E.3 The Santa Ana sucker populations in each RU are stable or increasing (a) averaged over 15 years or for a period of time determined to be appropriate by sufficiently robust population viability analysis (PVA), and (b) with occupancy in each of the following areas or as determined to be appropriate by a sufficiently robust PVA:

<u>Santa Ana River Watershed RU</u>

- Santa Ana River mainstem (Prado Reach and Imperial Reach);
- Four tributaries in the Prado Reach and/or Imperial Reach (potentially including but not limited to, Tequesquite Arroyo, Anza Drain, Hole Creek, Evans Drain, Sunnyslope Creek, Day Creek, Aliso Creek, Santiago Creek); and
- Three tributaries in the La Cadena Reach (potentially including but not limited to, City Creek, Lytle Creek, Cajon Wash, Hemlock Creek, Plunge Creek, Santa Ana River above Seven Oaks Dam).

<u>San Gabriel River Watershed RU</u>

- The East, West, and North Forks of San Gabriel River in the San Gabriel Reach;

- Three tributaries in the San Gabriel Reach (potentially including but not limited to, Bear Creek, Big Mermaids Creek, Cattle Canyon Creek); and
- The Cogswell Reach, the East Fork above the "Bridge to Nowhere", or one tributary in the Whittier Reach (potentially including but not limited to, San Dimas Wash, Fish Canyon Creek).

Los Angeles River Watershed RU

- Big Tujunga Creek in the Hansen Reach;
- Two tributaries in the Hansen Reach (potentially including but not limited to, Haines Creek, Little Tujunga Creek); and
- One tributary in either the Big Tujunga Reach or Los Angeles Reach (potentially including but not limited to, Fall Creek, Mill Creek, Arroyo Seco Creek, Bell Creek).

E.4 Long-term monitoring and management plans, each covering an appropriate geographical scale (such as for each RU or Reaches, or by jurisdiction or land-manager), have been developed throughout the range of the species and are all being sufficiently implemented. The plans should include management to ameliorate identified threats and monitoring to determine effectiveness of the management, identify new threats, and to inform potential changes to future management and monitoring. The monitoring methodology should be designed in coordination with ongoing monitoring and management efforts and with post-delisting monitoring requirements in mind.

Estimated Date and Cost of Recovery:

Date: 2041

Cost: $7,060,000 + TBD

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I. BACKGROUND

We, the U.S. Fish and Wildlife Service (USFWS or Service), listed the Santa Ana sucker (*Catostomus santaanae*) as a threatened species on April 12, 2000 (USFWS 2000, entire), under the Endangered Species Act of 1973 (Act), as amended. At that time, we considered the range of the listed entity to include the Los Angeles River, San Gabriel River, and Santa Ana River basins (watersheds). Though another population of Santa Ana sucker was known from the Santa Clara River watershed, information available at the time led us to conclude that the Santa Clara River population was of introduced origin (see USFWS 1999, p. 3915; USFWS 2000, p. 19687); as such, we did not include that population as part of the listed entity.[1] With the adoption of the new format for the list of endangered and threatened wildlife on August 4, 2016, the listed entity was recognized as a distinct population segment (DPS) under the Act (USFWS 2016a, pp. 51552). It now is listed as the "Santa Ana sucker, three California river basins DPS" (USFWS 2016a, pp. 51576). This change in name did not change the geographical limits of the listed entity. Except where noted, this recovery plan addresses the listed entity as it was defined in 2000, focusing on the Santa Ana River, San Gabriel River, and Los Angeles River watersheds.

We designated revised critical habitat for the Santa Ana sucker on December 14, 2010 (USFWS 2010, entire), and conducted a threats assessment and review of the biological status in a 5-year status review for the species in 2011 (USFWS 2011, entire). We also prepared a recovery outline for Santa Ana sucker that was approved on March 30, 2012 (USFWS 2012, entire). The draft recovery plan for the species, upon which this final plan is based, was made available for public comment and review on November 24, 2014 (USFWS 2014, entire); we also solicited peer review from species experts. We have incorporated the applicable information or suggested changes into the text to the extent appropriate, and we have summarized comments and provided responses in Appendix B.

The Santa Ana sucker is assigned a Recovery Priority Number of 6C, which indicates the species faces a high degree of threat, has a low potential for recovery, and the listed entity is a taxonomically defined as a DPS (USFWS 1983a; 1983b). The "C" indicates conflict with construction or other development projects or other forms of economic activity.

The Santa Ana sucker is one of only a few native freshwater species of fish currently extant in southern California. The listed species' range has been reduced in the three watersheds where it occurs and there is no opportunity for natural movement between watersheds. Santa Ana suckers are also patchily distributed within each watershed, with dispersal to other reaches limited by

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[1] Although some authors had doubted the introduced status of the Santa Clara River population (Greenfield *et al.* 1970, p. 166; Haglund and Baskin 2003 , p.2), it was not until late in 2015, after we had published the draft recovery plan, that new scientific information (a preliminary analysis of genetic data) became available that did not support the introduction theory; instead, it strongly suggested that the Santa Clara River population of Santa Ana sucker is a separate and distinct population (Richmond *et al. in litt.* 2016a). An unpublished manuscript then became available to us in 2016 (Richmond *et al.* 2016b, in prep., entire). We discuss the Santa Clara River population in greater detail in Appendix A.

barriers that prevent or severely limit two-way (upstream and downstream) fish passage within the respective watersheds. The primary threat to Santa Ana sucker is habitat loss, degradation, and modification through hydrological modifications rangewide. Additionally, isolation by impassable barriers or unsuitable habitat limits gene flow within and between watersheds, thus increasing the vulnerability of small populations to a range of stochastic environmental and genetic factors.

Recovery plans focus on restoring the ecosystems on which a species is dependent or reducing threats to the species. Recovery plans constitute important Service documents that serve as a logical path to recovery of a species based on what we know about the species' biology and life history, and threats to the species. Recovery plans help to provide guidance to the Service, States, and other partners on methods of minimizing threats to listed species and measurable objectives against which to measure progress towards recovery. Recovery plans are advisory documents, not regulatory documents, and cannot substitute for the determinations and promulgation of regulations required under section 4(a)(1) of the Act. A decision to revise the status of, or to remove a species from the Federal List of Endangered and Threatened Wildlife (50 CFR 17.11) is ultimately based on an analysis of the best scientific and commercial data available, regardless of whether that information differs from the recovery plan. Such a determination will be done through the Federal Government's rule-making process, which includes first publishing a proposed rule (which will be available for public comment) and then publishing a final rule.

The following discussion summarizes characteristics of Santa Ana sucker biology, demography, distribution, population status, and threats that are relevant to recovery. Additional information is available in the critical habitat rule, 5-year review, and recovery outline for the species (USFWS 2010; USFWS 2011; USFWS 2012), and associated literature.

A. Species Description and Taxonomy

Figure I-1. *An adult Santa Ana sucker using its protrusible lips that extend from a downward-oriented mouth to forage on algae. (Christine Medak, USFWS)*

The Santa Ana sucker is a small, short-lived member of the sucker family of fishes (Catostomidae). These fishes are called suckers primarily because of the downward orientation and anatomy of their mouth parts, which allow them to suck up algae, small invertebrates, and other organic matter with their fleshy, protrusible (extendable) lips (Moyle 2002, p. 179) (Figure I-1). The Santa Ana sucker was described in 1908 by Snyder as *Pantosteus santa-anae* from a type specimen collected in the Santa Ana River near Riverside, California (Snyder 1908, p. 33). Later, the American Fisheries Society removed the hyphen from the specific epithet (Bailey *et al*. 1960, p. 18) and Smith (1966, pp. 53–58) relegated *Pantosteus* to a subgenus of *Catostomus*, which represented a new combination, *Catostomus santaanae*. Recent work has been conducted to investigate the phylogenetic relationships between suckers in western North America (Unmack *et al*. 2014), but there is still some uncertainty where *Catostomus santaanae* would be placed. Currently, the best scientific data available indicate that the Santa Ana sucker is diagnosable at the taxonomic rank of species. This taxonomic classification has not changed since the species was listed.

Santa Ana suckers are generally less than 6.3 inches (in) (16 centimeters (cm)) in length; however, some have been collected at lengths up to 8 in (20.3 cm) (Russell 2010, p. 3). Males and females appear to grow at equivalent rates (Greenfield *et al.* 1970, p. 174; Moyle 2002, p. 183). Their jaws have cartilaginous scraping edges inside the lips. Their color is silvery-white on the belly and dark gray on the sides and back, with irregular dorsal blotches on the sides and faint patterns of pigmentation arranged in lateral stripes. Membranes connecting the rays of the caudal (tail) fin are pigmented, but the anal and pelvic fins usually lack pigmentation (Moyle 2002, p. 182).

Spawning tubercles (raised growths on sexually mature fish) are present on most parts of the body of breeding males and are heaviest on the anal fin, caudal fin, and lower half of the caudal peduncle (narrow region of body immediately in front of the caudal fin), particularly at the beginning of the breeding season. Female Santa Ana suckers grow tubercles on the caudal fin and the caudal peduncle (Moyle 2002, pp. 182–183).

B. Population Trends and Distribution

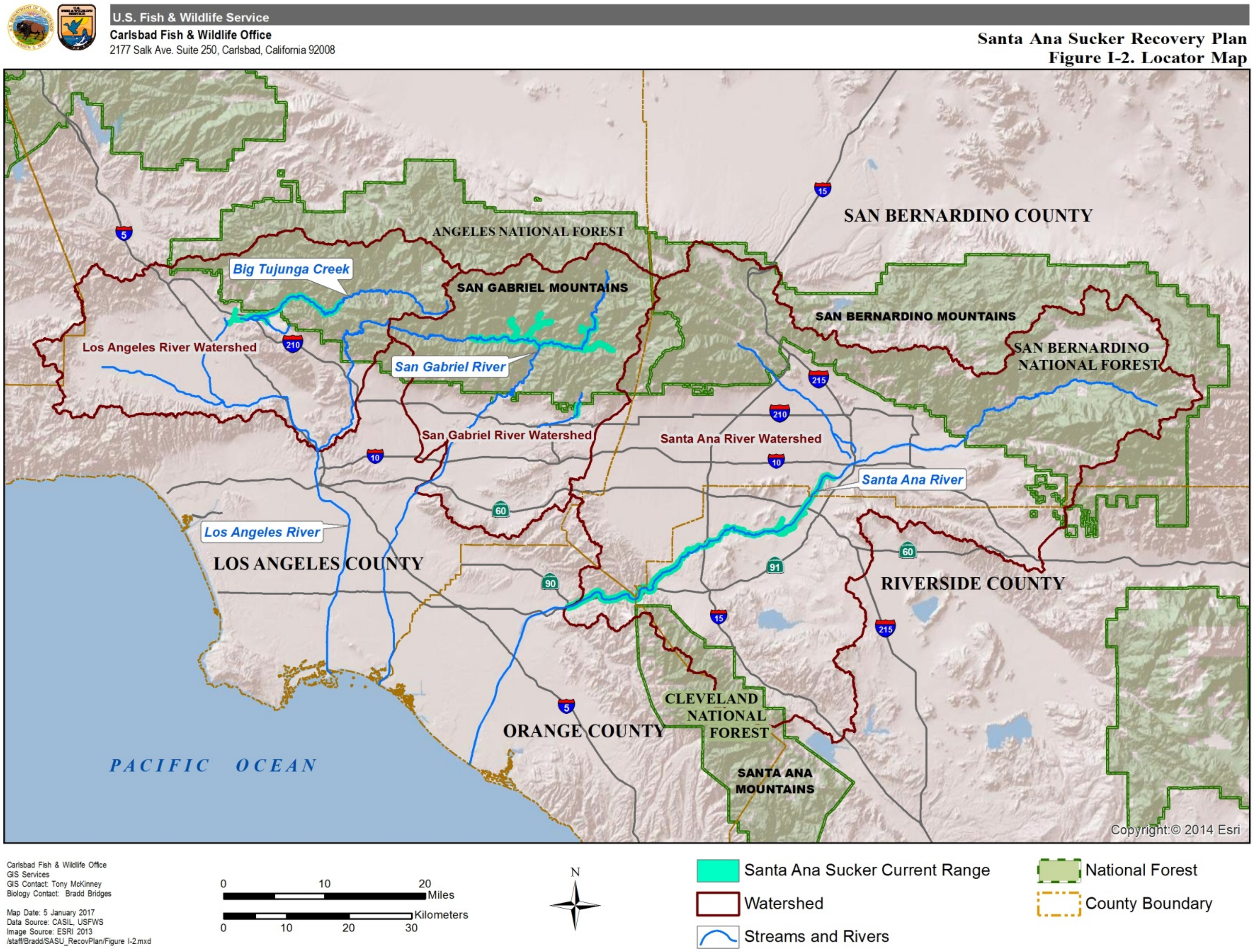
For the purposes of this recovery plan, the *historical range* of the Santa Ana sucker (the listed entity) is the maximum geographical area within which the species occurred (or, given the limited historical data, the area in which it likely occurred) under prevailing conditions prior to any hydrologically significant manmade changes to watersheds as dictated by natural barriers that continuously and permanently prevented fish passage; the *current range* of the Santa Ana sucker (the listed entity) is the maximum geographical area within which the species can occur under prevailing conditions today as dictated by natural and manmade barriers that continuously and permanently prevent fish passage; and the *distribution* of the Santa Ana sucker (the listed entity) is the spatial arrangement of the species at a given time within the species' range.

The historical range of the Santa Ana sucker (the listed entity) included the rivers and larger streams in southern California emanating from the San Gabriel and San Bernardino Mountains in Los Angeles, Orange, Riverside, and San Bernardino Counties, including the mainstems and tributaries from near the Pacific Ocean to the upper portions of the Santa Ana River watershed, the San Gabriel River watershed, and the Los Angeles River watershed (USFWS 2000, p. 19686). Santa Ana suckers also occur in the Santa Clara River in Los Angeles and Ventura Counties, but this population was not considered part of the listed entity; additional information about the Santa Clara River population may be found in Appendix A. This recovery plan focuses on the listed entity.

Information about the historical distribution of the Santa Ana sucker within its historical range is incomplete; however, it is likely that the species' distribution within each of the watersheds varied over time, depending on habitat suitability and access (for example, physical barriers or water availability). Thus, the distribution of the species within each watershed expanded and contracted or otherwise changed seasonally, from year to year, and over short-to-medium time-frames (years to decades), depending on changes in local conditions based primarily on variations in water flows over those times (such as annual wet-season–dry-season cycles and inter-annual flood-drought cycles) and the associated physical changes in the riverbed (such as channel size and available substrate). This non-static distribution was further accentuated by the species' life-history trait of "boom and bust" population fluctuations, where a population can quickly grow or crash depending on the prevailing habitat conditions. Connectivity between the main river channel (mainstem) and its tributaries probably occurred at least with some regularity if not continuously, allowing the species to move within the watersheds by vacating and recolonizing areas in response to habitat suitability. Because historical data are not available to determine the upper limit of the species within each tributary, we consider the historical range to have included the lower portions of each watershed up to a point (in the mainstem and tributaries) where the in-stream gradient (slope) is steep enough that flow rate would exceed the species' ability to feed, breed, and shelter. As we discussed in the final rule designating critical habitat for the species, we determined, based on a GIS analysis, that the maximum gradient is approximately 7 degrees (USFWS 2010, p. 77972). However, at least one species-expert has suggested that 7 degrees may be too steep for Santa Ana sucker habitat (Swift *in litt.* 2015; see also O'Brien *et al.* 2011, p. 158). Additional field-based research would help refine the maximum gradient for the species.

Also historically, there may have been opportunities for Santa Ana suckers to move between watersheds before the rivers were channelized and "tamed" by flood control measures. Such opportunities allowed for natural population augmentation and genetic exchange, improving genetic representation and population resiliency. However, there are no physical connections between watersheds currently (Figure I-2). Further, because of manmade changes to the rivers (channelization, dams, and other flood control measures), future natural contact between populations at the watershed level is unlikely. This isolation has reduced the resiliency of the remaining populations and has made the population in each watershed more important to the overall genetic representation within the species (see also USGS 2015, *in litt.*).

The United States Geological Survey (USGS) has conducted an assessment of genetic distinctiveness for all occupied streams, including the Santa Clara River. Additional information on the results of this assessment of the Santa Clara River population may be found in Appendix A. Because Santa Ana suckers in the Santa Clara River are not considered part of the listed entity, we are not addressing them in detail in this recovery plan. However, some research has been done on Santa Ana suckers in the Santa Clara River that is relevant to the species as a whole, and we include that information where appropriate.


U.S. Fish & Wildlife Service
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2177 Salk Ave. Suite 250, Carlsbad, California 92008
Santa Ana Sucker Recovery Plan
Figure I-2. Locator Map
SAN BERNARDINO COUNTY
ANGELES NATIONAL FOREST
Big Tujunga Creek
SAN GABRIEL MOUNTAINS
SAN BERNARDINO MOUNTAINS
SAN BERNARDINO NATIONAL FOREST
Los Angeles River Watershed
San Gabriel River
San Gabriel River Watershed
Santa Ana River Watershed
Santa Ana River
Los Angeles River
LOS ANGELES COUNTY
RIVERSIDE COUNTY
CLEVELAND NATIONAL FOREST
ORANGE COUNTY
SANTA ANA MOUNTAINS
PACIFIC OCEAN
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GIS Services
GIS Contact: Tony McKinney
Biology Contact: Bradd Bridges
Map Date: 5 January 2017
Data Source: CASIL, USFWS
Image Source: ESRI 2013
/staff/Bradd/SASU_RecovPlan/Figure I-2.mxd
0 10 20 Miles
0 10 20 30 Kilometers
N
Santa Ana Sucker Current Range
Watershed
Streams and Rivers
National Forest
County Boundary

The current range of the Santa Ana sucker is much smaller than the historical range. The listing rule states that approximately 70 percent of the Santa Ana sucker's historical range has been lost in the Santa Ana River watershed, 75 percent in the San Gabriel River watershed, and 80 percent in the Los Angeles River watershed (USFWS 2000, pp. 19687–19688). Today, the continuous and permanent up-stream limit of Santa Ana sucker movement in the Santa Ana, San Gabriel (West Fork), and Los Angeles Rivers is generally defined by artificial barriers to their movement, such as manmade dams or grade-control structures. Thus, the current range of the species in these watersheds is restricted or curtailed compared to what it was historically. If these artificial barriers did not exist, Santa Ana suckers would likely, at least under certain stream-flow conditions, be able to move into other portions (or reaches) of the occupied rivers, as well as associated tributaries, up to some upper limit.

In streams or rivers that are not restricted by artificial barriers, such as the San Gabriel River (North and East Forks), the upper limit of where fish are likely to occur is determined by the in-stream gradient and the fish's inability to physically swim upstream when a certain gradient (and thus flow rate) is exceeded. As noted above, the results from a GIS analysis suggest that Santa Ana suckers do not occur above areas where the in-stream slope exceeds 7 degrees (USFWS 2010, p. 77972), but this deserves further investigation. Since the time of listing, the overall geographic range of the species has not changed substantially.

The distribution of the Santa Ana sucker today is similarly much more limited than it was historically because there are fewer options in the spatial arrangement of the species as a result of the reduction in the amount of suitable habitat and concomitant contraction of the species' historic range. Since listing, the distribution of the Santa Ana sucker has changed because of inter-annual and multi-year changes to the physical and hydrological configuration of the respective watersheds, especially in the Santa Ana River watershed.

The historical abundance of Santa Ana suckers has been reduced in all three watersheds, because of the decrease in available habitat relative to the historical range of the species (Moyle and Yoshiyama 1992, p. 204), but comprehensive surveys and population estimates for the historically or currently occupied geographic area of Santa Ana sucker are lacking. Historical records are too scarce to generate population estimates, and while recent surveys are more numerous (for example, Drake 1988, p. 52; Saiki 2000, pp. 11–12; Chambers Group 2004, p. 3; Baskin *et al.* 2005, p. 1; Ecorp Consulting 2007, p. 9; Swift 2009, p. 3; Ecorp Consulting 2010b, p. 9), a lack of consistent survey methodology used among the three watersheds limits the ability to make meaningful comparisons of survey results over time or between the different locations. A brief discussion of the current range of the Santa Ana sucker in the Santa Ana River, San Gabriel River, and Los Angeles River watersheds is included below.

1. Santa Ana River Watershed

Historically, the Santa Ana sucker was documented throughout the upper and lower portions of the Santa Ana River watershed, including the mainstem from near the current location of Seven Oaks Dam to approximately 14 miles (mi) (22.5 kilometers (km)) below Prado Dam and multiple tributaries including City Creek, Warm Creek, Lytle Creek, Rialto Channel, Evans Lake drain, Tequesquite Arroyo, Sunnyslope Creek, Anza Park drain, and Chino Creek.

Today, the species is confined to the lowlands of the Santa Ana River watershed (Figure I-3). Barriers to dispersal in the Santa Ana River restrict the range of the Santa Ana sucker to approximately 34 mi (55 km)—from the South La Cadena Drive bridge in Riverside to near where California State Route 90 crosses the river in Yorba Linda. The extent of habitat suitable for spawning in the mainstem varies from year to year but ranged from approximately 2.6 to 8.8 mi (4.2 to 14.2 km) above Prado Dam between 2006 and 2016 (USFWS 2016b). Data in 2016 suggests that there is suitable spawning habitat (cobble/gravel) extending from the Rialto Channel 8.8 miles downstream approximately to the Metropolitan Water District crossing (USFWS 2016b). Substrate within the remainder of the mainstem above Prado Dam predominately consists of silt and sand (Thompson *et al.* 2010, p. 327; SAWA 2014, p. 24), which are less suitable for Santa Ana suckers (see the H**abitat Characteristics/Ecosystem** section, below). We have no information to indicate that spawning is occurring below Prado Dam. The species is also known to occupy tributaries within this range, including Rialto Channel, Tequesquite Arroyo, Sunnyslope Creek, and Anza Park drain. Cumulatively, within the current range, these tributaries contain approximately 1.25 mi (2.0 km) of suitable habitat for the species, with the remainder channelized for flood control. Rialto Channel is the only occupied tributary where the habitat is consistently good quality for both foraging and spawning (0.30 mi, 0.48 km).

Surveys were conducted annually for the Santa Ana sucker in three 100-meter reaches above Prado Dam between 2001 and 2011 (Even *et al.* 2012, first page (unpaginated)). Population estimates (expressed as fish per mile) during this period ranged from 475 in 2009 to 1,975 in 2002 (Even *et al.* 2012, first page (unpaginated)). Overall, fish densities were highest at the reach farthest upstream (above the Riverside Avenue bridge), but varied substantially from year to year, among and within monitored sites (Even *et al.* 2012, entire). In 2013, surveys for Santa Ana sucker were conducted in 32 locations above Prado Dam (SAWA 2014). While the results are not directly comparable to previous surveys due to differences in survey methodology, the majority of Santa Ana suckers were captured in the upper survey reaches, from the Rialto

Figure I-3. *The mainstem of the Santa Ana River, below the Highway 60 bridge. (Christine Medak, USFWS)*

Channel confluence to just downstream from Mission Boulevard. Santa Ana suckers have previously been captured below Mission Boulevard in numbers similar to what is currently found above Mission Boulevard (for example, Chadwick and Associates 1992, Swift 2002a, Tennant 2003); however, the prevalence of sand substrate and lack of habitat complexity are likely factors limiting the distribution of the species between Mission Boulevard and Prado Dam (see Section D: Habitat Characteristics/Ecosystem below). Only a few Santa Ana suckers have been detected below Prado Dam since 2001 (for example, Haglund *et al.* 2003, p. 12; Baskin and Haglund 2008, not paginated; Russell 2010, p. 3).

2. San Gabriel River Watershed

Historically, Santa Ana suckers were documented throughout the upper and lower portions of the San Gabriel River watershed, including the San Gabriel River mainstem near Fish Canyon, Fern Canyon, Rio Hondo, San Jose Creek, West Fork, Bear Creek, North Fork, East Fork, Cattle Canyon Creek, and San Dimas Wash. The lower San Gabriel River was channelized for flood control purposes and, today, it does not provide suitable habitat for Santa Ana sucker (see the **Habitat Characteristics/Ecosystem** section, below).

The species is now confined to approximately 26 mi (42 km) in the upper portions of the San Gabriel River watershed. It occurs above San Gabriel Dam in the West Fork (east of Cogswell Dam), Bear Creek, North Fork, East Fork, and Cattle Canyon Creek. Distribution of the Santa Ana sucker in the West Fork and Cattle Canyon has decreased by several kilometers, compared to 1975 (O'Brien *et al*. 2011, p. 158). In addition, Santa Ana suckers were not observed in Big Mermaids Canyon in 2007–2008, though they had been seen in 1991 surveys (Hagland and Baskin 1992, p. 31).

Additionally, the subspecies was detected (at least formerly) below San Gabriel Dam in approximately 1.5 mi (2.4 km) of San Dimas Wash (Morrissey 2008, entire), a tributary isolated from the San Gabriel River by approximately 10 mi (16 km) of cement-lined channels and underground culverts. However, the occupied stretch had intermittent flows when surveyed in February 2014 and no Santa Ana suckers were detected (SRMA 2014, entire). Moreover, information from a preliminary report suggests that the San Dimas Wash population was the result of a recent introduction (Richmond *et al.* 2016b, in review, p. 15).

Santa Ana suckers are more abundant and in better condition (length-weight relationship) in the San Gabriel River, compared to those in the Santa Ana River (Saiki *et al.* 2007, p. 98). The better body condition may be attributed to physical conditions such as intermediate water velocities and the prevalence of pools and riffles with coarser bottom substrates (Saiki *et al.* 2007, pp. 99–100). Within the San Gabriel River, there are some distinct differences between the three forks of the river (North, West, and East), which seem to correlate with both fish abundance and life-stage occupancy (Tennant 2006, pp. 4–5, 9). For example, past surveys indicate that the East Fork, with faster flows and more abundant riffles, supports more juveniles, whereas the West Fork, with slower flows and deeper pools, supports more of the adults (Tennant 2006, pp. 5–9).

Overall, Santa Ana suckers appear to be more abundant in the East Fork of the river than the West or North Forks (Tennant 2006, p. 6; O'Brien *et al.* 2011, p. 152) (Figure I-4). They have been consistently observed in all three forks (Haglund and Baskin 1992, p. 31; Haglund and Baskin 2003, p. 72; Tennant 2004, p. 5; Tennant 2006, p. 5; Ecorp Consulting 2007, p. 9; Ecorp Consulting 2010b, p. 9; O'Brien *et al.* 2011, p. 152), but recent surveys have noted that the populations have declined, likely due to drought (Pareti *in litt.* 2016). We consider the San Gabriel River population to be the most viable of the populations in the three watersheds because of the amount suitable habitat available and less extensive threats impacting the species, compared to the other two watersheds.

Figure I-4. *The East Fork of the San Gabriel River. (Christine Medak, USFWS)*

3. Los Angeles River Watershed

Formerly, the Santa Ana sucker was documented throughout the upper and lower areas of the Los Angeles River watershed, including the Los Angeles River mainstem near Universal City and Los Feliz Boulevard, and the tributaries Big Tujunga Creek and Arroyo Seco Creek. However, between 1938 and 1960, 51 mi (82 km) of the Los Angeles River and numerous tributaries within the lower watershed were channelized and cement lined (Gumprecht 2001). The Santa Ana sucker is now extirpated from this area.

Today, the species consistently occupies approximately 13 mi (21 km) of Big Tujunga Creek (a tributary to the Los Angeles River) (Figure I-5) between Hansen and Big Tujunga Dams, and approximately 2.2 mi (3.5 km) of Haines Creek (a tributary to Big Tujunga Creek). There are other tributaries (for example, the lower portion of Little Tujunga Creek (Swift *in litt.* 2015)) that may be periodically occupied, but this depends on availability of water in the creek and habitat conditions.

Habitat assessments conducted throughout Big Tujunga Creek indicate that habitat suitability is variable throughout the system, although there are areas of good and excellent habitat that are suitable for all life stages (for example, Andresen 2001, entire; EDAW and SMEA 2009, pp. 18–22; BonTerra Psomas 2015, pp. 21–27). Some of this variability in habitat suitability may also be due to the periodic isolation of upper and lower reaches from a lack of perennial flow during dry summer months (Haglund and Baskin 2010, pp. 1–2). As a result, the density of Santa Ana suckers in Big Tujunga Creek is variable, likely due to the variability in habitat suitability and surface flows (Ecorp Consulting 2010a, p. 5; Haglund and Baskin 2010, pp. 5–6; Ecorp Consulting 2013a, p. 32; BonTerra Psomas 2015, pp. 29–30, 35, 36). In 2011, the Los Angeles County Department of Public Works, in coordination with the Santa Ana Sucker Working Group, installed a low-flow valve at Big Tujunga Dam, allowing for summer releases of water (assuming sufficient supply) in an effort to benefit the Santa Ana sucker through adaptive management (EDAW and SMEA 2009, p. 1; BonTerra Psomas 2015, p. 1).

Figure I-5. *Big Tujunga Creek of the upper Los Angeles River watershed. (Carey Galst, USFWS)*

C. Life History and Ecology

Santa Ana suckers have several life history traits (early sexual maturity, a protracted spawning season, and high fecundity) that allow them to survive through periods of unfavorable environmental conditions associated with the dynamic fluvial systems they inhabit (Greenfield *et al.* 1970, p. 177; Moyle 2002, p. 183). Spawning primarily occurs between mid-March to early July, with peak activity usually in April (Moyle 2002, p. 183). For a small species of the sucker family, fecundity (number of eggs or offspring produced by an individual) of Santa Ana suckers is high and increases linearly with body weight (Greenfield *et al.* 1970, p. 170). Spawning takes place over gravelly riffles (Moyle 2002, p. 184) where fertilized eggs adhere to the substrate and hatch within 15 days (Greenfield *et al.* 1970, p. 169). Larvae measure approximately 0.28–0.39 in (7–10 millimeters (mm)) at hatching (Greenfield *et al.* 1970, p. 169; Feeney and Swift 2008, p. 67). Greenfield *et al.* (1970, p. 170) did not observe gravid (with eggs) females smaller than 1.9 in (49 mm) or under 0.07 ounce (2.05 grams). Santa Ana suckers in the Santa Clara River generally mature during their second summer and die at the end of their third summer at 3 to 4.3 in (75 to 110 mm) standard length (Greenfield *et al.* 1970, p. 172). However, some individuals have been observed to survive through a fourth summer growing to a size of 5.6 to 6.0 in (141 to 153 mm) standard length (Greenfield *et al.* 1970, p. 172), and those in the San Gabriel River may survive into their fifth summer (Drake 1988, p. 56). Additionally, one exceptionally large (8 in (20.3 cm)) Santa Ana sucker was found in the Santa Ana River (Russell 2010, p. 3), but its age was unknown. Maximum age appears to vary among the watersheds, for unknown reasons, possibly due to the quality of habitat and overall fish condition. In captivity, where there are fewer stressors (for example, no predation or disease, and water quality and quantity are managed), some Santa Ana suckers can live for 6 or more years (Russell *in litt.* 2015). Further investigation of age structure is necessary to fully understand the age, growth, and size relationship of Santa Ana sucker across its range.

D. Habitat Characteristics/Ecosystem

Santa Ana suckers occur in the watersheds draining the San Bernardino and San Gabriel Mountains of southern California. Their historical distribution extended from upper watershed areas to the Pacific Ocean; hence, they are capable of occupying habitats as diverse as mountain streams and rivers in alluvial floodplains (relatively flat landform created by the deposition of sediment over a long period of time from one or many rivers) (Swift *et al.* 1993, pp. 119–121; Moyle 2002, p. 183).

The streams that the Santa Ana sucker inhabits are generally perennial streams with water ranging in depth from a few inches to several feet and with currents ranging from slight to swift (Smith 1966, p. 57). Perennial flows with suitable water quality[2] and substrate are needed to

[2] Water quality can be broadly defined as the physical, chemical, and biological composition of water as related to its intended use for such purposes as drinking, recreation, irrigation, and fisheries (NRCS 2003, p. 1-2). Thus, the term can have different meanings to different users, including for example, many of the responsible parties and partners identified in this document or agencies who define or otherwise enforce water quality standards. For our purposes in this recovery plan, the term *water quality* circumscribes those physical, chemical, and biological

support breeding, feeding, and sheltering. These streams are also naturally subject to periodic, severe flooding (Moyle 2002, p. 183) and may experience extended periods of low flow as a result of drought conditions that are typical of southern California climate cycles (CRWQCB 1995, p. 1-4). However, there are also areas within the range of Santa Ana sucker that experience periods of no flow as a result of past and current hydrological modifications to the watershed (for example dams, diversions, or recharge basins) (CRWQCB 1995, p. 1-4). Not only is the presence of water vital to the Santa Ana sucker, the volume and flow rate are important in shaping the watershed. Periodic high-flow events (flood flows) deliver coarse substrates (such as gravel and cobble) to occupied areas. Flood flows also reshape the channel to create the complex habitat needed to support all life history stages for Santa Ana sucker (for example, open sandy bars for juveniles and deep, undercut banks and runs for adults).

Over the course of the Santa Ana sucker's life cycle, each life stage uses different portions of the watercourse, each with different physical properties. Spawning occurs in areas with gravel substrates at a moderate depth, but close to areas of deeper water or aquatic vegetation that serve as refugia (Haglund *et al.* 2003, pp. 77–85, 102). Fry are found in areas with negligible flow over silty substrate (Haglund *et al.* 2003, p. 102) and often "bask" in shallow, sunny areas but then retreat to vegetated areas for protection (Haglund *et al.* 2003, pp. 77–85; Feeney and Swift 2008, p. 70). Because adult and juvenile Santa Ana suckers primarily feed by scraping algae from hard substrates, they prefer well-lit reaches with coarse substrates, where photosynthetic algae can grow (Haglund *et al.* 2003, pp. 77–85; Feeney and Swift 2008, pp. 68; SMEA 2010a, p. 10; BonTerra Psomas 2015, p. 10, 55). Adults and juveniles are found over gravel, cobble, or a mixture of gravel or cobble with sand within riffles, runs, and pools (Haglund *et al.* 2001, p. 60; Haglund and Baskin 2003, p. 55; Feeney and Swift 2008, pp. 68–70; Thompson *et al.* 2010, p. 329). Adults are found in deeper areas than juveniles and prefer runs over pools or riffles (Haglund *et al.* 2003, p. 98; Haglund and Baskin 2004, p. 24). Therefore, a stream system needs to contain the appropriate quantity and configuration of habitat for fry, juveniles, and adults to sustain a viable population of Santa Ana suckers—including riffles, runs, and pools with a range of substrates, depths, and water velocities to provide the space for successful reproduction and juvenile development and growth of algae as a primary food source.

Specific tolerances to water quality variables such as water temperature, dissolved oxygen, and turbidity have not been determined for Santa Ana sucker. However, Santa Ana suckers are most abundant in clear water at temperatures that are typically less than 72 ºF (22 ºC) (Moyle 2002, p. 183, see also Feeney and Swift 2008, p. 70). Mortality has been observed where water temperatures have become elevated. High mortalities have been recorded in recent years in conjunction with extremely high air and water temperatures in both the Santa Ana River (water temperature of 91.0°F (32.8°C) during summer 2010; SMEA 2010b, pp. 1–2) and Big Tujunga Creek (water temperatures above 80°F (26.7°C) during summer 2011; C. Galst 2011, pers. obs.;

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features that are important for Santa Ana suckers to live and reproduce and are, as such, components of Santa Ana sucker habitat. These features include (but are not limited to) water temperature, thermal fluctuations, dissolved oxygen, turbidity, nitrates/nitrites, total dissolved solids, perchlorate, chlorine, sulfides, ammonia, various metals, and other organic compounds.

T. Hovey 2011, pers. comm.). The Santa Ana River (in particular) has elevated temperatures in the summer months and turbid conditions associated with high, storm-related flows that typically happen during winter and spring but may also occur (though less frequently) as a result of thunderstorms during summer and fall, yet the continued presence of Santa Ana suckers in the Santa Ana River demonstrates that they are able to tolerate these conditions to some extent (Chadwick and Associates, Inc. 1992, p. 37; Saiki 2000, p. 25; Moyle 2002, p. 183). Although Santa Ana suckers can tolerate such conditions, reproduction appears to be negatively affected (Swift *in litt.* 2015). Riparian cover may offer areas of shade that helps to cool the water during the warmer months (Swift 2001, p. 35). Similarly, areas of groundwater upwelling provide refugia of cool water (Feeney and Swift 2008, p. 75).

While specific levels of tolerance for dissolved oxygen are not known for the Santa Ana sucker, there is some evidence that the presence or absence of Santa Ana suckers in a given area at a given time may depend upon levels of dissolved oxygen (BonTerra Psomas 2015, pp. 58–59). Levels of dissolved oxygen depend upon several factors, such as the presence of rocks and cobles (the turbulence caused by these features increases the dissolved oxygen) and the amount of organic matter (decaying organic matter decreases the amount of available dissolved oxygen) (BonTerra Psomas 2015, pp. 63, 69–70). Additionally, because Santa Ana suckers forage on algae, increases in turbidity could decrease food sources by limiting the light available for photosynthetic production of algae (Kirk 1985, entire).

Tributaries, particularly those located near the confluence of occupied areas of the river mainstem, may also provide important habitat for Santa Ana suckers. Surveys have repeatedly reported the presence of adults in spawning condition (tuberculated) and juveniles along the margins in tributaries of the Santa Ana River (Chadwick and Associates, Inc. 1992, p. 49; Chadwick Ecological Consultants, Inc. 1996, p. 16; Haglund *et al.* 2002, pp. 54–60; SMEA 2011, p. 1). In addition to supporting spawning, tributaries may provide shallow-water refuge for juveniles from larger predatory fish and may similarly act as refuge for juvenile and adult Santa Ana suckers from flood flows in the mainstem during storm events. Finally, the species may be attracted to tributaries due to the relatively colder water temperatures typically found in these higher-order streams (Swift 2001, p. 26).

E. Critical Habitat

Critical habitat was originally designated for Santa Ana sucker on February 26, 2004 (USFWS 2004, p. 8839). On December 14, 2010, critical habitat for the species was revised, designating critical habitat in Los Angeles, Orange, Riverside, and San Bernardino Counties, California (USFWS 2010, p. 77962). The designated critical habitat includes approximately 9,331 ac (3,776 ha) of Federal, State, and private lands. Three units were designated: Unit 1, the Santa Ana River; Unit 2, the San Gabriel River; and Unit 3, Big Tujunga Creek (Los Angeles River). Individual units are each intended to independently support a population of Santa Ana sucker in a functioning hydrological system that provides suitable water quality, water supply, and coarse sediments. Primary constituent elements (PCEs) for the Santa Ana sucker are those physical and biological features that support life history functions essential to the conservation of the species and may require special management considerations or protection. These include primarily a functioning hydrological system that provides sources of water and course sediment necessary to maintain all life stages, including adults, juveniles, larvae, and eggs of Santa Ana sucker. A detailed description of the PCEs and the function of critical habitat for the species can be found within the 2010 final rule designating critical habitat (USFWS 2010, p. 77969).

F. Reasons for Listing and Current Threats

The following discussion is a brief summary of ongoing threats that continue to impact the Santa Ana sucker and its habitat. For additional information regarding the Santa Ana sucker, see the final rule listing the species as a threatened species (USFWS 2000, p. 19686), the final rule revising the designation of critical habitat (USFWS 2010, p. 77962), the 5-year review for the Santa Ana sucker (USFWS 2011, entire), and the Santa Ana sucker recovery outline (USFWS 2012, entire). In determining whether to list, delist, or reclassify (change from endangered to threatened status, or threatened to endangered status) a species under section 4(a) of the Act, we evaluate five factors: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence.

The final rule listing the species (USFWS 2000, pp. 19686–19698) identified the following threats to Santa Ana sucker: (1) habitat destruction, (2) natural and human-induced changes in stream-flow, (3) urban development and related land-use practices, (4) intensive recreation, (5) introduction of nonnative competitors and predators, and (6) demographics associated with small population size.

The 5-year review for Santa Ana sucker (USFWS 2011, entire) and the Santa Ana sucker recovery outline (USFWS 2012, entire) identified the following threats to Santa Ana sucker: (1) modification, fragmentation, and loss of habitat attributable to (a) dams, (b) changes in water allocations, and (c) other hydrological modifications; (2) water quality degradation; (3) increased fire frequency; (4) OHV use; (5) mining; (6) nonnative vegetation; (7) predation; (8) small population size; and (9) climate change. We believe the primary threat to Santa Ana sucker is rangewide modification, fragmentation, and loss of habitat through hydrological modifications. A detailed evaluation of all threats is included in the 2011 5-year review (USFWS 2011, entire). Threats to Santa Ana sucker are summarized below under each of the five factors.

Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Currently, the threats to Santa Ana sucker habitat are primarily attributed to past and ongoing urbanization and the continuing repercussions of human population growth in Los Angeles, Orange, Riverside, and San Bernardino Counties. Modification, fragmentation, and loss of habitat have been the primary reasons for the decline in Santa Ana sucker populations throughout its range compared to its status and distribution historically, and they continue to be significant threats to the recovery of the species in portions of its range. We classify Factor A threats (all of which are attributable to or outgrowths of urbanization) to Santa Ana sucker habitat or range into the following categories: (1) Hydrological modifications, (2) water quality, (3) nonnative vegetation, (4) wildfire, (5) off-highway vehicle (OHV) use, and (6) mining activities.

Hydrological Modifications

Human activities, such as construction of dams, water diversions, flood control channels, roads, and other impervious surfaces, have altered the hydrology of the watersheds throughout Santa Ana sucker's historical range. While we recognize the importance of these activities to people in southern California and that many of the stakeholders identified in this plan have obligations to provide services to the public that these activities are intended to address, we nevertheless believe that such activities, as they have been implemented in the past or in many cases are being implemented now, have impacted fish dispersal and have modified the Santa Ana sucker's habitat to the point that much of it is no longer suitable. The Santa Ana sucker remains in a small portion of its historical range and although no additional construction of anthropogenic barriers to dispersal or further fragmentation of Santa Ana sucker habitat has occurred since its listing, habitat degradation continues due to ongoing operations of flood control and water conservation facilities and permanent modifications to the watersheds.

Not only is the presence of water vital to the Santa Ana sucker, the volume and flow rate are important in shaping the watershed and maintaining appropriate substrate composition in occupied areas. In the Santa Ana River, there are significant pressures put on the hydrological process through water diversions and impediments, which may impact the suitability of available habitat for Santa Ana sucker. Over time, the natural flow regime has been greatly modified. The water that provides the habitat for Santa Ana sucker in the Santa Ana River throughout most of the year and all of the water during dry summer months does not originate primarily from natural sources, but instead comes from discharges of treated wastewater (CRWQCB 2008, p. 1-11; USFWS 2008, pp. 2–3). In addition, water diversions for human uses have appropriated most of the available water in the Santa Ana River watershed (CRWQB 2010, p. 2). At this time, treatment plant discharges in the Santa Ana River provide the only constant source of water for Santa Ana suckers in that watershed. While this source is very important under current hydrological conditions, it does not resemble the natural flow regime in the watershed and may not be sufficient to maintain the high-quality habitat, with the complex diversity of habitat variables necessary to support each life stage of the species (for example, sufficient sediment with appropriate grain size for spawning, pools, riffles, shallow stream margins, undercut banks, emergent aquatic vegetation, and riparian vegetation). While wastewater alone may not be the best source of water for high-quality Santa Ana sucker habitat, a reduction or elimination of wastewater flows (in the Santa Ana River in particular) would result in a concomitant reduction or elimination of Santa Ana sucker habitat.

Water flow in Big Tujunga Creek and in the West Fork of the San Gabriel River is also regulated by dams, but the extent that altered hydrology may impact Santa Ana sucker habitat in the San Gabriel River or Big Tujunga Creek is not well understood. Unregulated flows are available to maintain habitat for the Santa Ana sucker in the East and North Forks of the San Gabriel River and their associated tributaries. Several unregulated tributaries also flow into Big Tujunga Creek.

Dams and regulated flows have reduced the delivery of coarse substrates (for example, cobble and gravel) to occupied habitat, which is needed for breeding and forage habitat. The accumulation of sediment above dams may also be altering habitat for the Santa Ana sucker. As sediment accumulates above the dam, the actively flowing stream channel gradually converts to a still-water marsh. Marsh habitat favors nonnative animals, such as largemouth bass

(*Micropterus salmoides*) and other centrarchids that are predators on the Santa Ana sucker (USACE 2001, p. 4-28) (see also *Factor C*). Also, slow or standing water allows fine materials to settle out resulting in a substrate that does not support breeding and foraging habitat for Santa Ana sucker. In particular, Prado Dam may be altering habitat for Santa Ana sucker in a large portion of the Santa Ana River. Based on surveys conducted annually since 2006, 76 percent of the remaining perennial stream habitat for the Santa Ana sucker above Prado Dam (first 18.5 mi (29.8 km)) generally lacks cobble and gravel and instead is predominantly sandy substrate, which does not support spawning or foraging (USFWS 2016b).

Flood control infrastructure (for example, levees, culverts, bank protection) designed to protect urban development may require regular maintenance. Maintenance that requires frequent disturbance to the stream channel can modify and degrade habitat for Santa Ana sucker by removing/displacing substrate, impacting aquatic and riparian vegetation, and increasing the distribution of nonnative vegetation. Remaining Santa Ana sucker spawning habitat in the Santa Ana River is largely contained within areas between flood control levees. When the river channel naturally meanders and approaches the levees, maintenance typically includes relocation of the river channel, which often results in destruction or modification of Santa Ana sucker habitat and displacement of individuals into downstream areas that are generally less suitable for spawning.

Hydrological modification may also limit or sever habitat connectivity, which affects the dispersal of Santa Ana suckers. Such modifications include flood control dams, drop structures, recreational dams, road crossings (for example, culverts) and levees. Large dams, such as Prado Dam, severely limit connectivity between Santa Ana suckers, only allowing limited, unidirectional migration downstream. Drop structures also impede or prevent upstream movement. Recreational dams, constructed out of rocks, vegetation, or other debris to create pools for recreational waterplay, create barriers during low-flow conditions but may be passable during higher flow conditions. Though recreational dams are typically destroyed by high winter flows, recreationalists subsequently rebuild new dams. Trash and debris can also build up during high flows and create barriers. Culverts and other road crossings may prevent access into tributaries or limit connectivity within the main river channel. Additionally, prolonged periods of low flows as a result of reduced water input (such as through flood control measures, storage, or diversion, or through drought conditions) can allow native and nonnative vegetation to accumulate, which can sometimes serve as barriers to fish passage (for example, OCWD 2012, entire).

Levees limit and often prevent the natural meandering process of watercourses, thereby limiting streams to more linear paths. As such, Santa Ana sucker habitat is confined to a narrower geographical area and, under most conditions, a shorter linear length. Additionally, during flood events, the water confined within the levees flows faster and the areas that serve as refugia habitat where Santa Ana suckers can take shelter become scarce.

In summary, hydrological modifications have significantly altered Santa Ana sucker habitat throughout Santa Ana sucker's historical range, which has impacted the species distribution and has resulted in a reduction in the species' range (that is, the current range is smaller compared to its historical range). The water in which the Santa Ana sucker lives is now distributed differently on the landscape and, in some locations for much of the year, originates from anthropogenic sources. Dams and other structures prevent fish passage, changing habitat conditions, reducing gene flow, and limiting or preventing population replenishment. These structures also disrupt the distribution of sediment, impacting the quality of foraging and spawning habitat available to Santa Ana suckers. Additionally, levees and other methods of channelization, and their maintenance further reduce the quantity and quality of habitat available for the species.

Water Quality

Water quality and related environmental conditions vary across and within the rivers occupied by Santa Ana suckers. Natural, unregulated stream flows support the Santa Ana sucker in the East Fork of the San Gabriel River, whereas, regulated, wastewater discharges support the Santa Ana sucker in the Santa Ana River. While wastewater-dominated rivers, like the Santa Ana River, are subject to increased inputs of regulated and unregulated contaminants (Kolpin *et al*. 2002, pp. 1202–1211; Jenkins *et al*. 2009, p. 39), more research is needed to determine if the water quality conditions prescribed by existing regulatory mechanisms are protective of the Santa Ana sucker and its habitat. For example, wastewater discharges are often warmer than natural groundwater sources (Swift 2015, *in litt.*). Elevated water temperatures may degrade Santa Ana sucker habitat and may promote productivity of nonnative species (Aspen 2015, p. 3). It is also unclear whether or to what extent organic wastewater compounds and endocrine disrupting compounds are affecting the species and its habitat. Other factors that may reduce water quality and in turn impact habitat for the Santa Ana sucker include unregulated discharges (for example, cross-connected sewers and illegal encampments), although efforts are underway in some areas to reduce these sources (Riverside County Flood Control and Water Conservation District 2015, *in litt.*). Trash and illegal dumping along watercourses can also be sources of contaminants. Because Santa Ana suckers are aquatic, the species' habitat quality is closely tied to water quality; however, more research is needed to identify which variables and at what levels (quantitative measurements) are most important.

Nonnative Species

Aquatic habitat may be modified by the presence of nonnative vegetation in a variety of ways. There are two nonnative, invasive species in particular that substantially modify or curtail Santa Ana sucker habitat or have the potential to do so: *Arundo donax* and *Compsopogon caeruleus*. Additionally, nonnative wild pigs have been observed in the Santa Ana River watershed. These species are addressed below.

Arundo donax (giant reed) is a nonnative, bamboo-like, perennial grass (Poaceae). It is commonly found growing along lakes, streams, and other wetted areas, but once established it can survive long periods of drought. Compared to other riparian vegetation, it is known to use large amounts of water to support exceptionally high growth rates (Bell 1997, p. 104). This species is considered a primary threat to riparian corridors, and thus Santa Ana sucker habitat, because of its ease of establishment and spread and its ability to alter the hydrology of the system (CDFW 2015a, p. F-11). While the presence of *Arundo donax* can allow hydrologic processes to create small pools that serve as habitat for Santa Ana suckers, in the same way that pools can form because of the presence of native vegetation and boulders (Swift *in litt.* 2015), *Arundo donax* also tends to form large, continuous masses through colonial (rhizomatous) growth. These dense masses can stabilize river or stream banks, alter the flow regime of the system, and prevent or alter natural dynamic processes such as stream meandering and sediment deposition and scouring (Bell 1997, p. 106). As a result of the altered flow regime, *Arundo donax* reduces habitat quality for Santa Ana suckers and improves habitat quality for nonnative aquatic predators (see *Factor C: Predation* below).

A nonnative, invasive, filamentous red alga (*Compsopogon caeruleus*) was identified as a novel threat in 2014 in the Santa Ana River (Spoo-Chupka 2014). This red alga is a tropical species that has likely been introduced into the Santa Ana River. The first record for this species in the Santa Ana River was from 2012, when it was found near Yorba Linda Boulevard, Yorba Linda, California, but information on this detection was not widely circulated (Sheath and Stancheva 2014). The second detection was made in February 2014 when it was found in the discharge pool of the Rapid Infiltration and Extraction Facility (RIX), City of Colton, California. The RIX discharge pool appears to be an introduction location, as the alga has not been found to occur upstream from this location. The red alga attaches to hard substrates and exists as an aquatic epilith (growing on rocks) or epiphyte (growing on plants). In the upper Santa Ana River the red alga was more abundant in areas of cobble or gravel substrate and less abundant in areas dominated by sand (C. Medak and K. Palenscar 2014, pers. obs.). This field observation was supported by experimental research that found that the nonnative red alga prefers larger cobble surfaces in streams with flow velocities exceeding 1 foot per second and perennial water temperatures greater than 20 degrees Centigrade (RCRCD 2016).

One concern is that the presence of this nonnative red alga has reduced the available foraging and spawning habitat for the Santa Ana sucker because it grows very rapidly, up to 10 centimeters per day (Palenscar 2014a, pers. obs.), and creates dense carpets of filaments that cover the bottom via layering. Recent *ex situ* research provides evidence that Santa Ana sucker utilize the nonnative red alga as in-stream cover but no observations were made of Santa Ana sucker choosing the nonnative red alga as forage (RCRCD 2016). This study also found that larval fish were not affected by the presence of the nonnative red alga but the density of the alga in the system was not dense enough nor the study rigorous enough (small sample size) to make conclusions in regard to the spawning success of Santa Ana sucker in the wild when river conditions favor the growth of dense layering of algal filaments. When conducting a snorkel survey in the Santa Ana River in late February 2014, fewer Santa Ana sucker were observed in areas where the alga was abundant (Medak and Palenscar 2014, pers. obs.). Santa Ana sucker are not known to forage on or spawn within filamentous algae, therefore, it is doubtful that Santa Ana sucker selectively feed on the nonnative red alga in the Santa Ana River or spawn within areas of heavy red algal growth.

This rapid invasion of a nonnative species has altered vital Santa Ana sucker habitat throughout most of its occupied range within the upper portion of the Santa Ana River as well as potentially altering ecosystem processes. There was approximately 0.5 mi (0.8 km) of suitable spawning habitat within the Santa Ana River in February 2014 (Medak and Palenscar 2014, pers. obs.). The risk of spreading of this alga to other watersheds is high (water fowl or human transport), but the likelihood of the species naturalizing in this Mediterranean climate is very low due to its specific environmental requirements. Discharge of wastewater effluent from treatment plants provides an artificially warmed aquatic environment, creating appropriate habitat for this alga (Žáková *et al.* 2013). Findings by a Riverside-Corona Resource Conservation District (RCRCD) study suggest that the alga does not persist when water temperatures drop below 20 degrees Centigrade for durations longer than two hours, when it is exposed to direct sunlight for extended periods (damp), or when dried (RCRCD 2016). Long-term management of this alga may be possible by augmenting river flows or by reducing the temperature of the effluent to below hospitable levels for the alga.

Nonnative feral pigs have been detected in the Santa Ana River watershed (Medak 2016, pers. obs.). Pigs, when foraging, actively dig in the streambeds, trampling vegetation, causing erosion, and altering sedimentation patterns and turbidity. Additional research would help us assess potential impacts from feral pigs to the Santa Ana sucker and its habitat.

In sum, we believe nonnative, invasive vegetation—*Arundo donax* and *Compsopogon caeruleus* in particular—can substantially modify Santa Ana sucker habitat. *Arundo* reduces habitat quality throughout much of the species' range by (1) preventing or altering natural dynamic processes such as stream meandering and sediment deposition and scouring, and (2) by improving the habitat quality for nonnative, aquatic predators, which then increases the amount of predation (*Factor C*). *Compsopogon caeruleus* is a novel threat that is, at this time, in a limited area within the Santa Ana River. It is a concern where it occurs because it can reduce the quality and quantity of foraging habitat, and likely also spawning habitat; however, additional study is needed to develop control measures and research potential impacts to the Santa Ana sucker. Lastly, nonnative feral pigs have the potential to impact Santa Ana sucker habitat, but additional research is needed to quantify the impacts of this invasive species that has only recently been detected in the Santa Ana River.

Wildfire

Wildfire may impact Santa Ana sucker habitat throughout occupied and unoccupied reaches of all three watersheds. Wildfire may eliminate vegetation that shades the water and moderates water temperature and may further impact water transport, sediment transport, water quality, and flow regime. Burned uplands in the watersheds may also affect Santa Ana sucker habitat by producing silt-and-ash-laden runoff that can fill in pools and significantly increase turbidity of rivers. The impacts of large wildfires on Santa Ana sucker habitat may also affect the species by isolating populations and causing local extirpations. While wildfire has the potential to impact the Santa Ana sucker throughout its range, we expect the impacts to be localized and temporary. Therefore, we do not consider wildfire to be a substantial threat to Santa Ana sucker habitat at this time.

Off-highway Vehicle Use

Off-highway vehicle (OHV) use is a form of recreational activity that can impact both riparian and in-stream habitat important for Santa Ana suckers. OHV use along the banks of rivers is likely to degrade bank stability and lead to erosion; it also has the potential to damage riparian plant communities that provide shade over the river and help increase bank stability. Driving of OHVs through the river may disturb sediments, create increased turbidity, potentially crush Santa Ana suckers, and otherwise disturb substrates that Santa Ana suckers require for feeding and rearing young. In our observations, OHV use primarily occurs in two areas of Santa Ana sucker habitat: (1) the San Gabriel Canyon OHV area, which is at the confluence of the East and West Forks of the San Gabriel River, and (2) above Mission Avenue in the Santa Ana River. The 160-acre (65-hectare) San Gabriel Canyon OHV area is managed by the U.S. Forest Service

(USFS) to reduce impacts to the Santa Ana sucker and its habitat; for example, OHV drivers may only cross the river at certain specific locations and the site is monitored for compliance (ANF 2012, entire). The USFS also monitors the effectiveness of management actions (for example, see Ecorp Consulting 2010b). OHV use in the Santa Ana River is unauthorized, but we note that an inter-agency team in San Bernardino County is working to control illegal OHV use. Although OHV use is currently not considered a substantial threat, it has the potential to impact Santa Ana sucker in absence of specific management actions and enforcement.

Mining Activities

There are several forms of mining occurring in or upstream of occupied Santa Ana sucker habitat. Mining activities occurring upstream may have subsequent impacts on habitat areas downstream. One form of mining is sand and gravel extraction. Sand and gravel are used as construction aggregate for public works projects such as roads and highways and a multitude of other commercial uses (Kondolf 1997, p. 540). In-stream sand and gravel mining alters the channel geomorphology and bed elevation, and can require water diversion, clearing, and excavation (Kondolf 1997, p. 541). The practice of in-stream mining may induce channel incision and erosion, but more importantly for Santa Ana suckers, mining for gravel and sand removes from the watershed the physical features that serve as spawning and foraging substrates for Santa Ana sucker habitat and discharges back into the watershed fine-grained residual sediment that degrades Santa Ana sucker habitat. Sand and gravel mining is ongoing in the Santa Ana River floodplain, upstream of occupied areas of Santa Ana sucker habitat, which may reduce habitat quality for the Santa Ana sucker in the future.

Another form of mining, vacuum or suction dredging, is also used to find precious minerals within streams and rivers. Within the range of the Santa Ana sucker, suction dredging is generally a recreational activity that occurs most frequently on U.S. Forest Service (USFS) lands. These activities have been known to occur in the San Gabriel River and Los Angeles River watersheds; however, effective January 1, 2016, under a new State law, the use of vacuum or suction dredge equipment is unlawful in California rivers, streams, and lakes (CDFW 2016, p. 1). Additionally, sluicing and high banking, techniques also used to find precious minerals, have been observed in the San Gabriel River (Ally 2003, p. 2; CDFW *in litt*. 2015b) and may also occur in Big Tujunga Creek (Welch 2010, pers. comm.).

Any mining activities that affect the water channel can also directly kill or injure individual Santa Ana suckers. In all, precious mineral mining only occurs in a few areas and, appears to be less extensive than other recreational activities in the same areas (Medak 2016, pers. obs.). While mining is not currently considered a substantial threat, changes in restrictions that increase the rangewide extent of mining activities could have a substantial impact on the species.

Summary of Factor A

Santa Ana sucker habitat continues to be degraded and modified through ongoing activities within each of the three watersheds. Hydrological modifications have limited the amount of available water and, in the Santa Ana River in particular, such activities continue to reduce sediment transport. A reduction in the distribution of sediments further reduces and degrades the quality of available habitat for the Santa Ana sucker. Changes in the quality of the water available are also affected by manmade alterations to the three watersheds, especially the Santa Ana River. Additionally, nonnative, invasive vegetation—*Arundo donax* and *Compsopogon caeruleus* in particular—impact the Santa Ana sucker by reducing habitat quality throughout much of the species' range. More information is needed on the impact of feral pigs. Although OHV use and recreational mining are currently not considered substantial threats to the species' habitat, they have the potential to impact Santa Ana sucker habitat in absence of specific management actions and enforcement.

Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The 2000 listing rule indicated that CDFW reported the illegal harvest of Santa Ana suckers with gill and throw nets in the Santa Ana River below Prado Dam (M. Maytorena, CDFW, 1997, pers. comm.). Since listing, we received information that Santa Ana suckers may be a food source for people living in illegal encampments along the Santa Ana River and that there may be a correlation between the presence of these encampments with the observed decline in the size of Santa Ana sucker populations close to these camps (RCRCD 2007, p. 13). However, the overall impact of illegal harvesting of the species is unknown at this time. At least in some areas along the Santa Ana River, local agencies and jurisdictions are working to remove trespassers and illegal encampments (Riverside County Flood Control and Water Conservation District 2015, *in litt.*; City of San Bernardino Municipal Water Department 2015, *in litt.*, enclosure 1). At this time, we do not believe that overutilization of Santa Ana sucker in the San Gabriel River or Los Angeles River watersheds is a substantial threat to the Santa Ana sucker.

Factor C: Disease or Predation

We have no information indicating that disease is a substantial threat to the continued existence of Santa Ana suckers throughout its range, although scoliosis (from an unknown cause) has been observed in the Santa Ana River (Medak and Palenscar 2016, pers. obs.). Research on this topic would help us determine whether it has an impact on Santa Ana sucker populations.

Nonnative predators, such as bass and sunfish (Family Centrarchidae), tilapia (Family Cichlidae), carp (Family Cyprinidae), and catfish (Family Ictaluridae), have been reported in each of the watersheds currently occupied by Santa Ana sucker (Allen 2003, p. 6; Chambers Group 2004, p. 6-3; RCRCD 2006, p. 11; Morrissey 2009, p. 7; Ecorp Consulting 2010a, p. 7; Ecorp Consulting 2010b, p. 9). The American bullfrog (*Rana catesbeiana*), another potential predator, has also been observed in Big Tujunga Creek (Haines Creek) (Ecorp Consulting 2013a, pp. 29–31) and the Santa Ana River near the confluence with Rialto Channel (Palenscar 2014b, pers. obs.), and is probably ubiquitous throughout the range of the Santa Ana sucker (CDFW 2015a, pp. 5.5-16–5.5-17; CDFW *in litt.* 2015b; Swift *in litt.* 2015). Mosquito fish (*Gambusia* spp.) are found throughout much of the range of the Santa Ana sucker and are known to be predators of small fish, potentially including larval Santa Ana suckers; research is needed to help clarify whether mosquito fish have an impact on Santa Ana sucker populations. Additionally, the red swamp crayfish (*Procambarus clarkii*) is known from Big Tujunga Creek (CDFW *in litt.* 2015b) and may also be more widespread. Brown trout (*Salmo trutta*) is a potential predator in the upper reaches of the Santa Ana River, but currently Santa Ana suckers do not occur in those areas.

The relative abundance of Santa Ana suckers appears to decrease with increasing numbers of exotic fish (Swift 2001, p. 29; Ecorp Consulting 2013a, p. 19). As noted in *Factor A*, dams and impoundments (such as engineered flood control dams, recreational dams, drop structures, and groundwater recharge basins) and pools created as the result of changes in hydrology from *Arundo donax* can improve habitat for nonnative predators, allowing their populations to increase. These areas can serve as source populations, from which predators can disperse, as has been suggested for Hansen Dam reservoir on Big Tujunga Creek, San Gabriel Dam reservoir on the San Gabriel River, and the Prado flood control basin on the Santa Ana River (CDFW *in litt.* 2015b; Swift *in litt.* 2015). An increase in the abundance of nonnative predators increases the potential for predation on all life history stages of the Santa Ana sucker; however, the magnitude of the threat relative to specific predator abundances is unknown. Juvenile Santa Ana suckers that passively disperse downstream are more likely to be exposed to predator-rich environments in all three watersheds, including Prado Basin (Santa Ana River), San Gabriel Reservoir (San Gabriel River) and Hansen Dam (Big Tujunga Creek), at least until the flow rate subsides allowing the remaining suckers to move out of the impoundments and back upstream. Even outside of impoundments, Santa Ana suckers may be exposed to predator-rich environments, such as certain areas below Prado Dam on the Santa Ana River, where deep, warm-water conditions predominate (Aspen 2015, p. 3).

It is not clear just how much of an overall impact nonnative predators have on Santa Ana sucker populations because the conditions that promote exposure to predation is highly variable from year to year and from location to location. Further study is needed to determine the quantity of Santa Ana suckers consumed by nonnative predators to better describe the magnitude of this threat. That said, it is clear that predation from nonnative aquatic species further exacerbates the threat posed by changes in hydrology caused by human endeavors and through the hydrological effects associated with the growth of *Arundo donax*.

Factor D: Inadequacy of Existing Regulatory Mechanisms

In the listing rule, existing regulatory mechanisms thought to have some potential to protect Santa Ana sucker included: (1) California Endangered Species Act (CESA) (where the Santa Ana sucker co-occurred with State-listed species), (2) California Environmental Quality Act (CEQA), (3) National Environmental Policy Act (NEPA), (4) Clean Water Act (CWA), (5) the Endangered Species Act (where, prior to listing, Santa Ana sucker co-occurred with other federally listed species), and (6) land management or conservation measures by Federal, State, or local agencies or by private groups and organizations (USFWS 2000, pp. 19686–19698). The listing rule noted that despite these existing regulatory mechanisms the Santa Ana sucker continued to decline.

Other than the protections now afforded by the Act to the Santa Ana sucker, the status of the other existing regulatory mechanisms and their adequacy for protecting the species remains largely unchanged. One change is the banning of suction dredging activities in California, but such mining activities, prior to the ban, were localized. Additionally, several State and Federal mechanisms provide a conservation benefit to Santa Ana sucker. However, the Act is the primary Federal law that provides protection for this species since its listing as threatened in 2000. Critical habitat was revised in 2010 and was designated throughout the range of the Santa Ana sucker, including unoccupied areas essential for the conservation of the species (USFWS 2010,

p. 77962). The range of the species in Riverside County is within the plan area for the Western Riverside County Multiple Species Habitat Conservation Plan (Western Riverside County MSHCP) (Dudek and Associates 2003a, p. 2-30). For the Santa Ana sucker, the 75-year Western Riverside County MSHCP specifically identifies conservation objectives to (1) provide long-term conservation for the species, (2) develop a management and monitoring plan for the species, and (3) mitigate for impacts to Santa Ana sucker habitat that are associated with permittee activities (Dudek and Associates 2003, pp. F19–F37).

Other Federal and State regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent its status under the Act. We are not aware of any new regulatory mechanisms that have been enacted since the time of listing that would preclude the need for protection of the species under the Act. Therefore, in absence of the Act, other laws and regulations have limited ability to protect the species from the threats described in the other Factors.

Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence

The majority of the Santa Ana sucker's historical range was lost prior to listing, and the distribution of this species has continued to shrink in portions of the San Gabriel River and Santa Ana River watersheds (see *Factor A*). As a result, Santa Sucker populations are now limited in size and restricted to small geographical areas with little connectivity. For example, survey data indicate that the density of Santa Ana suckers is variable in the Santa Ana River (SMEA 2009, p. 1; SMEA 2010a, p. 6), the San Gabriel River (O'Brien *et al*. 2011, p. 10), and Big Tujunga Creek (Ecorp Consulting 2010a, p. 5; Haglund and Baskin 2010). Small populations of Santa Ana sucker are more vulnerable to extirpation during catastrophic or environmental stochastic events, such as flood (that can physically wash Santa Ana suckers away), fire (and its subsequent impacts on the Santa Ana sucker habitat and water quality; see *Factor A*), or sustained drought (that can result in the loss or reduction of surface flows and concomitant increases in water temperature). Results of recent analysis of genetic data shows evidence of recent population bottlenecks in the Santa Ana sucker (Richmond *et al.* 2016b, in review, p. 17). Population bottlenecks are periods of small population size and can lead to inbreeding depression, which is a reduction in reproductive fitness (Hedrick and Kalinowski 2000, p. 141; Frankham *et al.* 2002, p. 24). Thus, because Santa Ana suckers occur in small, isolated populations, the magnitude of the threat posed by environmental stochasticity and inbreeding depression is elevated. In other words, the synergistic effects associated with small population size and stochastic events amplify the threats caused by hydrological modifications to Santa Ana sucker habitat and vice versa.

Current climate change forecasts for terrestrial areas in the Northern Hemisphere predict warmer air temperatures, more intense precipitation events, and increased summer continental drying by the year 2100 (Field *et al.* 1999, p. 1; Cayan *et al.* 2005, pp. 7–8; IPCC 2007, pp. 8–9). Santa Ana suckers prefer cooler water. They are capable of withstanding elevated water temperatures (Saiki *et al.* 2007, pp. 98–99), but the lethal upper temperature limit is unknown. Fish are generally more stressed at the upper extremes of their temperature range and though they may be able to survive, elevated temperature is an example of a stressor that may affect them through decreased growth and reduced disease resistance (Barton *et al.* 2002, pp. 111–148). Reduced connectivity within the watersheds may be further exacerbated by the predicted decreases in annual precipitation, and fish may not have access to areas with cool, clean water because of the lack of water or barriers to dispersal. Similarly, altered precipitation and drying associated with climate change may reduce surface flows, which in turn may promote increased groundwater pumping, which may affect groundwater upwelling, a source of cool water that is used by Santa Ana suckers in some areas. Additionally, increasing air temperatures and decreasing precipitation levels, predicted to occur as a result of global climate change, are likely to impact the availability of suitable cooler-water habitat. This climate-based increase in water temperatures would be additive to the already warmer water in those areas where flows are largely from anthropogenic sources, which are typically warmer than natural flows (Swift *in litt.* 2015). Therefore, though difficult to quantify, change in global climate may impact the Santa Ana sucker throughout its range.

Summary and Synthesis of the Five Factors

The primary threat to Santa Ana sucker is the direct and indirect effects associated with past and ongoing habitat loss, degradation, and alteration through hydrological modifications throughout the range of the species. The loss of available habitat (caused by dams, changes in water allocations, and other hydrological modifications) combined with other increasing threats (such as water quality degradation, impacts to habitat from recreation, and potential effects of nonnative vegetation and predators) have a cumulative effect on Santa Ana sucker and its habitat. Some hydrological modifications also serve as fish-passage barriers, which not only prevent movement of individual Santa Ana suckers but also have the potential to impact Santa Ana sucker habitat by changing the stream gradient and altering hydrological and sediment-transport processes. Additionally, impassable barriers or areas of unsuitable habitat limit gene flow, thus increasing the vulnerability of small populations to a range of environmental stochastic factors and inbreeding depression.

Threats are likely to continue to affect the species because we anticipate that there will be increasing pressure for water conservation (storage) for human use through dams and water diversions. While we recognize that water for human use is important and that certain stakeholders identified in this plan have an obligation to address this need, we also believe that addressing these needs in the same ways as they have been addressed in the past will likely limit and further reduce the amount of water available for fish. We further expect continuing impacts to the Santa Ana sucker from urbanization, recreation, degraded and fragmented habitat, degraded water quality, vulnerability of small populations, and potentially, the effects associated with global climate change. However, the scope and severity of impacts to the Santa Ana sucker varies geographically and temporally and will likely continue to vary within and among the three watersheds.

Santa Ana River Watershed—The Santa Ana River watershed has been highly modified as a result of changes to the hydrology from urban development and barriers, such as Prado Dam and Seven Oaks Dam. The distribution of Santa Ana suckers is limited to where suitable spawning habitat exists, primarily a few miles of the mainstem below South La Cadena Drive and a few small tributaries. The system is largely channelized, and the extent of suitable habitat is constrained by a reduction of water and sediment from their sources upstream. Water quality is geographically and temporally variable and over time may result in impacts to the sucker throughout its range in the Santa Ana River Watershed. Nonnative species, including aquatic predators and the recently identified invasive alga, also pose serious threats to the Santa Ana sucker and its habitat in the Santa Ana River.

San Gabriel River Watershed—The San Gabriel River watershed provides more suitable habitat for the Santa Ana sucker than either the Santa Ana or Los Angeles River Watersheds with abundant cobble substrate and natural water flows within a portion of the available habitat. Although the hydrology has been altered on the West Fork of the San Gabriel River by Cogswell Dam, reducing the habitat quality in this portion of the watershed, unregulated flows are available in the East and North Forks and associated tributaries. Recreational activities (swimming, fishing, off-highway vehicle use) are extensive and contribute to the degradation of habitat. For example, recreational dams are abundant in the lower portions of the North, East, and West Forks. Predators have been reported in the watershed and may gain access from Cogswell and San Gabriel reservoirs. Nonnative plants are present in the lower portions of the East and West Forks and may contribute to habitat degradation.

Los Angeles River Watershed—At the time of listing we estimated that the current range of the Santa Ana sucker in the Los Angeles River watershed had been reduced by 80 percent. The species is currently confined to an area between Hansen Dam and Big Tujunga Dam (USFWS 2000; O'Brien and Stephens 2009). Flows regulated by Big Tujunga Dam can affect suckers by limiting water and sediment transport in Big Tujunga Creek; however, unregulated flows from several tributaries are beneficial to the Santa Ana sucker. The available information is limited, and we cannot determine whether the existing water and sediment sources in this stretch are adequate to maintain Santa Ana sucker habitat. Many road crossings, recreational dams, and culverts limit fish passage and contribute to habitat degradation. Nonnative predators are abundant in Haines Creek and gain access to the system from the Tujunga ponds.

G. Conservation Efforts

Since listing, surveys for Santa Ana suckers have been conducted in various portions of its range. Species-specific projects have also been conducted in each of the three watersheds where the Santa Ana sucker occurs. There have been studies exploring life history parameters, population dynamics and demographics, habitat assessments, environmental conditions, possible restoration sites, and potential reintroduction[3] opportunities. These studies have been important for making decisions regarding the status of the species and the current conditions within each of the watersheds. Other activities have also occurred for the benefit of Santa Ana sucker, such as removal of nonnative vegetation and nonnative predators. Examples of these activities and past research are listed in Tables I-1 to I-3 below. These are not intended to be exhaustive lists but rather illustrative of the range of past and ongoing efforts. Efforts that benefit the Santa Ana sucker and contribute to recovery include on-the-ground recovery actions and implementation of

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[3] In this plan the term *reintroduction* is used to refer to the act of placing Santa Ana suckers (irrespective of their source) into unoccupied habitat within the species' historical range. The historical range is defined in the **Population Trends and Distribution** section. Reintroductions, and all associate activities, will follow all necessary laws and policies and will only be done after appropriate approvals have been obtained.

management plans, including through active cooperation with partners through sections 7 and 10 of the Act.

An example of active cooperation with partners is the Upper Santa Ana River Habitat Conservation Plan (HCP), a regional habitat conservation plan being developed under Section 10(a)(1)(B) of the Act. Although the Upper Santa Ana River HCP was not complete at the time this recovery plan was being finalized, early indications suggest that it will include provisions that provide additional flood protection and increased local water supplies in the San Bernardino Valley. Seven federally listed species, including Santa Ana sucker, are anticipated to be covered by this plan. If permitted, this plan is expected to increase the recurrence interval between storm flow events, reduce the amount of wastewater effluent discharged, and reduce the amount of storm water that reaches the Santa Ana sucker-occupied portion of the Santa Ana River. Proposed mitigation for permitted impacts include (1) improving water supply by restoring and maintaining five tributary creeks along the mainstem of the river, (2) enhancing habitat on the mainstem of the river through habitat augmentation and invasive species removal, (3) establishing a captive breeding program, (4) reintroducing Santa Ana suckers into three mountain tributaries in the San Bernardino National Forest, and (5) maintaining and monitoring the reintroduced fish. The Upper Santa Ana River HCP used the draft recovery plan for the Santa Ana Sucker as a guide to create the conservation measures stated above.

An example of active cooperation with partners through Section 7 of the Act is a consultation with the U.S. Army Corps of Engineers for the Santa Ana River Project. In order to offset impacts to Santa Ana sucker habitat below Prado Dam, the U.S. Army Corps of Engineers will enhance habitat upstream of the Dam within the mainstem of the river, as well as establish a new population of fish elsewhere in the watershed. Conservation measures that will be implemented by the U.S. Army Corps of Engineers are designed to complement mitigation proposed as part of the Upper Santa Ana River Habitat Conservation Plan.

Additionally, the Santa Ana sucker is a covered species under the Western Riverside MSHCP (Dudek and Associates 2003a, p. 2-30), another regional HCP, which was finalized in 2004. As described in the plan (Dudek and Associates 2003b, pp. F-25), "conservation for this species will be achieved by inclusion of at least 3,480 acres of suitable Conserved Habitat including the occupied habitat (water and freshwater marsh) and adjacent buffer and streambank (includes a variety of habitats) within the MSHCP Conservation Area," and further noting that "[a]ll of the known and potential refugia and spawning areas are included within the MSHCP Conservation Area."

Table I-1: Examples of conservation efforts illustrating the studies and activities being funded and carried out to benefit the Santa Ana sucker in the Santa Ana River.

Year	Title	Reference
1992	Santa Ana River use-attainability analysis	Chadwick and Associates 1992
1996	Current status of the Santa Ana sucker in the Santa Ana River	Chadwick Ecological Consultants Inc. 1996
1999	Conservation program for the Santa Ana sucker in the Santa Ana River	Baskin and Haglund 1999
2000	Water quality and other environmental variables associated with variations in population densities of the Santa Ana sucker. [Santa Ana and San Gabriel Rivers]	Saiki 2000
2001	Santa Ana sucker survey/seining in the Santa Ana River	Baskin and Haglund 2001
2001	The Santa Ana sucker in the Santa Ana River: distribution, relative abundance, spawning areas, and impact of exotic predators	Swift 2001
2001–2012	Implementation of the Santa Ana sucker Conservation Program for the Santa Ana River	Haglund *et al*. 2001, 2002, 2003, 2007, 2010, 2012; Haglund and Baskin 2004
2002	Evaluation of Santa Ana sucker (*Catostomus santaanae*) habitat and water quality changes in the Santa Ana River as a result of temporary shutdowns at the Rapid Infiltration and Extraction Plant	Allen 2002
2003	Evaluation of Santa Ana Sucker (*Catostomus santaanae*) spawning success in the Santa Ana River and the potential effects on temporary shutdowns at RIX	Allen 2003
2004	Assessment of the influence of hydrology and sediment transport in the Santa Ana River on Santa Ana sucker habitat	Humphrey *et al.* 2004
2006–2014	Santa Ana sucker research and population augmentation project annual reports	RCRCD 2006, 2007, 2008, 2009, 2011a, 2013, 2014
2007–2009	Santa Ana Watershed Association annual reports	SAWA 2007, 2009
2009	45-day survey report on pre-construction presence/absence surveys for the Santa Ana sucker (*Catostomus santaanae*) at three locations on the Santa Ana River	Ecorp Consulting 2009
2010	Feasibility of the Restoration of Sunnyslope Creek for Santa Ana suckers	SAWA 2010
2010	Influence of habitat dynamics on the distribution and abundance of the federally threatened Santa Ana sucker, *Catostomus santaanae*, in the Santa Ana River	Thomson *et al*. 2010

2011	Draft Seven Oaks Dam Gate Test	USACOE 2011
2011	The Riverside North Aquifer Storage and Recovery Project on the Santa Ana Sucker	AECOM 2011
2011	Sunnyslope nonnative electro-shocking report	RCRCD 2011b
2012–2016	Sunnyslope Creek native fish habitat restoration project monitoring reports	OCWD and SAWA 2012, 2015, 2016
2012–2014	Fish passage barrier identification and assessment throughout the range of Santa Ana sucker	Baskin 2014
2012–2016	USGS analysis of the population genetics of the Santa Ana sucker	Richmond *et al.* 2016b, in review
2013–2014	Relative abundance and habitat surveys by SAWA	SAWA 2014
2014–2016	Ongoing monitoring initiated in Santa Ana River by the Service to assess effects of nonnative red alga on Santa Ana sucker	RCRCD 2016

Table I-2: Examples of conservation efforts illustrating the studies and activities being funded and carried out to benefit the Santa Ana sucker in the San Gabriel River.

Year	Title	Reference
2001–2006	Surveys for the Santa Ana sucker (*Catostomus santaanae*) on the San Gabriel River	Tennant 2001, 2004, 2006
2002	Status of the Santa Ana sucker and Santa Ana speckled dace in the U.S. Forest Service San Gabriel River OHV area	Haglund and Baskin 2002
2003	Final Report Habitat and resource utilization by the Santa Ana sucker (*Catostomus santaanae*) and the Santa Ana speckled dace in the East Fork of the San Gabriel River	Haglund and Baskin 2003
2004	Estimating leakage from Cogswell Dam (West Fork San Gabriel River)	Ally 2004a
2004	Survey of selected stream parameters in the East Fork San Gabriel River and its tributary Cattle Canyon, and in the North Fork San Gabriel	Ally 2004b
2004	Results of electrofishing surveys done in the San Gabriel River (West, North, and East Forks) and tributaries Bear Creek and Cattle Canyon during June and July 2003	Ally 2004c
2004	Results of electrofishing surveys done in four streams of the San Gabriel River drainage in June 2004	Ally 2004d
2007	Fish population and habitat surveys San Gabriel Canyon OHV area	Ecorp Consulting 2007
2008	Update for the Santa Ana sucker located in San Dimas Canyon East Fork	Chambers Group 2008
2010	Santa Ana sucker population and habitat monitoring surveys in the U.S. Forest Service San Gabriel Canyon OHV area	Ecorp Consulting 2010b
2011	Status of fishes in the upper San Gabriel River basin	O'Brien *et al*. 2011
2012	45 day report for the Santa Ana sucker capture and relocation activities below the San Dimas Dam	Chambers Group 2012a
2011–2012	Santa Ana sucker surveys in USFS OHV area, San Gabriel River, Angeles National Forest	Chambers Group 2012b
2013–2014	Santa Ana sucker habitat monitoring surveys in the U.S. Forest Service San Gabriel Canyon OHV area	Ecorp Consulting 2013b, 2014

Table I-3: Examples of conservation efforts illustrating the studies and activities being funded and carried out to benefit the Santa Ana sucker in the Los Angeles River (Big Tujunga Creek).

Year	Title	Reference
2001	Lower Big Tujunga stream pool location survey	Andresen 2001
2002	Fish survey of Big Tujunga Creek below Big Tujunga Dam No. 1 with special reference to Santa Ana sucker	Swift 2002b
2004	Report - Los Angeles River Haines Creek Fish Survey for LACDPW	Baskin and Haglund 2004
2007–2008	Santa Ana sucker (*Catostomus santaanae*) habitat suitability survey 2007-2008 Big Tujunga Creek	EDAW and SMEA 2009
2009	Data summary of the 2009 fish surveys in the Big Tujunga Creek Basin	O'Brien and Stephens 2009
2010	Report for the Santa Ana sucker (*Catostomus santaanae*) survey and relocation effort in the Big Tujunga	Ecorp Consulting 2010a
2010	Santa Ana sucker (*Catostomus santaanae*) and macroinvertebrate baseline survey 2009, Big Tujunga Creek	Haglund and Baskin 2010
2010	Big Tujunga Creek baseline survey year 2 (2010) Santa Ana sucker and macroinvertebrates	SMEA 2010c
2011	Fish surveys at Big Tujunga Dam	BonTerra Consulting 2011
2012–2013	Santa Ana sucker habitat suitability survey results, and Annual Santa Ana sucker and benthic macroinvertebrate baseline survey results	BonTerra Consulting 2012, 2013
2012–2014	Exotic aquatic species removal at Big Tujunga	Ecorp Consulting 2012, 2013a, 2015
2015	Santa Ana sucker habitat suitability survey results, and Annual Santa Ana sucker and benthic macroinvertebrate baseline survey results	BonTerra Psomas 2015
2016	Fish screen installation on Haines Creek to reduce nonnative species invasion from Tujunga Ponds	Ecorp Consulting 2016

H. Summary and Synthesis of Background Section

The Santa Ana sucker is a small, short-lived freshwater fish in southern California. The species has a downward-orientated mouth used to suck up algae and other food items from the substrate. The listed species' historical range included the rivers and larger streams in southern California emanating from the San Bernardino and San Gabriel Mountains in San Bernardino, Riverside, Orange, and Los Angeles Counties (see also Appendix A regarding the population in the Santa Clara River). These included the mainstems and tributaries of the Santa Ana, the San Gabriel, and the Los Angeles Rivers, from the upper portions of those watersheds to near the river's mouths at the Pacific Ocean. Today, because the three rivers have been dammed, channelized, or otherwise altered in many reaches for flood protection purposes, the individual Santa Ana suckers within each watershed are now confined to their respective watersheds. Additionally, because of habitat loss, Santa Ana suckers are now limited to smaller portions of each watershed, which means the species' current range is smaller. The Santa Ana sucker's distribution within the current range may differ year-to-year or even month-to-month, depending on natural and manmade variations in annual and seasonal surface flows and other habitat conditions.

The watersheds of southern California have undergone drastic physical and hydrological changes, largely to facilitate urbanization. These changes have resulted in substantial impacts to Santa Ana sucker populations and the species' habitat, with ongoing ramifications today. Flood control, water extraction, wastewater discharge, and recreational activities (building cobble dams, waterplay, OHV use, and certain kinds of mining) continue to physically disturb the Santa Ana sucker and its habitat, limit the species' movement, and alter the timing, quality, and quantity of surface flows. As a result, portions of the range of the Santa Ana sucker no longer provide the habitat variables necessary to support each life stage of the species.

The limited range and smaller population sizes of Santa Ana suckers within three isolated watersheds reduces their resiliency in the face of ongoing threats and increases the risk of extirpation. Physical barriers that prevent fish passage (including, for example, dams, drop structures, and areas of unsuitable habitat) reduce the species' ability to capitalize on the dynamic nature of the river systems it inhabits, preventing or severely limiting natural recolonization of otherwise suitable habitat. The remaining isolated populations have limited ability to avoid habitat areas degraded by invasive plants and predatory animals; they are also more vulnerable to stochastic events, such as wildfire or severe flooding, the frequency and severity of which will likely increase from the effects of global climate change. Moreover, the small, isolated populations have reduced genetic exchange, which may result in decreased fitness.

The sucker is dependent on habitat that has been, and continues to be, under developmental pressures. Protection and active management are needed to improve and restore suitable habitat in order to prevent further decline and to enable recovery of the species. Some conservation efforts have been implemented and others are ongoing. These include such activities as research (to inform future management), monitoring (to better understand population status and trends), and habitat improvements (such as nonnative species removal, habitat restoration, and changes in how surface flows are managed). While ongoing efforts have been helpful, they do not fully alleviate the threats to the species. Conservation efforts will need to be expanded throughout the species' range to further ameliorate existing threats. Key challenges will be developing a recovery strategy that can be implemented in consideration of the continuing water needs of people in the region and the requirements for flood control operations to maintain human health and safety. Comprehensively balancing these diverse needs will require a truly concerted effort among the varied and sometimes disparate parties within each of the watersheds.

Santa Ana suckers rely on perennial flows with suitable water quality and substrate to support breeding, feeding, and sheltering. Over different life history stages, suckers depend on a variety of coarse substrate types, such as gravel, cobble, or mixtures of gravel or cobble with sand, and a variety of riverine features, such as shallow riffles and deeper runs and pools. Thus, we consider high-quality Santa Ana sucker habitat to be areas in the mainstem or tributaries with cool water flowing in riffles, runs, or pools with gravel, gravel-sand, cobble, or cobble-sand substrates.

Individual Santa Ana suckers may occur and survive in areas that do not have all of the characteristics of high-quality habitat; we consider such areas to be low-quality Santa Ana sucker habitat. Because Santa Ana suckers live in dynamic riverine systems that typically vary on a seasonal basis, the suite of conditions that compose suitable habitat for the species is not static. For the purposes of this recovery plan, high-quality habitat for the Santa Ana sucker is habitat that is suitable for all of the fish's life stages and those conditions exist for a long enough period of time to allow for reproduction and recruitment. Low-quality Santa Ana sucker habitat may be "suitable" for only short periods of time. For example, low-quality habitat may allow individual fish to survive (or, in some cases, subsist) but may be inadequate for spawning and population maintenance. Because environmental conditions in the rivers fluctuate and change (be it for natural or manmade reasons), an area that supports high-quality habitat may become an area of low-quality habitat from time to time (or even permanently), and similarly, suitable habitat may temporarily or permanently become unsuitable habitat from time to time.

Yet, the ability of Santa Ana suckers to tolerate environmental extremes has allowed the species to survive in this dynamic and variable system, even when habitat conditions deteriorate. Additionally, its life history traits of early sexual maturity, prolonged spawning, and high fecundity have allowed the species to capitalize on good habitat conditions when they do occur. However, the threats described above are likely to become more pronounced over time as competition for fresh water for human use increases and as the climate changes, and the existing conservation efforts, while helpful, do not fully alleviate the existing threats. Therefore, we conclude that the conservation status of the Santa Ana sucker will become worse in the future. As a result, a program to recover the species is necessary. This program is described in the following sections.

II. Recovery Program

This section describes the recovery program for the Santa Ana sucker by outlining a strategy, identifying where recovery will occur (recovery units), defining the recovery goal and objectives, and delineating criteria that, when met, will allow us to remove the Santa Ana sucker from the list of threatened and endangered species (delist the species).

A. Recovery Priority Number

The recovery priority number for Santa Ana sucker is 6C. This number, per our guidance (USFWS 1983a; 1983b), indicates the listed species faces a high degree of threat, has a low potential for recovery, and has a taxonomic status of a distinct population segment (as opposed to a species or monotypic genus). The high degree of threat is due to (1) the reduced quantity and quality of Santa Ana sucker habitat as a result of anthropogenic hydrologic modifications, reduced water quality, and the effects of invasive, nonnative plant species, wildfire, OHV use, and mining activities; (2) predation by introduced predators; and (3) susceptibility of small populations to stochastic events, which is likely to be further exacerbated by climate change. The low potential for recovery is due to the significant amount of effort needed to secure the required water supply, restore habitat, and secure funding for research. The “C” indicates conflict with construction or other development projects or other forms of economic activity, specifically water conservation (storage) and flood control projects and associated infrastructure (for example, dams, diversions, and drop structures).

B. Recovery Strategy

Past and ongoing large-scale hydrological modifications throughout the range of the Santa Ana sucker have resulted in a decrease of occupied, suitable habitat. This, in turn, has reduced the species’ resiliency (most of the existing populations are too small to withstand stochastic events) and redundancy (there are too few populations to ensure that the species can withstand catastrophic or environmental stochastic events). Additionally, a reduced level of representation (maintaining the breadth of the genetic makeup to conserve the adaptive ability of the species) is a concern because (1) the species is geographically restricted to three, now-separate populations in three watersheds, and (2) each watershed supports a now-reduced population that, to varying degrees, consists of smaller subpopulations separated by barriers or areas of unsuitable habitat. Therefore, the highest priority for the recovery of Santa Ana sucker is to increase the amount of occupied, high-quality habitat that allows for feeding, breeding, and sheltering for all of the species’ life stages.

To do this, we believe it will require active management on two fronts: (1) providing additional areas of high-quality habitat in each of the watersheds through habitat restoration and, if necessary, habitat creation, and (2) reestablishing Santa Ana suckers in areas of unoccupied high-quality habitat (whether currently existing, restored, or created) through removal of existing barriers to fish passage (to allow natural recolonization) or, if necessary and where appropriate, through active reintroduction. Santa Ana suckers are naturally adept at recolonizing unoccupied areas of suitable habitat due to their life history traits, including early sexual maturity, protracted spawning period, and high fecundity.

Reintroductions are most needed in areas where natural recolonization is precluded. In the Santa Ana River, reintroduction of Santa Ana suckers into currently unoccupied areas has been considered as a potential conservation mechanism for many years (for example, OCWD 2009, entire). Planning for reintroductions, if and where necessary, should incorporate the best scientific information (such as demographic, genetic, and habitat data), should address all applicable laws and policies, and should include full coordination with the appropriate partners and stakeholders.

Increasing the amount of occupied habitat through active management of habitat and populations, as called for above, will maintain or improve the representation, resiliency, and redundancy of the Santa Ana sucker in each of the watersheds. This will also help to reduce the relative magnitude of many of the other threats facing the species. Larger, more connected populations within watersheds will be less vulnerable to (1) stochastic events, even if they become more pronounced through the effects of global climate change, because larger populations offer increased resilience and more populations provide redundancy; (2) low fitness, because large, connected populations are more likely to have high levels of genetic representation and redundancy; and (3) predation by nonnative species, because greater amounts of connected, high-quality habitat will allow Santa Ana suckers to avoid and evade predators. In all, we expect increasing the amount and extent of occupied habitat with the two-prong approach mentioned above will eliminate or reduce the threats facing the Santa Ana sucker and allow populations in each of the three watersheds to increase, thereby bringing this threatened species to a point at which the measures provided by the Act are no longer necessary.

To ensure that these management actions will be effective, studies are needed that will lead to a thorough understanding of the factors that contribute to improving the quality of Santa Ana sucker habitat, including (1) the current and future ramifications of past and ongoing hydrological modifications throughout the range of the species; (2) the effectiveness of controlling invasive, nonnative species (predators and plants); (3) the effectiveness of actions taken to minimize impacts from recreational pressures[4]; and (4) the tolerance of Santa Ana suckers to water quality variables and levels of contaminants. We note and emphasize that aspects of these factors are often interrelated or interdependent. We have separated them to help explicitly address particular threats, but study designs, and subsequent management strategies, may need to address some of these aspects in combination. Furthermore, the management actions will need to incorporate adaptive management techniques to address uncertainties, especially those associated with global climate change. And lastly, stakeholders and partners will be critical to this process because we will not be able to implement the actions called for in this plan without their cooperation and participation.

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[4] We recognize that water-based recreation in rivers and streams, such as dam-building, swimming, exploration, and fishing, is an important way for people to connect with and enjoy the outdoors and nature. And we also recognize that some land managers, many of which are stakeholders with respect to Santa Ana sucker recovery, have an interest or obligation to provide opportunities for recreation. However, not all recreational activities are entirely compatible with management for the Santa Ana sucker.

1. *Recovery Units*

The establishment of Recovery Units (RU) is an effective tool for species that are divisible into geographically or otherwise identifiable units that are essential to the recovery of the species. Recovery Units are areas that are individually necessary for long-term sustainability of the species and serve to facilitate species recovery. Recovery goals, and criteria to reach those goals, are set for each RU and when accomplished should be considered as indicators that the species could be delisted. Recovery actions will be prioritized differently between recovery units depending on the magnitude and intensity of threats.

We have identified three RUs for the Santa Ana sucker, corresponding to the three watersheds in which the species occurs: (1) the Santa Ana River Watershed RU (Figure II-1 and Figure II-2), (2) the San Gabriel River Watershed RU (Figure II-3), and (3) the Los Angeles River Watershed RU (Figure II-4). To have sufficient levels of resiliency, redundancy, and representation for recovery, the Santa Ana sucker must comprise healthy, viable populations within each of the three RUs. Further, we identify below several reaches of the mainstem and its associated tributaries that lack connectivity due to barriers to fish passage where RU-specific recovery actions are being considered.

<u>Santa Ana River Watershed Recovery Unit (SARW-RU)</u>

The SARW-RU includes the Santa Ana River and its tributaries. Areas being considered for possible reintroduction include, but are not necessarily limited to, those that are marked with an asterisk (*) and may potentially also include unnamed drains and side channels.

SARW-RU Reaches:

- <u>La Cadena Reach</u>: Santa Ana River above South La Cadena Drive and its connecting tributaries* (for example, Santa Ana River above Seven Oaks Dam*, Mill Creek*, Lytle Creek*, Cajon Wash*, City Creek*, Plunge Creek*, Warm Creek*, Mountain Home Creek*, Bear Creek*, Hemlock Creek*) (Figure II-1).
- <u>Prado Reach</u>: Santa Ana River between Prado Dam and the drop-structure at South La Cadena Drive and its connecting tributaries (for example, Sunnyslope Creek, Tequesquite Arroyo, Hole Creek, Anza Drain, Rialto Channel, Temescal Creek*, Chino Creek*, San Antonio Creek*, Cucamonga Creek*, Day Creek*, and other potential restorable tributaries) (Figure II-2).
- <u>Imperial Reach</u>: Santa Ana River from California State Route 90 to Prado Dam and its connecting tributaries (for example, Aliso Creek*, Santiago Creek*[5]). (Figure II-2).

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[5] Santiago Creek, which was recommended for consideration by one of the peer reviewers (Swift *in litt.* 2015), enters the Santa Ana River downstream from State Route 90 and is not mapped.

San Gabriel River Watershed Recovery Unit (SGRW-RU)

The SGRW-RU includes the East, North, and West Forks of the San Gabriel River, Bear Creek, Cattle Canyon Creek, San Dimas Wash, and other tributaries. Areas being considered for possible reintroduction include, but are not necessarily limited to, those that are marked with an asterisk (*) and may potentially also include unnamed drains and side channels.

SGRW-RU Reaches:

- Cogswell Reach: West Fork of the San Gabriel River above Cogswell Dam* (Figure II-3).
- San Gabriel Reach: The San Gabriel River, north of San Gabriel Dam, from Cogswell Dam to the easternmost section of Cattle Canyon Creek. This reach includes the East (including area above the "Bridge to Nowhere"*), North, and West Forks of San Gabriel River and its connecting tributaries (for example, Bear Creek, Big Mermaids Creek, Cattle Canyon Creek) (Figure II-3).
- Whittier Reach: San Gabriel River from above Whittier Narrows Dam to Morris Dam and its connecting tributaries (for example, San Dimas Wash, Fish Creek*, Dalton Creek*, Santa Anita Creek*, Monrovia Creek*) (Figure II-3).

Los Angeles River Watershed Recovery Unit (LARW-RU)

The LARW-RU includes Big Tujunga Creek, Little Tujunga Creek, Haines Creek, and other tributaries. Areas being considered for possible reintroduction include, but are not necessarily limited to, those that are marked with an asterisk (*) and may potentially also include unnamed drains and side channels.

LARW-RU Reaches:

- Big Tujunga Reach: Big Tujunga Creek above Big Tujunga Dam and its connecting tributaries (for example, Fall Creek*, Mill Creek*) (Figure II-4).
- Hansen Reach: Big Tujunga Creek between Big Tujunga Dam and Hansen Dam and its connecting tributaries (for example, Little Tujunga Creek, Haines Creek, Gold Creek, Delta Canyon Creek, Stone Canyon Creek, Vogel Canyon Creek, Clear Creek) (Figure II-4).
- Los Angeles Reach: Los Angeles River down to the Los Angeles/Arroyo Seco confluence and its connecting tributaries (for example, Arroyo Seco Creek*, Pacoima Wash*, Bell Creek*) (Figure II-4).

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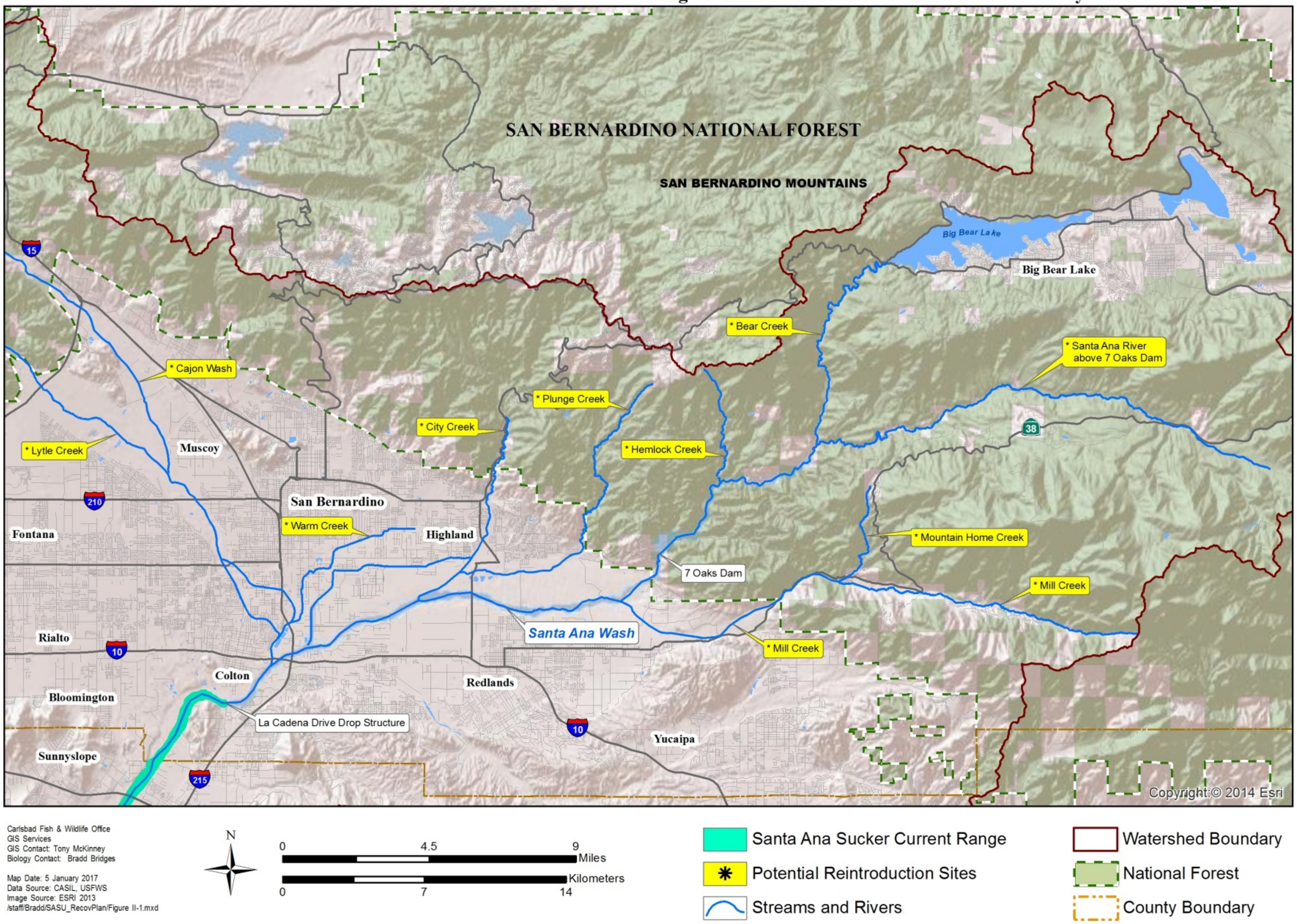
Santa Ana Sucker Recovery Plan
Figure II-1. Santa Ana River Watershed Recovery Unit: La Cadena Reach



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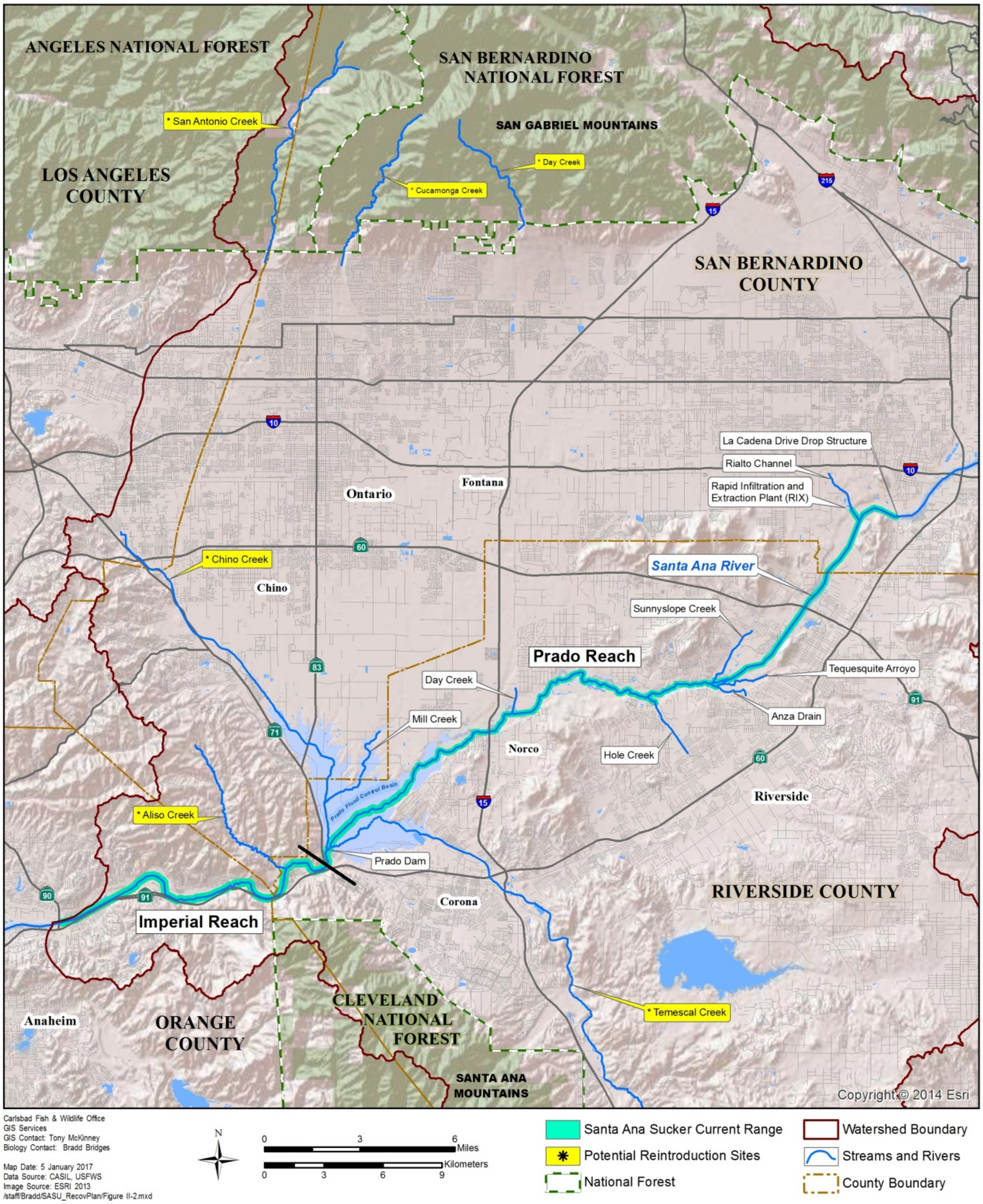
Santa Ana Sucker Recovery Plan

Figure II-2. Santa Ana River Watershed Recovery Unit: Imperial and Prado Reaches



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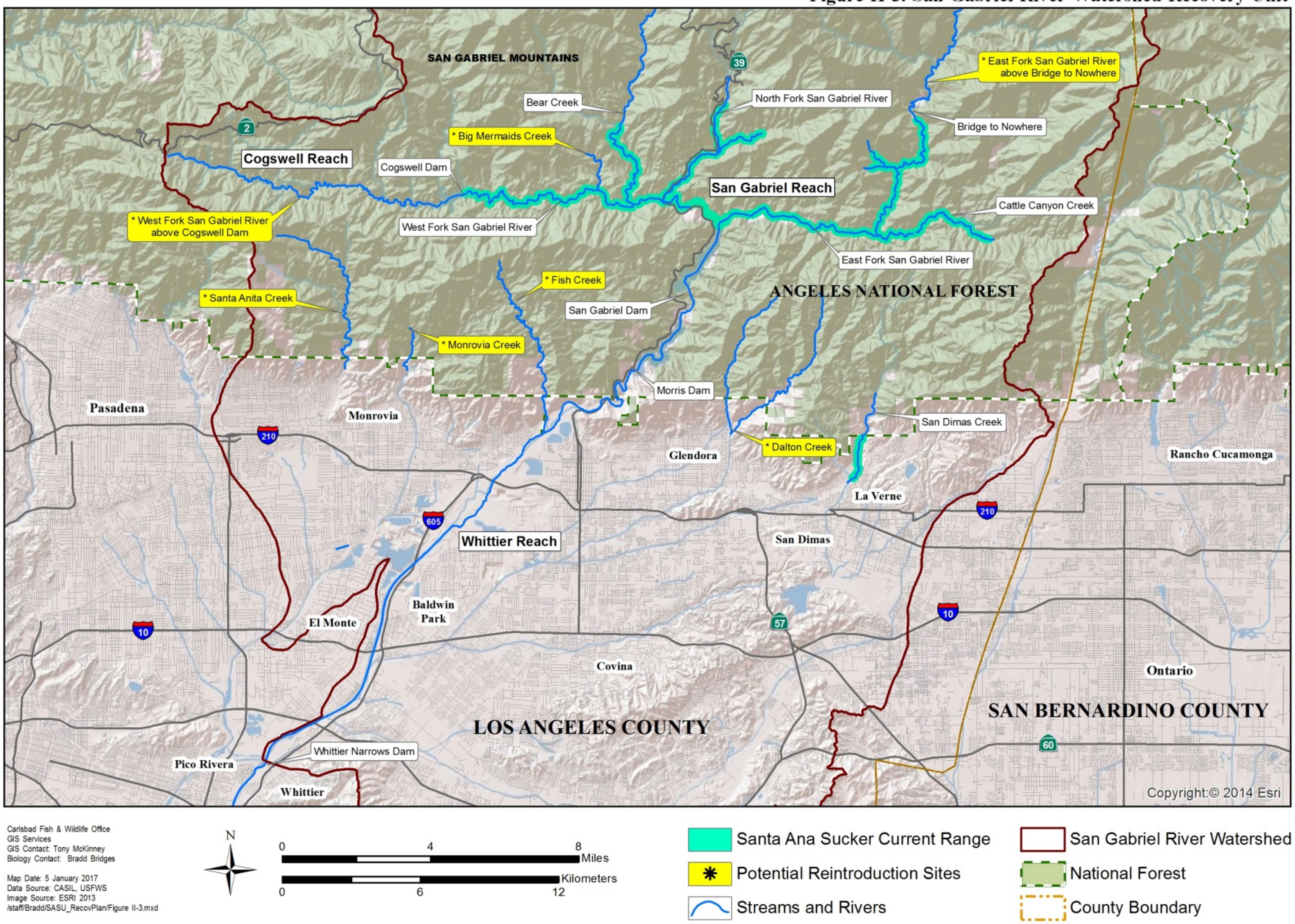
Santa Ana Sucker Recovery Plan
Figure II-3. San Gabriel River Watershed Recovery Unit



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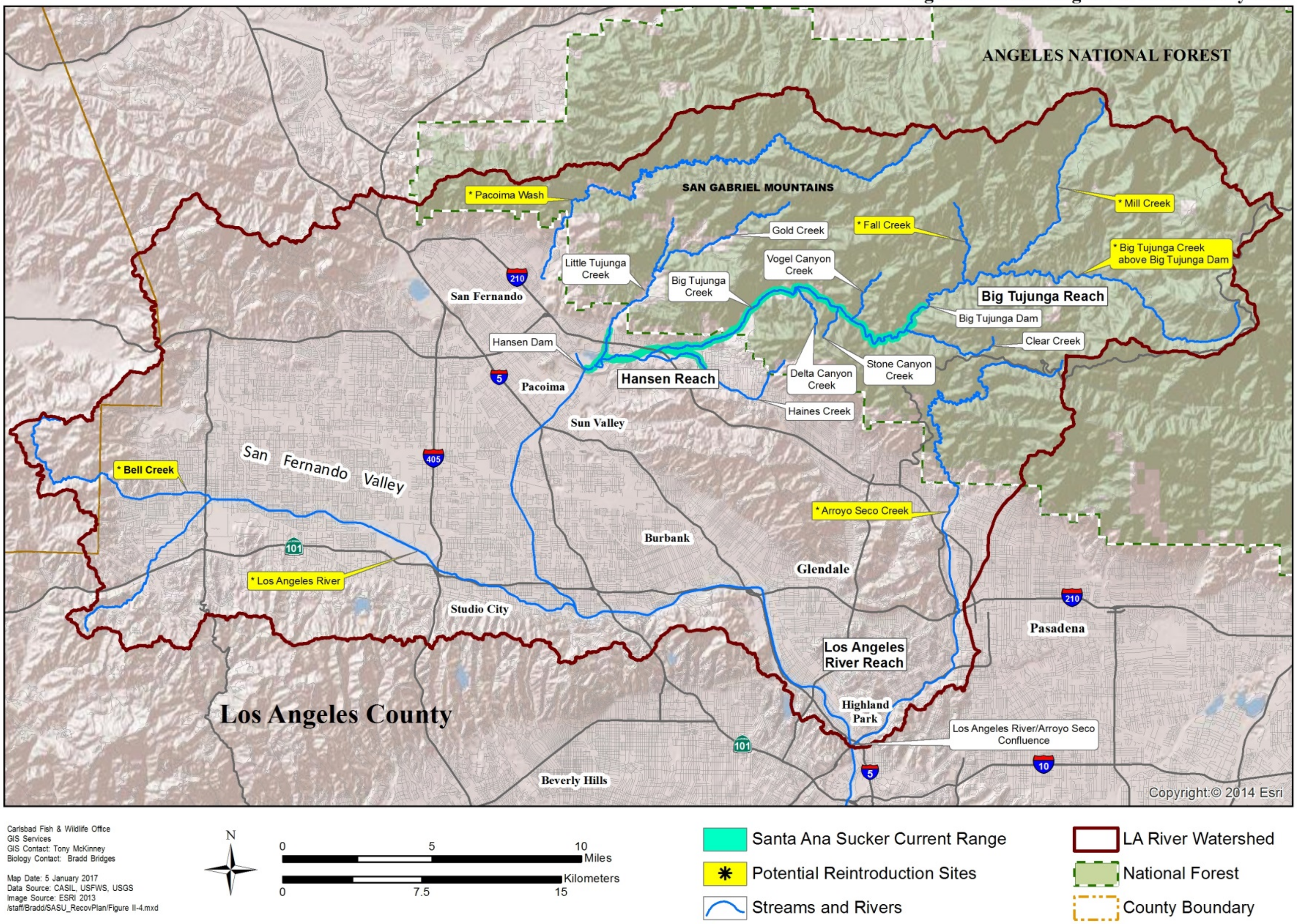
Santa Ana Sucker Recovery Plan
Figure II-4. Los Angeles River Recovery Unit



2. Recovery Goal

The goal of this recovery plan is to provide a program for the conservation and survival of the Santa Ana sucker by eliminating, controlling, or otherwise reducing threats to the listed entity such that it is again a secure, self-sustaining member of its ecosystem and the protections afforded by the Act are no longer required, thereby allowing the species to be delisted on the basis of recovery.

3. Recovery Objectives

We have identified four recovery objectives based on the recovery strategy and current threats to the species.

Work with landowners and other stakeholders to accomplish the following:

1. Develop and implement a rangewide monitoring protocol to accurately and consistently document (a) populations (quantitatively and qualitatively), (b) occupied habitat, and (c) threats.
2. Conduct research projects specifically designed to inform management actions and Santa Ana sucker recovery.
3. Increase the abundance and develop a more even distribution of Santa Ana suckers within its current range by reducing threats to the species and its habitat.
4. Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.

4. Recovery Criteria

An *endangered species* is defined in the Act as a species that is in danger of extinction throughout all or a significant portion of its range. A *threatened species* is one that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. When we evaluate whether or not a species warrants downlisting (reclassifying an endangered species to a threatened species) or delisting due to recovery, we consider whether the species meets either of these definitions. A recovered species is one that no longer meets the Act's definitions of a threatened species or an endangered species due to amelioration of threats. Determining whether a species should be downlisted or delisted requires consideration of the same five categories of threats which were considered when the species was listed and which are specified in section 4(a)(1) of the Act. Downlisting or delisting actions are performed through a separate rule-making process, which includes an opportunity for public review and comment.

Recovery criteria are objective, measurable conditions that, when met, indicate that a species may warrant downlisting or delisting. Thus, recovery criteria are mileposts that measure progress toward recovery. Because the appropriateness of delisting is assessed by evaluating the five categories of threats identified in the Act, the recovery criteria below pertain to and are organized by these categories. These recovery criteria are our best assessment at this time of what needs to be completed so that the species may be removed from the list entirely. Because we cannot envision the exact course that recovery may take and because our understanding of the vulnerability of a species to threats is very likely to change as more is learned about the species and its threats, it is possible that a status review may indicate that delisting is warranted before all recovery criteria are met. Conversely, it is possible that the recovery criteria could be met and a status review may indicate that delisting is not warranted; for example, a new threat may emerge that is not addressed by the recovery criteria below.

The Santa Ana sucker is classified as a threatened species at this time; thus, the criteria in this plan will only address delisting.

Delisting Criteria

Recovery occurs when threats outlined in Section I(F) (**Reasons for Listing and Current Threats)** have been sufficiently ameliorated such that the best scientific and commercial data available indicate that the species is no longer an endangered species or a threatened species. We believe that the plan's recovery objectives will be met by implementing the recovery criteria presented below and that this, in turn, will indicate that the identified threats have been addressed. Unless stated explicitly, the plan's recovery criteria are applicable to each and every recovery unit. We will consider delisting the Santa Ana sucker when the following conditions have been met in all of the recovery units (Santa Ana River, San Gabriel River, and Los Angeles River RUs):

Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

A.1 Adequate amounts of high-quality Santa Ana sucker habitat are restored, protected, and managed in perpetuity, thereby expanding the range of the species (within its historical range) and improving its distribution (including increased within-RU connectivity), such that the population of each RU is viable.[6]

Factor B: Overutilization for commercial, recreational, scientific, or educational purposes

No substantial threats have been identified under this Factor; therefore, no delisting criteria are included under this topic.

[6] For the purposes of this recovery plan, a population is *viable* if it has the ability to be self-sustaining in the wild over time. A population viability analysis (PVA) would help to inform a determination of a given population's viability. Good quality data are needed to populate the PVA model; poor data may yield spurious results (for example, see Boyce 1992, entire; Beissinger and Westphal 1998, entire; Morris *et al.* 2002, entire). As of the preparation of this recovery plan, a PVA has not completed for the Santa Ana sucker. In the absence of a PVA, population of Santa Ana suckers that is self-sustaining through time and that consists of all life stages is likely to be viable. In such a scenario, stable (or increasing) populations displaying good demographic structure over time will have a survival rate that is equal to or greater than the death rate.

Factor C: Predation[7]

C.1 Management is developed and implemented to reduce predation by nonnative species to levels determined to be necessary for the maintenance of viable Santa Ana sucker populations.

Factor D: the inadequacy of existing regulatory mechanisms

No substantial threats have been identified under this Factor; therefore, no delisting criteria are included under this topic.

Factor E: Other natural or manmade factors affecting its continued existence

E.1 The population of each RU is expanded through modification or removal of existing barriers, restoration of suitable habitat, and/or reintroduction of the species to areas within its historical range in a configuration that ensures, with reasonable certainty that (a) the genetic makeup of the species has been adequately preserved, and (b) the population within each RU can withstand catastrophic and environmental stochastic events.

E.2. Adequate movement of individual Santa Ana suckers is maintained between occupied areas of each RU, through natural processes or management, to ensure population viability and genetic exchange.

E.3 The Santa Ana sucker populations in each RU are stable or increasing (a) averaged over 15 years[8] or for a period of time determined to be appropriate by sufficiently robust population viability analysis (PVA), and (b) with occupancy in each of the following areas or as determined to be appropriate by a sufficiently robust PVA:[9]

<u>Santa Ana River Watershed RU</u>

- Santa Ana River mainstem (Prado Reach and Imperial Reach);
- Four tributaries in the Prado Reach and/or Imperial Reach (potentially including but not limited to, Tequesquite Arroyo, Anza Drain, Hole Creek, Evans Drain, Sunnyslope Creek, Day Creek, Aliso Creek, Santiago Creek); and

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[7] Disease was not identified as a substantial threat; therefore, no delisting criteria are included under this topic.

[8] This time-frame is expected to capture at least one period of drought, especially given that drought frequencies have been increasing (Meko *et al.* 1980, entire; Diffenbaugh *et al.* 2015, entire).

[9] We anticipate criterion E.3(b) would be achieved, in part, through the completion of actions associated with criterion A.1, which calls for restoring and repopulating habitat areas. Thus, meeting criterion E.3(b) represents, at a minimum, the maintenance of populations occurring in a net increase in the species' current range and also a more geographically continuous distribution of individual Santa Ana suckers within that range.

- Three tributaries in the La Cadena Reach (potentially including but not limited to, City Creek, Lytle Creek, Cajon Wash, Hemlock Creek, Plunge Creek, Santa Ana River above Seven Oaks Dam).

<u>San Gabriel River Watershed RU</u>

- The East, West, and North Forks of San Gabriel River in the San Gabriel Reach;
- Three tributaries in the San Gabriel Reach (potentially including but not limited to, Bear Creek, Big Mermaids Creek, Cattle Canyon Creek); and
- The Cogswell Reach, the East Fork above the "Bridge to Nowhere", or one tributary in the Whittier Reach (potentially including but not limited to, San Dimas Wash, Fish Canyon Creek).

<u>Los Angeles River Watershed RU</u>

- Big Tujunga Creek in the Hansen Reach;
- Two tributaries in the Hansen Reach (potentially including but not limited to, Haines Creek, Little Tujunga Creek); and
- One tributary in either the Big Tujunga Reach or Los Angeles Reach (potentially including but not limited to, Fall Creek, Mill Creek, Arroyo Seco Creek, Bell Creek).

E.4 Long-term monitoring and management plans, each covering an appropriate geographical scale (such as for each RU or Reaches, or by jurisdiction or land-manager), have been developed throughout the range of the species and are all being sufficiently implemented. The plans should include management to ameliorate identified threats and monitoring to determine effectiveness of the management, identify new threats, and to inform potential changes to future management and monitoring. The monitoring methodology should be designed in coordination with ongoing monitoring and management efforts and with post-delisting monitoring requirements in mind.

III. RECOVERY ACTION NARRATIVE AND IMPLEMENTATION SCHEDULE

The actions identified below are those that, in our opinion, are necessary to bring about the recovery of Santa Ana sucker and ensure its long-term conservation. However, these actions are subject to modification as dictated by new findings, changes in species status, and the completion of other recovery actions. We anticipate this recovery plan will be evaluated periodically to determine if the objectives are being achieved, and will be updated as necessary to incorporate new information.

Each action has been assigned a priority according to our determination of what is most important for the recovery of these species based on the life history, ecology, and threats (see Section I, the **Background** section, of this document). We use the following definitions to assign priority:

Priority 1: An action that is taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2: An action that is taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3: All other actions necessary to provide for full recovery of the species.

The numeric recovery priority system follows that of all Service recovery plans. Priority 1 actions are needed to prevent extinction or stabilize and secure populations or ecological functions undergoing irreversible degradation. Because of how the terms *endangered species* and *threatened species* are defined by the Act, there will likely be few Priority 1 recovery actions that address a threatened species. Priority 2 actions are needed to prevent the significant decline of the species or a reduction of habitat quality or quantity. Priority 3 actions include other actions necessary for the full recovery of the species. Assigning priorities does not imply that some recovery actions are of low importance; instead, it implies that those actions may be deferred while higher priority recovery actions are being implemented. Moreover, because situations change over time, priority numbers must be considered in the context of current conditions and in light of past and potential future actions at all sites. Therefore, the assigned priority numbers are intended to guide, not to constrain, the allocation of limited conservation resources.

Priorities for each action will vary among recovery units, depending on the magnitude and scope of the threats and the concomitant risk of species extirpation (local extinction) in a given watershed. For example, the threats to Santa Ana suckers within the SARW-RU and LARW-RU are greater than in the SGRW-RU because of the extent of habitat modified by altered hydrology and development. In contrast, the hydrology in a large portion of the SGRW-RU remains largely unaltered (East and North Forks and associated tributaries).

The timing and order in which actions are implemented may also be affected by the availability of funding, landowner permission, and the extent of information required to formulate an appropriate management action to address the threat. Some threats may require specific research in order to inform management actions (for example, the timing and extent of flows needed to maintain suitable habitat conditions), while others can be addressed based on the current information available (for example, control of unauthorized OHV activity in occupied habitat). Additionally, some recovery actions will require coordination with the landowners and other stakeholders, which vary by action and watershed. Therefore, separate implementation tables are provided for each watershed to identify priority actions necessary for recovery. The **Recovery Action Narrative** provides details of the actions necessary to achieve Santa Ana sucker recovery. The priorities within each Recovery Unit are specified below.

Although we have identified these actions as necessary to recover the species, recovery plans are guidance and planning documents only. Identification of an action to be implemented by a Responsible Party[10] is not intended to limit involvement by other parties or to require the involvement of the party identified. Being listed as Responsible Party does not create a legal obligation beyond existing legal requirements. We anticipate that implementing most if not all of the identified actions will require coordination and collaboration with appropriate partners and stakeholders. While we explicitly emphasize the anticipated collaboration in several of the actions listed below, we expect that all of these actions are collaborative in nature, even if a given action does not explicitly state that it is collaborative. Collaboration is needed not only to plan and implement site-specific actions, but to help inform future actions both within and, where appropriate, across the watersheds. Collaboration among parties will also maximize opportunities for complementary uses of resources.

The Service has existing mechanisms, such as Safe Harbor Agreements and Habitat Conservation Plans, to assist land-owners or land-managers whose actions contribute to the recovery of the Santa Ana sucker and other listed species. We encourage stakeholders to contact us to discuss the available options.

A. Recovery Action Narrative

1. *Develop and implement a rangewide monitoring protocol to accurately and consistently document (a) populations (quantitatively and qualitatively), (b) occupied habitat, and (c) threats.*

   A standard protocol for monitoring Santa Ana sucker is needed to evaluate the efficacy of Recovery Actions and progress towards meeting Recovery Criteria. It will also allow for comparison of the relative status of the species within and between watersheds and would help in the development of a PVA.

   1.1. Develop a rangewide monitoring protocol, including a frequency schedule for each action (for example, every year, every 5 years). The protocol should include but need not be limited to the following components (**Priority 2**):

   - Metrics related to the status of the Santa Ana sucker population (for example, abundance, age structure, population-level genetics, and distribution).

[10] Public or private parties who may voluntarily participate in any aspect of implementation of a recovery action.

- Metrics related to the suitability of habitat for each life stage (for example, water quality, water quantity, substrate, and food sources).
- Metrics related to the status of threats (for example, barriers to dispersal, predators, nonnative vegetation, and OHV use).
- Standardized data gathering and storage.

1.2. Conduct rangewide monitoring per the protocol developed in Recovery Action 1.1 (**Priority 2**).

1.3. Regularly (such as every 5 years) review and update the monitoring protocol to reflect new information as it becomes available. For example, research that leads to a better understanding of life history strategies, such as patterns of migration, growth, reproduction, and recruitment, may result in changes to metrics used to define suitable habitat for each life stage. (**Priority 3**)

2. *Conduct research projects specifically designed to inform management actions and Santa Ana sucker recovery.*

There are numerous gaps in our understanding of Santa Ana sucker biology and ecology. Additional information will help us make informed management decisions, including in the planning and implementation of recovery actions 3 and 4 (below) and would help in the development of a PVA. In coordination with partners and stakeholders, conduct research needed to identify optimum habitat conditions and to identify how to best minimize impacts caused by reduced water quality, altered hydrology, nonnative species, and small population size.

2.1. **Water Quality**—Determine the water quality variables that contribute to Santa Ana sucker habitat and the ranges of those variables such that high-quality habitat is maintained. Determine the tolerances of the Santa Ana sucker to variations in water quality variables, including contaminants. Variables may include but are not limited to water temperature, thermal fluctuations, dissolved oxygen, turbidity, nitrates and nitrites, total dissolved solids, perchlorate, chlorine, sulfides, ammonia, various metals, organic wastewater compounds, and endocrine disrupting compounds.

2.1.1. Evaluate sensitivity to environmental conditions in the Santa Ana River RU (**Priority 2**).

2.1.2. Evaluate sensitivity to environmental conditions in the San Gabriel River RU **(Priority 3).**

2.1.3. Evaluate sensitivity to environmental conditions in the Los Angeles River RU **(Priority 2).**

2.2. **Hydrology**—In areas with modified hydrology, determine hydrological processes necessary to maintain high-quality Santa Ana sucker habitat for breeding, feeding, and sheltering. Research should also focus on the timing and magnitude of flows that will maintain the complex diversity of habitat variables necessary to support each life stage (for example, sufficient sediment with appropriate grain size for spawning, pools, riffles, shallow stream margins, undercut banks, emergent aquatic vegetation, and riparian vegetation). In coordination with partners and stakeholders, the historical flow regime should be evaluated to determine the hydrological conditions that led to the creation of suitable habitat for the species and should be restored to the extent possible.

- 2.2.1. Evaluate hydrological processes in the Santa Ana River RU (**Priority 1**).
- 2.2.2. Evaluate hydrological processes in the San Gabriel River RU (for example West Fork) (**Priority 3**).
- 2.2.3. Evaluate hydrological processes in the Los Angeles River RU (**Priority 1**).

2.3. **Sediment Transport**—In areas with modified hydrology, evaluate sediment sources and transport to determine if sufficient sediment is available to maintain appropriate gradient and substrate composition for the species.

- 2.3.1. Evaluate sediment transport in the Santa Ana River RU (**Priority 1**).
- 2.3.2. Evaluate sediment transport in the San Gabriel River RU (**Priority 3**).
- 2.3.3. Evaluate sediment transport in the Los Angeles River RU (**Priority 3**).

2.4. **Habitat**—Determine the habitat conditions (for example, gradient, water quality, water velocity, and substrate) that are conducive to supporting breeding and feeding for the Santa Ana sucker rangewide.

- 2.4.1. Determine optimal habitat conditions for spawning rangewide. Research should focus on how Santa Ana sucker reproduction is affected by gradient, substrate composition, water velocity, water quality, and any other relevant aspect of its habitat. This may include studies related to spawning cues, spawning behavior, egg adhesion, and egg viability, and should be conducted over a range of environmental conditions (**Priority 2**).
- 2.4.2. Determine optimal habitat conditions for feeding rangewide. Research should include identification of food resources and habitat conditions necessary to sustain food resources (for example, water flow, water quality, and substrate) and feeding. Research should address food resources necessary to sustain all life stages (**Priority 2**).

2.5. **Nonnative Species**—Determine how and to what extent habitat quality can be improved through reduction of nonnative aquatic species and nonnative riparian vegetation.

- 2.5.1. Identify management actions that will ameliorate potential impacts of nonnative predators on Santa Ana sucker, including but not limited to direct control of predatory species and management of habitat conditions to reduce the suitability for predatory species. Identify which life stages and under what circumstances Santa Ana suckers are most susceptible to predation (for example monitor stomach contents of predators).

2.5.1.1. Identify actions to ameliorate impacts of predation in the Santa Ana River RU (**Priority 2**).

2.5.1.2. Identify actions to ameliorate impacts of predation in the San Gabriel River RU (**Priority 3**).

2.5.1.3. Identify actions to ameliorate impacts of predation in the Los Angeles River RU (**Priority 2**).

2.5.2. Determine whether and to what extent habitat quality for Santa Ana sucker can be improved through the management (removal or control) of nonnative riparian vegetation (**Priority 3**).

2.5.3. Investigate the extent of impacts of invasive red alga (*Compsopogon caeruleus*) to Sana Ana sucker habitat within the Santa Ana River Recovery Unit. If impacts are found to be significant, investigate management actions to remove or treat this nonnative species to reduce impacts to the Santa Ana sucker (**Priority 1**).

2.6. **Captive Propagation**—Captive propagation may be necessary to assist in the recovery of the species in any of the recovery units in the future as a result of limited extent of suitable spawning habitat or reduced population level. However, based on current conditions, actions have been identified for the Santa Ana River Recovery Unit.

2.6.1. Use data available from monitoring activities and studies of Santa Ana sucker genetics, demography, life history, and ecology to determine if captive propagation is needed to reestablish occurrences or a refuge population (**Priority 1**).

2.6.2. Determine the methodology necessary for captive propagation of Santa Ana suckers and rearing of all life stages (**Priority 2**).

2.6.3. If captive propagation is needed, assemble the necessary information to comply with the Fish and Wildlife Service's captive propagation policy, including development of a captive propagation plan that includes the following information (**Priority 2**):

- Locations of facilities.
- Number and origin of fish required for propagation.
- Methodology used for care and propagation.
- Number of reproductive crosses needed.
- Target number of fish to be produced.
- Disposition of all fish produced.

2.7. **Population Viability Analysis**—Use data from monitoring and research to develop a robust PVA for the Santa Ana sucker in each RU, which would help inform the implementation of other recovery actions and the assessment of recovery criteria.

2.7.1. Develop a PVA for the Santa Ana River RU (**Priority 3**).

2.7.2. Develop a PVA for the San Gabriel River RU (**Priority 3**).

2.7.3. Develop a PVA for the Los Angeles River RU (**Priority 3**).

3. *Increase the abundance and develop a more even distribution of Santa Ana sucker within its current range by reducing threats to the species and its habitat.*

   Work with partners to plan and implement management for the Santa Ana sucker in each Recovery Unit. Management should include the implementation of Recovery Actions aimed at reducing threats to the Santa Ana sucker and its habitat. The abundance and distribution of Santa Ana suckers have been reduced in all watersheds as a result of modification (including fish-passage barriers) or destruction of suitable habitat. Protection, restoration, and management of habitat within the current range of the species are critical to maintaining a stable population within each watershed. Many of the actions listed below will help to address multiple threats.

   3.1. **Ameliorate Hydrological Modifications**—In coordination with partners and stakeholders, ameliorate the effects of hydrological modifications (such as those resulting from flood control operations, water conservation (storage) activities, and wastewater inputs) and associated changes in sediment transport that are affecting the Santa Ana sucker and its habitat. Secure sufficient water flows and sources of sediment to maintain habitat for all life stages of the Santa Ana sucker using the results of research and monitoring (for example, hydrology, sediment transport, and life history studies). Natural hydrological functions should be maintained, augmented, or mimicked to the extent possible, and habitat should be managed to simulate natural processes as necessary to maintain suitable habitat for the species, especially in areas with regulated discharge.

   3.1.1. Using information from research and monitoring and in coordination with partners and stakeholders, prepare and implement RU-specific management plans to conserve and restore Santa Ana sucker habitat. The management plans should include but are not limited to the following:

   - Restore natural water flows (or flows that mimic the natural hydrologic regime) sufficient to maintain habitat for Santa Ana sucker.
   - Provide supplemental water to restore or create Santa Ana sucker habitat using appropriate sources, which could potentially include potable water supplies. How and where these activities will occur will be determined in coordination with appropriate partners and stakeholders, and with due consideration of applicable policies and laws.
   - Work with partners and stakeholders to improve habitat conditions through modification of water-related operations. Changes in operations (such as amount and timing of releases) may contribute to restoration of a more natural system of water flow and sediment transport, which would improve habitat quality for the Santa Ana sucker.
   - Manage sediment supply and distribution (for example, use sluice gates or other mechanisms to allow sediment transport through detention facilities) to sustain and improve Santa Ana sucker habitat.
   - Restore natural gradient in streams where flood control structures have altered the natural gradient.
   - Manage vegetation and channel configuration to emulate conditions caused by flood-related disturbances.

3.1.1.1. Prepare and implement management plan to address hydrological modifications in the Santa Ana River RU **(Priority 1).**

3.1.1.2. Prepare and implement management plan to address hydrological modifications in the San Gabriel River RU **(Priority 3).**

3.1.1.3. Prepare and implement management plan to address hydrological modifications operations in the Los Angeles River RU **(Priority 2).**

3.1.2. Reduce impacts of maintenance activities associated with flood control and related infrastructure. Work with our partners to determine if operation or design of flood control facilities could be altered to reduce the frequency of disturbance to the Santa Ana sucker and its habitat.

- Evaluate and change flood control facility maintenance practices to reduce the frequency of disturbance required.
- Redesign levees/embankments to eliminate the need for frequent repairs associated with storm flows.
- Enlarge, redesign, or replace culverts to efficiently convey sediment transport and minimize clogging (and also accommodate two-way fish passage, see Recovery Action 3.2).

3.1.2.1. Reduce impacts associated with flood control maintenance in the Santa Ana River RU **(Priority 2).**

3.1.2.2. Reduce impacts associated with flood control maintenance in the San Gabriel River RU **(Priority 3).**

3.1.2.3. Reduce impacts associated with flood control maintenance in the Los Angeles River RU **(Priority 3).**

3.2. **Ameliorate Fish-passage Barriers**—In coordination with partners and stakeholders, improve up-stream and down-stream movement of Santa Ana suckers by removing or modifying existing fish-passage barriers and preventing the creation of future barriers. Determine which barriers to remove or modify to improve connectivity and reduce impacts to fish dispersal and sediment transport. Implement removal or modification of identified barriers. Potential barriers include the following:

- **Recreational Dams.** Identify and remove recreational dams that are barriers to dispersal or otherwise impact Santa Ana sucker, post signs prohibiting the construction of recreational dams, create educational brochures for distribution on public lands, and work with land managers to allow for recreational opportunities at more compatible sites.
- **Road Crossings.** Create low-flow channels or fish ladders within cement aprons under bridge crossings. Install bridges or culverts of a size and configuration that will allow fish passage over a wide range of flow levels.
- **Tributary Connections.** Reestablish connectivity between a watershed's maintstem and its tributaries by, for example, removing cement barriers or cement lining in channels (such as in Day Creek and Evans Drain) to increase the amount of Santa Ana sucker habitat and refuge areas for adults and juveniles. Restore tributary flow rates sufficient to keep the low flow channel clear of vegetation and suitable for Santa Ana sucker.

- **Dewatered Floodplains.** Acquire (if necessary) and restore riverine processes to manmade uplands within the floodplain, such as abandoned golf courses and other areas where artificial fill has been placed, and where artificial reductions in water flow have left the watercourse unduly dry.

3.2.1. Address specific fish passage barriers in the Santa Ana River RU **(Priority 2).**

3.2.2. Address specific fish passage barriers in the San Gabriel River RU **(Priority 3).**

3.2.3. Address specific fish passage barriers in the Los Angeles River RU **(Priority 3).**

3.3. **Improve Water Quality**—In coordination with partners and stakeholders, ameliorate the threats to the Santa Ana sucker associated with reduced water quality. Based on the results of water quality studies (Recovery Action 2.1), ensure the water quality of flows altered by hydrological modification and wastewater discharges are improved, as necessary, to support high-quality habitat for the Santa Ana sucker (as defined in section I(H) of this recovery plan).

- Identify and address, where appropriate, those water quality variables that are affected by water quantity, source, and flow rates.
- Identify and implement best management practices for dams and other facilities to maintain suitable water quality.
- Integrate appropriate water quality standards for Santa Ana sucker into stakeholder monitoring programs.

3.3.1. Provide water quality suitable for the Santa Ana sucker in the Santa Ana River RU (**Priority 2**).

3.3.2. Provide water quality suitable for the Santa Ana sucker in the San Gabriel River RU (**Priority 3**).

3.3.3. Provide water quality suitable for the Santa Ana sucker in the Los Angeles River RU (**Priority 3**).

3.4. **Ameliorate Nonnative Species**—In coordination with partners and stakeholders, ameliorate predation by nonnative species to levels determined to be necessary for the maintenance of viable Santa Ana sucker populations

3.4.1. Manage nonnative predators, as necessary (based on the results of research conducted under Recovery Action 2.5.1) to reduce impacts caused by these species. Potential strategies include:

- Work with partners to alter operations of dams and other facilities to help suppress nonnative species by periodically increasing flow releases when there is an abundance of nonnative species such that there is a net benefit to the Santa Ana sucker.
- Reduce the extent of habitat available to support nonnative predators (for example, remove recreational dams and nonnative riparian vegetation where appropriate).
- Reduce the introduction of nonnative predators into habitat for Santa Ana sucker (for example, install fish screens to prevent escape of nonnative predators from ponds and artificial wetlands).

3.4.1.1. Manage predators in the Santa Ana River RU (**Priority 2**).

3.4.1.2. Manage predators in the San Gabriel River RU (**Priority 3**).

3.4.1.3. Manage predators in the Los Angeles River RU (**Priority 2**).

3.4.2. Manage nonnative vegetation, as necessary (based on the results of research conducted under Recovery Actions 2.5.2 and 2.5.3) to reduce impacts to Santa Ana sucker habitat caused by nonnative vegetation.

- Remove nonnative riparian vegetation in areas that will improve habitat conditions for Santa Ana sucker.
- Coordinate with appropriate partners and stakeholders, including those already conducting nonnative riparian vegetation removal programs, to target areas that will improve habitat conditions for Santa Ana sucker.
- Control the extent of the invasive red algae by drying, chemical treatment, managing flows, or altering water quality.

3.4.2.1. Manage nonnative vegetation in the Santa Ana River RU (**Priority 3**).

3.4.2.2. Manage nonnative vegetation in the San Gabriel River RU (**Priority 3**).

3.4.2.3. Manage nonnative vegetation in the Los Angeles River RU (**Priority 3**).

3.5. **Ameliorate Impacts from Recreational Activities**—In coordination with partners and stakeholders, ameliorate the impacts to Santa Ana sucker habitat from recreational activities (for example, OHV use, waterplay, fishing, and mining). Strategies should consider the timing, frequency, location, and magnitude of recreational activities that can be implemented in occupied habitat for the Santa Ana sucker without causing a decline in productivity within the watershed. Develop or improve existing strategies, and then implement the strategies to reduce impacts from recreation. These may include but are not limited to the following:

- Limit the number of activity permits issued and implement timing restrictions.
- Reduce the number of access points.
- Increase the number of trash facilities and the frequency of trash collection.
- Install signs informing the public of authorized activities.
- Patrol and enforce limitations on authorized activities.
- Development and implementation of educational programs.

3.5.1. Manage recreation in the Santa Ana River RU **(Priority 2).**

3.5.2. Manage recreation in the San Gabriel River RU **(Priority 2).**

3.5.3. Manage recreation in the Los Angeles River RU **(Priority 2).**

4. *Expand the current range of the Santa Ana sucker (a) by restoring Santa Ana sucker habitat for all life stages (as appropriate), and (b) by reintroducing populations (where appropriate) within the species' historical range.*

The abundance and distribution of the Santa Ana sucker, and therefore its redundancy and representation, have been reduced by modification and destruction of suitable habitat.

Reestablishment of Santa Ana suckers in areas outside of the current range of the species is needed for recovery. To reestablish populations, areas within the historical range of the species will need to be restored, protected, and managed to provide high-quality habitat for the Santa Ana sucker. Restoration and management actions will address both the physical (such as the qualitative, quantitative, and temporal aspects of surface flows, including water quality parameters) and biological (such as the potential presence of nonnative predators) requirements of habitat for Santa Ana sucker.

Expansion of the Santa Ana sucker's range can occur passively through the removal of fish-passage barriers (which would then allow natural dispersal) or actively through the intentional reintroduction of the Santa Ana sucker to appropriate areas of habitat within its historical range. This plan does not call for introducing Santa Ana suckers to areas outside of the listed species' historical range.

The amount and configuration of additional occupied habitat that will be needed for the recovery of the species will be dictated by the scope and severity of threats within each watershed coupled with the ability to manage those threats. An expanded range, including refuge populations, provides greater redundancy, which in turn provides greater overall resiliency for the species, even where threats within the current range cannot be reduced effectively or to an extent needed to maintain a stable population. We will prioritize locations for possible reintroduction based on the ability to reduce threats in the current range in a timely and effective manner. We will also assess population-level genetic data and demographic information, to the extent that it is available, from potential source populations to inform our decisions of which individuals are used for reintroductions.

The planning and implementation of projects involving range expansion of the species will involve cooperation with multiple stakeholders, including, but not limited to private landowners, local resource management agencies, and State, and Federal agencies. We also recognize that certain areas where recovery actions may potentially occur are operating under Court-adjudicated agreements and that the Court retains jurisdiction over the water rights and groundwater management of the watershed. In such areas, the Court and/or Court-appointed Watermaster[11] would be included on the list of stakeholders and that the Court's final judgment will be part of the information considered. It is our goal to conduct reintroductions in a way that includes the appropriate partners and stakeholders and is transparent to all interested parties.

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[11] The following Watermasters commented on the draft recovery plan: (*i*) Main San Gabriel Basin, (*ii*) Six Basins, and (*iii*) Upper Los Angeles River Area. Other adjudicated basins occur within the range of the Santa Ana sucker.

Range expansion will generally occur as follows:

4.1. **Assess Range-expansion Sites**—In coordination with partners and stakeholders, determine whether and where habitat within the historical range can be restored and made suitable for passive natural dispersal or active reintroduction of Santa Ana suckers. The highest priority should be given to suitable areas within the historical range that contain the known habitat requirements (described in the **Habitat Characteristic/Ecosystem** section above) or can be restored with reasonable effort to provide these characteristics.

- 4.1.1. Assess areas within the Santa Ana River RU for potential range expansion. Areas to be considered for possible reintroduction include but are not limited to the following: Aliso Creek, Santiago Creek, Temescal Creek, Chino Creek, San Antonio Creek, Cucamonga Creek, Day Creek, Hemlock Creek, Santa Ana River above Seven Oaks Dam, Mill Creek, Lytle Creek, Cajon Wash, City Creek, Plunge Creek, Warm Creek, Mountain Home Creek, Bear Creek (**Priority 1**).
- 4.1.2. Assess areas within the San Gabriel RU for potential range expansion. Areas to be considered for possible reintroduction include but are not limited to the following: upstream from Cogswell Dam, East Fork San Gabriel River above the "Bridge to Nowhere," Fish Creek, Dalton Creek, Santa Anita Creek, and Monrovia Creek (**Priority 3**).
- 4.1.3. Assess areas within the Los Angeles River RU for potential range expansion. Areas to be considered for possible reintroduction include but are not limited to the following: Fall Creek, Mill Creek and Arroyo Seco Creek, Pacoima Wash, and Bell Creek (**Priority 3**).

4.2. **Plan and Implement Range Expansion**—In coordination with partners and stakeholders, plan and implement on a site-specific basis those actions necessary to restore the habitat and to repopulate it with Santa Ana suckers, including activities needed for reintroduction. Such planning should consider input and data obtained from partners and stakeholders, data from research and monitoring activities (such as from Recovery Actions 1 and 2), and through the habitat assessments from Recovery Action 4.1. The resulting "restoration and reintroduction plan" should address one or more sites in a way that is geographically or procedurally efficient and is understandable and transparent to the reader. A restoration and reintroduction plan may, depending on the particulars, only address in detail restoration (such as where passive natural dispersal is anticipated) or reintroduction (such as where the existing habitat is of adequate quality and no restoration is needed). These plans should include at a minimum the following information to assist in evaluating how the actions may benefit the Santa Ana sucker:

- A description of existing habitat conditions (for example, water quality, hydrology, stream gradient, substrate, cover, and other habitat variables determined to be important for supporting the species).
- A description of potential threats to Santa Ana suckers (for example, altered hydrology, nonnative species, recreation, poor water quality).
- The methodology for restoration of suitable habitat (if necessary).

- Number, age class(s), and origin of donor fish (if necessary). The origin of fish should incorporate genetic data to ensure the proposed relocation does not have unintended consequences.
- Methods for transport and release of fish (if necessary).
- Timing of project implementation.
- Pre- and post-project monitoring strategy to assess effectiveness of the habitat restoration or reintroductions. Monitoring should be conducted for a sufficiently long period of time to determine if the project was successful.
- Long-term management activities required to maintain the species within the expanded range and to address ongoing threats as described in Objective 3 above. Adaptive management strategies should be incorporated as needed to address new threats as they are identified. For isolated populations, management should consider whether future introductions may be necessary to ensure minimal genetic drift, genetic bottlenecks, and other risks associated with low genetic variability.

4.2.1. Prepare and implement restoration and reintroduction plan(s) for the Santa Ana River RU (**Priority 1**).

4.2.2. Prepare and implement restoration and reintroduction plan(s) for the San Gabriel River RU (**Priority 2**).

4.2.3. Prepare and implement restoration and reintroduction plan(s) for the Los Angeles River RU (**Priority 2**).

B. Implementation Schedule

The following implementation schedule outlines actions and estimated costs for this recovery plan. This schedule prioritizes actions, provides an estimated timetable for performance of actions, indicates the responsible parties, and estimates costs of performing actions. Cost estimates are provided for the entire recovery period (estimated to be 25 years) as well as detailed for the first 5 years of the recovery period. These actions, when accomplished, should further the recovery and conservation of the listed species.

1. Key to additional terms and acronyms used in the Implementation Schedule:

Definition of action durations:

Number: The predicted duration of the action in years.

Ongoing: An action that is currently being implemented and will continue throughout the recovery period.

Continual: An action that is not currently being implemented but will be implemented continuously throughout the recovery period once begun.

Unknown: Either action duration or associated costs are not known at this time.

2. *Responsible Parties*

Responsible parties are those partnering agencies who may voluntarily participate in any aspect of implementation of particular tasks listed within this recovery plan. Responsible parties may willingly participate in project planning, provide assistance with funding or staff time, or help with any other means of implementation. The identification of responsible parties for specific tasks in the Implementation Schedule (Tables III-1 through III-4) is not intended to limit involvement by other parties or to require the involvement of the party identified. Key land managers, land owners, or other stakeholders that have been identified include (but are not necessarily limited to) the following:

- California Department of Fish and Wildlife (CDFW)
- California Regional Water Quality Control Board, Los Angeles Region (CRWQCB)
- California Regional Water Quality Control Board, Santa Ana Region (CRWQCB)
- City of Los Angeles
- City of Pasadena
- City of Pomona
- City of Rialto
- City of Riverside (Riverside)
- City of San Bernardino Municipal Water Department
- County of Los Angeles Department of Public Works (LACDPW)
- County of San Bernardino
- East Valley Water District
- Endangered Habitats League (EHL)
- Golden State Water Company (GSWC)
- Inland Empire Resource Conservation District (IERCD)
- Inland Empire Utilities Agency
- Los Angeles County Department of Parks and Recreation (LACDPR)
- Los Angeles County Sanitation Districts
- Los Angeles Department of Water and Power (LADWP)
- Main San Gabriel Basin Watermaster (MSGBW)
- Metropolitan Water District of Southern California
- Orange County Flood Control District (OCFCD)
- Orange County Water District (OCWD)
- Pomona Valley Protective Association (PVPA)
- Private landowners (Private)
- Riverside County Flood Control and Water Conservation District (RCFCWCD)
- Riverside Public Utilities
- Riverside-Corona Resource Conservation District (RCRCD)
- San Bernardino County Flood Control District (SBCFCD)
- San Bernardino Valley Municipal Water District
- San Bernardino Valley Water Conservation District
- Santa Ana Watershed Association (SAWA)
- Santa Ana Watershed Project Authority (SAWPA)
- Six Basins Watermaster (SBW)
- Southern California Coastal Water Research Project (SCCWRP)
- Southern California Edison (SCE)
- U.S. Army Corps of Engineers, Los Angeles District (USACE)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Forest Service (USFS)
- U.S. Geological Survey (USGS)
- Upper Los Angeles River Area Watermaster (ULARAW)
- West Valley Water District
- Western Municipal Water District
- Western Riverside County Regional Conservation Authority (WRCRCA)

As a result of comments received on the draft recovery plan, we have included additional stakeholders to the list of Responsible Parties. We further expect that this list will not be static through time and that additional Responsible Parties will be identified as specific recovery actions are implemented.

Table III-1: Implementation Schedule—Actions to be completed across all recovery units (Santa Ana River, San Gabriel River, and Los Angeles River Recovery Units).

Santa Ana River, San Gabriel River, and Los Angeles River Recovery Units												
Action number	**Priority**	**Description**	**Responsible Parties**	**Duration (years)**	**Fiscal Year Cost Estimates (thousands of dollars)**						**Total cost of action for recovery (thousands of dollars)**
					2017	**2018**	**2019**	**2020**	**2021**	**Total**	
1.1	2	Develop a rangewide monitoring protocol.	USFWS	1	100					100	100
1.2	2	Conduct rangewide monitoring per the protocol.	USFWS	Unknown							TBD
1.3	3	Regularly review and update the monitoring protocol to reflect new information as it becomes available.	USFWS	Continual	TBD						TBD
2.4.1	2	Determine optimal habitat conditions for spawning.	USFWS CDFW	2		100	100			200	200
2.4.2	2	Determine optimal habitat conditions for feeding.	USFWS CDFW	2		100	100			200	200
2.5.2	3	Determine if habitat conditions for Santa Ana sucker can be improved through the removal/management of nonnative riparian vegetation.	RCRCD SAWA USFS	2	50	50				100	100
										Subtotal cost	600 + TBD

Table III-2: Implementation Schedule—Santa Ana River Recovery Unit.

Santa Ana River Recovery Unit											
Action number	**Priority**	**Description**	**Responsible Parties**	**Duration (years)**	**Fiscal Year Cost Estimates (thousands of dollars)**						**Total cost of action for recovery (thousands of dollars)**
					2017	**2018**	**2019**	**2020**	**2021**	**Total**	
2.1.1	2	Evaluate sensitivity to environmental conditions in the Santa Ana River RU.	USFWS USGS CRWQCB	2	100	100				200	200
2.2.1	1	Evaluate hydrological processes in the Santa Ana River RU.	USGS USACE	2	75	75				150	150
2.3.1	1	Evaluate sediment transport in the Santa Ana River RU.	USGS USACE	1			75			75	75
2.5.1.1	2	Identify actions to ameliorate impacts of predation in the Santa Ana River RU.	OCWD USACE	2	50	50				100	100
2.5.3	1	Investigate the extent of impacts of invasive red algae (*Compsopogon caeruleus*) to Santa Ana sucker habitat within the Santa Ana River RU. Investigate management actions to remove or treat this nonnative species to reduce impacts to the sucker where it occurs.	USFWS CRWQCB USACE CDFW RCRCD	Unknown	60	60				120	120

2.6.1	1	Use data available from monitoring activities and studies of Santa Ana sucker genetics, demography, life history, and ecology to determine if captive propagation is needed to reestablish occurrences or a refuge population.	USFWS	Unknown	TBD						TBD
2.6.2	2	Determine the methodology necessary for captive propagation of Santa Ana suckers and rearing of all life stages.	RCRCD	3	75	75	75			225	225
2.6.3	2	If captive propagation is required, assemble the necessary information to comply with the captive propagation policy, including development of a captive propagation plan.	USFWS CDFW USGS	1				50		50	50
2.7.1	3	Develop a PVA for the Santa Ana River RU.	USFWS USGS SAWA	2		30	30				60
3.1.1.1	1	Prepare and implement management plan to address hydrological modifications (flood control and water conservation operations) in the Santa Ana River RU.	USACE OCFCD RCFCWCD SBCFCD SAWPA	Unknown	TBD						TBD
3.1.2.1	2	Reduce impacts associated with flood control maintenance in the Santa Ana River RU.	USACE OCFCD RCFCWCD SBCFCD	Unknown	TBD						TBD
3.2.1	2	Address specific fish passage barriers in the Santa Ana River RU.	TBD	Unknown	TBD						TBD
3.3.1	2	Provide water quality suitable for the Santa Ana sucker in the Santa Ana River RU.	RWQCB USACE	Continual	TBD						TBD

3.4.1.1	2	Manage predators in the Santa Ana River RU.	OCWD Riverside CDFW USFWS	Continual	50	25	25	25	25	150	650
3.4.2.1	3	Manage nonnative vegetation in the Santa Ana River RU.	IERCD RCRCD SAWA OCFCD OCWD USFS	Continual	50	25	25	25	25	150	650
3.5.1	2	Manage recreation in the Santa Ana River RU.	OCWD OCFCD USACE USFS Private	Continual	40	20	20	20	20	120	520
4.1.1	1	Assess areas within the Santa Ana River RU for potential range expansion.	USFWS CDFW USFS RCRCD SRMA	2	50	50				100	100
4.2.1	1	Prepare and implement restoration and reintroduction plan(s) for the Santa Ana River RU.	USFWS USACE USFS USGS	Continual	TBD						TBD
										Subtotal cost	2,900 + TBD

Table III-3: Implementation Schedule—San Gabriel River Recovery Unit.

San Gabriel River Recovery Unit											
Action number	Priority	Description	Responsible Parties	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery (thousands of dollars)
					2017	2018	2019	2020	2021	Total	
2.1.2	3	Evaluate sensitivity to environmental conditions in the San Gabriel River RU.	USFWS USGS USFS	2	100	100				200	200
2.2.2	3	Evaluate hydrological processes in the San Gabriel River RU (for example, West Fork).	USGS LACDPW USFS	2	50	50				100	100
2.3.2	3	Evaluate sediment transport in the San Gabriel River RU.	USGS LACDPW USFS	1			75			75	75
2.5.1.2	3	Identify actions to ameliorate impacts of predation in the San Gabriel River RU.	USFS LACDPW	2	50	50				100	100
2.7.2	3	Develop a PVA for the San Gabriel River RU.	USFWS USGS USFS	2	30	30					60
3.1.1.2	3	Prepare and implement management plan to address hydrological modifications (flood control and water conservation operations) in the San Gabriel River RU.	LACDPW USFS	Unknown	TBD						TBD
3.1.2.2	3	Reduce impacts associated with flood control maintenance in the San Gabriel River RU.	LACDPW USFS	Unknown	TBD						TBD

3.2.2	3	Address specific fish passage barriers in the San Gabriel River RU.	USFS Private LACDPW	Unknown	TBD						TBD
3.3.2	3	Provide water quality suitable for the Santa Ana sucker in the San Gabriel River RU.	LACDPW USFS CRWQCB	Continual	TBD						TBD
3.4.1.2	3	Manage predators in the San Gabriel River RU.	LACDPW CDFW SRMA	Unknown	TBD						TBD
3.4.2.2	3	Manage nonnative vegetation in the San Gabriel River RU.	USFS	Unknown	TBD						TBD
3.5.2	2	Manage recreation in the San Gabriel River RU.	USFS	Continual	40	20	20	20	20	120	520
4.1.2	3	Assess areas within the San Gabriel River RU for potential range expansion.	USFWS CDFW USFS SRMA	2	25	25				50	50
4.2.2	2	Prepare and implement restoration and reintroduction plan(s) for the San Gabriel River RU.	USFWS CDFW USFS	Continual	TBD						TBD
										Subtotal cost	1,105 + TBD

Table III-4: Implementation Schedule—Los Angeles River Recovery Unit.

Los Angeles River Recovery Unit											
Action number	Priority	Description	Responsible Parties	Duration (years)	Fiscal Year Cost Estimates (thousands of dollars)						Total cost of action for recovery (thousands of dollars)
					2017	2018	2019	2020	2021	Total	
2.1.3	2	Evaluate sensitivity to environmental conditions in the Los Angeles River RU.	LACDPW CRWQCB	2	100	100				200	200
2.2.3	1	Evaluate hydrological processes in the Los Angeles River RU.	USGS LACDPW USFS	2	50	50				100	100
2.3.3	3	Evaluate sediment transport in the Los Angeles River RU.	USGS LACDPW USFS	1			75			75	75
2.5.1.3	2	Identify actions to ameliorate impacts of predation in the Los Angeles River RU.	LACDPW USFS	2	50	50				100	100
2.7.1	3	Develop a PVA for the Los Angeles River RU.	USFWS USGS	2	30	30					60
3.1.1.3	2	Prepare and implement management plan to address hydrological modifications (flood control and water conservation operations) in the Los Angeles River RU.	LACDPW USFS	Unknown	TBD						TBD
3.1.2.3	3	Reduce impacts associated with flood control maintenance in the Los Angeles River RU.	LACDPW	Unknown	TBD						TBD

3.2.3	3	Address specific fish passage barriers in the Los Angeles River RU.	USFS	Unknown	TBD						TBD
3.3.3	3	Provide water quality suitable for the Santa Ana sucker in the Los Angeles River RU.	LACDPW CRWQCB USFS	Continual	TBD						TBD
3.4.1.3	2	Manage predators in the Los Angeles River RU (for example, Haines Creek).	LACDPW CDFW SRMA	Continual	50	25	25	25	25	150	650
3.4.2.3	3	Manage nonnative vegetation in the Los Angeles River RU.	LACDPW USFS	Continual	50	25	25	25	25	150	650
3.5.3	2	Manage recreation in the Los Angeles River RU.	USFS LACDPR	Continual	40	20	20	20	20	120	520
4.1.3	3	Assess areas within the Los Angeles River RU for potential range expansion.	USFWS CDFW USFS	2	50	50				100	100
4.2.3	2	Prepare and implement restoration and reintroduction plan(s) for the Los Angeles River RU.	USFS USFWS CDFW LACDPW	Continual	TBD						TBD
										Subtotal cost	2,455 + TBD
										Total cost	7,060 + TBD

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V. APPENDIX A

A. Santa Ana Suckers in the Santa Clara River

1. Background

We, the U.S. Fish and Wildlife Service (USFWS or Service), listed the Santa Ana sucker (*Catostomus santaanae*) as a threatened species on April 12, 2000 (USFWS 2000, entire), under the Endangered Species Act of 1973 (Act), as amended. At that time, we considered the range of the listed entity to include the Santa Ana River, San Gabriel River, and Los Angeles River basins (watersheds). However, Santa Ana suckers are also found in the upper Santa Clara River watershed (the portion upstream or east of the Piru Gap, which is a large dry section of the Santa Clara River that separates the headwaters of the San Gabriel Mountains and the lower portion of the river) (Swift *et al.* 1993, p. 121). There are suckers west (downstream) of the Piru Gap as well, but those fish are thought to be hybrids between the Santa Ana sucker and the Owens River sucker (*Catostomus fumeiventris*) (Bell 1978, p. 14; Buth and Crabtree 1982, p. 440; see also Hubbs *et al*. 1943, p. 47). We did not include any of the suckers in the Santa Clara River as part of the listed entity because the Santa Ana suckers at that location were thought to be introduced (Hubbs *et al.* 1943, p. 47; Miller 1968, p. 175; USFWS 2000, pp. 19687 and 19689). Later, in our final rule redesignating critical habitat for the Santa Ana sucker (USFWS 2010, p. 77963) and in our 2011 5-year review (USFWS 2011, p. 47), we recommended that a genetic analysis be conducted to clarify the origin of the Santa Ana suckers in the Santa Clara River. That analysis has now been conducted by U.S. Geological Survey (USGS) using USFWS Science Support Partnership funds. However, as of the preparation of the recovery plan, the results of that study have not been published. We did receive preliminary results from one of the draft recovery plan's peer reviewers (USGS *in litt.* 2015), and subsequently, we received a draft of the manuscript submitted for publication (Richmond *et al*. 2016b, in review). Below, we briefly summarize the information from this study relevant to the Santa Clara River population.

2. USGS's Study

Richmond *et al*. (2016b, in review) used microsatellite and mtDNA datasets to investigate the genetic distinctiveness of Santa Ana suckers throughout the species' range to help determine whether fish from the Santa Clara River population were introduced. Genetic samples were obtained from fish in the Los Angeles River, San Gabriel River, Santa Ana River, and Santa Clara River watersheds. The authors used Bayesian methods to analyze the data for evidence of recent Santa Ana sucker introductions in the Santa Clara Rivers system. To test whether the Los Angeles River, San Gabriel River, and Santa Ana River basins could have served as the source population, they developed several likely scenarios based on historical data to determine which helped to best explain the history of the Santa Clara River population.

3. USGS's Findings

<u>Introduced versus Native</u>

Results from Richmond *et al.* (2016b, in review) support substantial genetic structure within *Catostomus santaanae*. Their analysis looked at differences in allele frequency among each of the drainages and they reported strong patterns of structuring with sampling geography. Samples from the Santa Clara River were distinguishable from the Los Angeles, San Gabriel, and Santa Ana Rivers. Their results do not support recent exchange between the Santa Clara population and the other populations, which would have been expected if Santa Clara population had been introduced. Therefore, they concluded that the Santa Clara River population is distinctive from the populations in the other drainages, and the data suggests that it was not introduced 80 to 100 years ago, as previously thought.

<u>Hybridization</u>

Results from Richmond *et al.* (2016b, in review) provide genetic evidence of hybridization of Santa Ana suckers with the Owens River sucker, confirming the conclusions of previous authors (Hubbs *et al*. 1943, p. 47; Buth and Crabtree 1982, p. 441; Swift *et al.* 1993, p. 121). Richmond *et al.* (2016b, in review) also confirm that hybridization is not occurring upstream of the Piru Gap and that the upstream suckers are pure Santa Ana sucker.

4. The Listed Entity

As noted above, the Santa Ana sucker—the listed entity—includes only the Los Angeles River basin, San Gabriel River basin, and Santa Ana River basin (50 CFR 17.11). The Santa Clara River basin population is not included as part of the listed entity. The recovery plan addresses the listed entity and, thus, focuses on the Los Angeles River, San Gabriel River, and Santa Ana River watersheds. We recognize that the pure population of Santa Ana sucker in the Santa Clara River is not without value with respect to recovery. To include the Santa Clara River population as part of the listed entity, it will need to be evaluated through a future rulemaking process.

VI. Appendix B

A. Summary of Public Comments

On November 24, 2014, we published a notice in the Federal Register announcing the availability of the draft recovery plan for the Santa Ana sucker (*Catostomus santaanae*) for public review and comment. We received 33 responses total, some of which were received after the January 23, 2015, close of the comment period. We received comments from a Federal agency (in addition to the comments we received from a Federal agency as a peer reviewer, see below) and 32 other members of the public, most of which were representing local jurisdictions, special districts, and similar local entities. The only response from a State agency was one from a peer reviewer (comments from peer reviewers are addressed separately, below). We received no comments from Native American Tribes.

Additionally, responding in part to comments received, we held a public workshop on July 1, 2015 (additional information below).

We appreciate the input from all commenters. Peer-review and public comments ranged from providing minor editorial suggestions to specific recommendations on plan content. We have considered all substantive comments and, to the extent appropriate, we have incorporated the applicable information or suggested changes into the final recovery plan. Below, we provide a summary of comments received from non-peer reviewers with our responses; however, some of the comments that we incorporated as changes into the final recovery plan did not warrant an explicit response and, thus, are not presented here.

Comment: Several commenters requested that we extend the official comment period beyond the original 60 days. Some of these commenters also requested that we conduct stakeholder meetings.

Response: While we did not extend the official comment period, we did hold a public workshop on July 1, 2015. In the information we provided to the attendees, we noted that members of the public may submit information after the close of the comment period. We noted further that although this information would not be treated as an official comment, we would incorporate it to the best of our ability during the recovery planning process. All of the comments received after the January 23, 2015, close of the comment period were reviewed and considered in preparation of this final plan. Also, as noted in the final recovery plan and in our responses to other comments, stakeholder involvement will be an integral part of the planning and implementation of many recovery actions.

Comment: Many commenters, including local jurisdictions, special districts, and other similar entities, expressed concerns over whether the recovery plan would require them to make changes in their operations or facilities. Several commenters included specific examples that were of concern to them. Examples of operational changes included such actions as detaining water longer, limiting releases, and restricting maintenance and repairs (including emergency repairs). Examples of facilities included dams and spreading grounds. Additionally, some commenters requested or otherwise anticipated that we would prepare a revised draft recovery plan that would address these concerns. Many also requested that we work collaboratively.

Response: While we cannot respond to the specific examples provided by some commenters in this general document, we do recognize that some recovery actions may call for changes in water flows to improve habitat conditions for the Santa Ana sucker. We emphasize that this recovery plan is a guidance and planning document only. Any cooperation from stakeholders to implement this recovery plan is voluntary, including any that involve changes to operations or facilities. Identification of an action in the recovery plan to be implemented by any public or private party does not create a legal obligation beyond existing legal requirements. All implemented actions must follow appropriate State, local, and Federal laws and regulations. Thus, changes in the operations and facilities, if any, undertaken to implement this plan will be executed through a collaborative process that will include the Service, the responsible parties, and any other stakeholders working together. Portions of this recovery plan have been revised to emphasize this. Issuing a revised draft recovery plan is not necessary for the above reasons.

Comment: Several commenters, including local jurisdictions and special districts, expressed concerns that reintroductions of Santa Ana suckers into currently unoccupied areas may result in negative consequences to water management operations or other managed activities such as wildfire suppression efforts and public recreation opportunities.

Response: The process for reintroducing Santa Ana suckers, as outlined in the final recovery plan, first calls for assessing potential habitat (recovery action 4.1), focusing on those areas that currently possess or could possess upon restoration those features that make an area suitable as habitat for Santa Ana suckers. This process will, by necessity, take into consideration the existing water management operations and existing facilities in that area. Any actions to improve habitat quality for Santa Ana suckers, including any potential changes in water management, alterations of facilities, or other management activities, and any subsequent reintroductions of Santa Ana suckers will be conducted in coordination with partners and stakeholders. Such actions would be voluntary and would take into account the effects associated with changes in water management operations and other management activities in the waterways where the reintroductions are to take place.

Comment: Several commenters, including local jurisdictions and special districts, provided information about certain locations or areas, often noting specific actions that were underway that reduced threats to the Santa Ana sucker at those locales. Others provided information suggesting that a given threat to the species described in the **Reasons for Listing and Current Threats** section was not occurring in a particular area.

Response: We thank the commenters for the information. We included some of the commenters' information in the recovery plan when appropriate, often as examples of actions that were occurring to alleviate threats; however, we emphasize to the reader that our description of the threats to the species is a general assessment. While we appreciate the species-conservation efforts that many stakeholders are undertaking and acknowledge that these efforts are helping to benefit the species, we are unable to include each and every such example that was submitted. If a particular party's beneficial action is not highlighted in the plan, it does not mean that it is not important or is not valued. Likewise, because our threats assessment is, by its nature, geographically and temporally generalized, not every threat we identified is necessarily applicable to each and every potential location at any given time. As we move forward, it will be helpful to have on-the-ground knowledge about a given area before implementing many of the recovery actions. As we work toward recovering the species, we will work with knowledgeable stakeholders and interested parties with site-specific experience.

Comment: One commenter noted that data on the geology, hydrology, waterway hydraulics, dam operations, and water delivery mechanisms has been collected by them and other water-related entities over the last several decades. Additional data are available on the biology of the Santa Ana sucker as well. They further offer to share their data.

Response: We thank the commenter for the generous offer. We look forward to working with all of the Responsible Parties and other stakeholders as we move forward to implement recovery actions. Any and all data that will help fill information needs and help inform decisions is welcome. We invite interested parties to contact the Carlsbad Fish and Wildlife Office (see p. *ii* of the recovery plan).

Comment: Several commenters were concerned over how the draft recovery plan called for using potable water to supplement flows to benefit the Santa Ana sucker. Additionally, one commenter noted specifically and several other commenters mentioned obliquely that the State considers domestic water supply as the highest beneficial use and that this should be considered when implementing recovery actions for the Santa Ana sucker.

Response: We have modified the wording of the final recovery action that included potable water as a possible source of supplemental water to improve Santa Ana sucker habitat. As with other recovery actions, managing Santa Ana sucker habitat, such as supplementing flows with potable water, will require broad coordination and cooperation among many parties. Supplementing flows with potable water is but one potential option to increase the quantity and quality of Santa Ana sucker habitat. It is an option that—other considerations aside—will quickly and easily provide benefits to the Santa Ana sucker. However, we recognize that there are other considerations, including domestic water uses, and that these considerations cannot be set aside easily. We know that clean water is a limited and thus valuable natural resource in southern California. It is not only valuable to people, it is also valuable to our trust resources, including the Santa Ana sucker. As such, we look forward to working with our partners to balance the needs of our waterways while recovering the species.

Comment: At least one commenter expressed concerns over our characterization of effluent from water reclamation facilities. The commenter noted that we had identified some aspects of water quality as potential threats to the Santa Ana sucker, particularly in wastewater-dominated systems. The commenter stated that discharges into rivers are required to meet certain State standards for water quality. The concern apparently being, that by identifying certain aspects of water quality as threats, we were implying water reclamation facilities may not be meeting the State's standards.

Response: We thank the commenters for providing their perspective on this topic. The final recovery plan has been modified. We do not intend to imply that any particular entity is out of compliance with existing standards. Employing a definition used by the Natural Resources Conservation Service (NRCS 2003, p. 1-2), we now note in the **Habitat Characteristics/Ecosystem** section the term *water quality* can be broadly defined as the physical, chemical, and biological composition of water as related to its intended use for such purposes as drinking, recreation, irrigation, and fisheries. As such, the term is subjective and can have different meanings to different users, including many of the responsible parties and partners identified in the final recovery plan or the agencies who address water quality standards. In other words, our intent is not to limit the term *water quality* to any one particular set of quantitative standards.

Comment: One commenter asked us to reconsider the priority we gave to the hydrologic, hydraulic, and sediment transport evaluations in the Santa Ana River, noting that such research takes a long time to complete and offers limited certainty. Instead, the commenter recommended that the final recovery plan should give a higher priority to analyses that will provide greater near-term information that will help increase the species population and range.

Response: In recovery plans, we use specific definitions for each priority level (see Section III, the **Recovery Action Narrative** in the recovery plan). We acknowledge that multiple factors will determine the order in which recovery actions are implemented and that they may not necessarily be implemented in priority number sequence. We will work with stakeholders and partners to implement recovery actions to the extent we can, and to do so in an order that best considers the available information at the time and incorporates any other factors that may influence action implementation.

Comment: One commenter was interested in having recovery actions that call for reintroduction of Santa Ana suckers to be classified as Priority 1.

Response: Priority 1 actions are those that must be taken to prevent extinction or to prevent the species from declining irreversibly (see Section III, the **Recovery Action Narrative** in the recovery plan). While we anticipate that reintroductions will likely be needed in some areas to achieve recovery of this threatened species, we do not consider it necessary to prevent extinction or an irreversible decline of this threatened species in all RUs.

Comment: One commenter recommended that we base our recovery units and recovery criteria on the results of a population viability analysis (PVA). The commenter further recommends that we include conducting a PVA as a Priority 1 recovery action.

Response: We agree that the results of a well-formulated PVA would help inform development of recovery units and recovery criteria; however, we do not have enough sufficiently robust data to populate a PVA model at this time. A PVA based on inaccurate information is likely to yield spurious results, leading to poor recovery management decisions (for example, see Boyce 1992, entire; Beissinger and Westphal 1998, entire; Morris *et al.* 2002, entire). In the absence of good data to populate a PVA model, recovery planning should be based on the best information available. We often look towards the conservation biology principles of representation, resiliency, and redundancy to guide our analysis. We considered these principles in the development of the recovery plan. We agree that PVAs would help in recovery in each RU and have added their development as a recovery action, but this action better fits as a Priority 3 action based on the definitions for the priority levels.

Comment: Two commenters recommended that the plan's Recovery Goal should be based on improving demographic or habitat parameters rather than being based on reducing threats. Based in part on this same perspective, these commenters also questioned our approach in how we developed our Recovery Objectives and other aspects of our stated Recovery Program for the species.

Response: While the approach of the commenters differs from ours, both approaches will get to the same point. To state it another way, the approaches are "two sides of the same coin." Threats affect a species negatively and result in degradation in demographic or habitat parameters. Adequately eliminating, controlling, or otherwise reducing those threats removes the negative effects, thereby resulting in positive effects and resulting in improvements in demographic or habitat parameters. For example, habitat loss and changes in the hydrology have caused the Santa Ana sucker to occur in small, isolated populations, which in turn are more likely to be negatively affected by stochastic events (see the **Reasons for Listing and Current Threats** section). Addressing the habitat loss and changed hydrology threats will result in increasing the amount of suitable and ultimately occupied habitat (achieving the latter may require additional management, such as reintroduction). This will improve connectivity and will result in larger Santa Ana sucker populations (see the Recovery Strategy section), which will improve demographic parameters and reduce the effects of stochastic events. We focus on the threats "side of the coin" because our determination whether to delist (or list, or reclassify) a species is necessarily based on the five threats-based factors under section 4(a)(1) of the Act. We use this approach throughout our Recovery Program for the Santa Ana sucker. We have made revisions to the final recovery plan to better explain our approach to recover the species while still keeping the threats-based approach.

Comment: One commenter expressed concern over the status of the Santa Ana sucker population in San Dimas Wash, suggesting that the population was introduced without any authorization.

Response: Information from a genetic analysis became available after the draft recovery plan was published. While not yet published at the time the recovery plan was finalized, we received a pre-publication manuscript that indicates that the San Dimas Wash population was likely recently introduced from a population within the range of the listed entity (Richmond *et al.* 2016b, in review, p. 15). We had no knowledge of this population prior to its discovery (Morrissey 2008, entire). We are not sure whether this population is extant at this time. The occupied stretch had intermittent flows when surveyed in February 2014 and no Santa Ana suckers were detected (SRMA 2014, entire), but there may be small pools (refugia) where individuals could potentially occur.

Comment: Several commenters informed us that certain areas within the range of the Santa Ana sucker are operating under Court-adjudicated agreements and that the Court retains jurisdiction over the water rights and groundwater management of the watershed; in such areas, the Court and/or Court-appointed Watermaster (plus the key participants) should be included in the list of stakeholders.

Response: We thank the commenters for this information; we have incorporated it into the final recovery plan.

Comment: Several commenters requested to be included as stakeholders.

Response: We thank the commenters for their interest; we have updated the list of Responsible Parties in the final recovery plan. We encourage any additional interested parties who would like to be included in recovery implementation and future planning to contact us at the Carlsbad Fish and Wildlife Office (see p. *ii* of the recovery plan).

Comment: Several commenters raised the topic of the population of Santa Ana suckers in the Santa Clara River, and one commenter asked that the recovery program address that population.

Response: We received additional information about the Santa Clara River population of Santa Ana suckers after the draft recovery plan was published. Though we recognize that the population of Santa Ana sucker in the Santa Clara River is not without value with respect to recovery, the recovery plan addresses recovery actions needed for recovery of the listed entity. At this time the Santa Ana sucker is listed in the Los Angeles, San Gabriel, and Santa Ana River Watersheds. Therefore, recovery actions in the recovery plan were limited to these geographic locations.

Comment: One commenter noted that the habitat quality for the Santa Ana sucker in the Imperial Reach of the Santa Ana River (the portion below Prado Dam) is low. The commenter suggested that the quality of the habitat there is unlikely to improve due to the ongoing operations of Prado Dam. Based on these situations, the commenter questioned whether reestablishing a population within the Imperial Reach is important to the species' recovery, and as such, questioned whether that area should be part of the recovery plan's delisting criteria. The commenter instead recommends that recovery investments should be directed to the Prado Reach, presumably (though unstated by the commenter) because most of that reach is not subject to ramifications that may result from the operations of Prado Dam.

Response: While we acknowledge that any Santa Ana suckers occurring in the Imperial Reach are subject to a suite of threats that may be ostensibly more difficult to ameliorate than the suite of threats that are affecting the species in the Prado Reach, the Santa Ana suckers in the Imperial Reach add to the redundancy of the Santa Ana River Watershed RU, which in turn contributes to the species' resiliency in the RU. Based on our analysis using these tenets of conservation biology, and without information to the contrary (such as those that may come from a robust PVA), we are including the Imperial Reach as a component included in the recovery plan's delisting criteria.

B. Summary of Comments from Peer Reviewers

We also solicited independent peer review of the draft recovery plan from seven individuals who have expertise and experience with the Santa Ana sucker and its habitat in one or more occupied riverine systems. We received comments from six peer reviewers. Peer reviewers included representatives from one Federal agency (U.S. Geological Survey (USGS)) and one State agency (California Department of Fish and Wildlife (CDFW)). In general, the draft recovery plan was well-received by the peer reviewers, garnering comments such as "an excellent and thorough document," "the plan as a whole is very sound, you have hit on all of the major issues surrounding the ultimate recovery of the species," and "[t]he issues involved in this species['] recovery are very well covered and most of my comments are more about emphasis or some minor technicalities." Several peer reviewers provided additional specific information, including documents or citations; we thank the reviewers for these data and we have added the information where appropriate. Below, we provide a summary of specific comments received from peer reviewers with our responses; however, we addressed many of the reviewers' specific critiques and incorporated their suggestions as changes to the final recovery plan. Such comments did not warrant an explicit response, and as such, are not addressed here.

Comment: None of the peer reviewers expressed concerns over the concept of moving Santa Ana suckers into unoccupied areas within the species' historical range, although several offered specific comments on ways to improve its implementation (which we infer as approval of the concept's use in recovering the species). Moreover, one peer reviewer was generally in favor of the concept of reintroduction/translocation, while two peer reviewers explicitly emphasized its importance to the recovery of the species. The State-agency reviewer (CDFW) stated, "one of the most important and readily achievable recovery actions for the species is translocation into formally occupied and currently suitable habitat," declaring that it should be a "top priority for the San Gabriel and Los Angeles populations," and further noting that CDFW has already identified potential receiver sites. The second peer reviewer suggested that reintroduction was "especially important in the Santa Ana River and Big Tujunga Creek."

Response: We thank the peer reviewers for the feedback on this topic. Moving a species into unoccupied areas of its historical range is not an action to be implemented lightly for a variety of reasons. As discussed in the recovery plan, when we apply the tenants of conservation biology to the generally small, geographically isolated populations of the Santa Ana sucker, we conclude that reintroduction/translocation activities will likely be an important component of recovery for the species. However, as noted in the **Summary of Public Comments** section above, certain stakeholders have expressed concerns over employing this practice. We are committed to working with the appropriate parties in our efforts to recover the species. In an effort to alleviate some of the concerns expressed by the public, we have made some changes in the recovery plan to help clarify the reintroduction activities. Nevertheless, given the peer reviewers' endorsement of reintroduction/translocation, we are keeping it as one of the potential methods for recovering the Santa Ana sucker.

Comment: One peer reviewer commented that communication and collaboration between the Service and the State's Regional Water Quality Control Board (RWQCB) is important and further recommended that we work with the CRWQCB to allow for more urban runoff into waterways occupied by Santa Ana suckers.

Response: We thank the peer reviewer for the feedback on this topic. Although we do not explicitly call out the CRWQCB in the Recovery Actions Narrative, planning for many of the specific actions would necessarily include the CRWQCB as one of the partners or stakeholders. We have added the CRWQCB as a Responsible Party in more of the actions identified in the Implementation Schedule (Tables III-1 through III-4) in the recovery plan.

Comment: One peer-reviewing Federal agency (USGS) provided information on preliminary results of an analysis it had conducted on the genetic structure of the Santa Ana sucker throughout its total range, including in the Santa Clara River. In November 2016, well after the comment period had closed, the commenter also provided a manuscript that had been submitted for journal publication.

Response: The information provided was incorporated to the recovery plan to the extent feasible, given that the plan had already been presented to the public as a draft recovery plan. We have removed the recovery actions that called for this type of analysis. The Santa Clara River population is addressed in Appendix A of the recovery plan.

Comment: One peer-reviewing Federal agency (USGS) recommended including a genetic assessment of populations in the different RUs as part of the long-term monitoring and management to provide a direct, quantitative measure of genetic diversity across time intervals that would be long enough to detect shifts in the genetic composition of Santa Ana sucker populations. They suggested intervals of 5 to 6 generations (approximately every 10 to 12 years for this species).

Response: We thank the peer reviewer for noting this. We have increased the emphasis of the importance of obtaining and using genetic data in the Recovery Actions.

Comment: One peer-reviewing State agency (CDFW) emphasized habitat modification and destruction through (1) recreational waterplay and dam building, and (2) recreational mining activities as threats to Santa Ana suckers, especially in the San Gabriel River. The commenter added that a discussion on the impacts from recreational mining to critical habitat (designated in 2010) should be added.

Response: While we agree that mining activities have the potential to impact the species and its habitat, including in areas designated under the Act as critical habitat for the Santa Ana sucker, potential impacts to designated critical habitat is not a topic that is addressed in our “five factor analyses” under section 4(a)(1) of the Act. We have added more discussion on the topic of mining and waterplay activities to the recovery plan.

U.S. Department of the Interior
U.S. Fish & Wildlife Service
Region 8, Pacific Southwest Region
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Copies may be obtained online (species search: Santa Ana sucker) at
http://ecos.fws.gov/ecp/

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