National Oceanic and Atmospheric Administration
United States Department of Commerce
NATIONAL MARINE FISHERIES SERVICE
California Coastal Office, West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

June 14, 2022 **Refer to NMFS No:** WCRO-2021-03490

John E. Simes, Jr.
Acting Area Manager
Bureau of Reclamation
27226 Via Industria, Suite A
Temecula, California 92590

Re: Endangered Species Act Section 7(a)(2) Biological Opinion for the Funding, Planning, Design, and Pre-construction of the VenturaWaterPure[1] Project, City of San Buenaventura (Ventura), California

Dear Mr. Simes:

Thank you for your letter of December 28, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.) for the funding, planning, design, and pre-construction of the VenturaWaterPure Project (proposed action).

The enclosed biological opinion concludes the proposed action is not likely to jeopardize the continued existence of the endangered Southern California Distinct Population Segment (DPS) of steelhead (*Oncorhynchus mykiss*) or destroy or adversely modify designated critical habitat for this species. NMFS concludes incidental take of endangered steelhead is reasonably certain to occur as a result of the proposed action; therefore, the attached incidental take statement includes the amount and extent of anticipated incidental take with reasonable and prudent measures and terms and conditions necessary and appropriate to minimize and monitor such impact on endangered steelhead.

Please contact Brittany Struck at Brittany.Struck@noaa.gov if you have a question concerning this consultation, or if you require additional information.

Sincerely,

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Enclosure

[1] Also described as the Ventura Water Supply Project or the VenturaWaterPure Program.

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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion

Funding, Planning, Design, and Pre-construction of the VenturaWaterPure Project

NMFS Consultation Number: WCRO-2021-03490
Action Agency: Bureau of Reclamation

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Southern California steelhead (*Oncorhynchus mykiss*)	Endangered	Yes	No	Yes	No

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By:
Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Date: June 14, 2022

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1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

NOAA's National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR part 402.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the California Coastal Office in Long Beach.

1.2. Consultation History

On July 23, 2021, the Bureau of Reclamation (Reclamation) requested technical assistance from NMFS for the City of Ventura's (City) "VenturaWaterPure" Project (proposed action). The request included a draft biological assessment, a summary of pre-construction[2] activities, a pre-construction monitoring and assessment program, a monitoring, assessment, and adaptive management program, and the EFH survey report. NMFS provided feedback to Reclamation during a conference call on August 6, 2021, specifically on the proposed habitat-response monitoring, operational jurisdiction, and triggers for potential reinitiation of consultation in the future given the lifespan of the proposed action.

On November 24, 2021, Reclamation again requested technical assistance from NMFS. The request sought NMFS' feedback on content of a draft consultation package. NMFS provided feedback to Reclamation during a conference call on December 13, 2021, specifically on changes to estuarine-habitat acreage as a result of the proposed action including potential ecological benefits from designing a proposed action that mimics natural, unimpaired hydrological conditions under which the species evolved.

On December 29, 2021, NMFS received Reclamation's request (Reclamation File No. SCAO-1500, 2.2.1.06) for formal consultation under Section 7 of the ESA. After careful review of Reclamation's consultation request, NMFS determined the consultation package was sufficient to develop a clear understanding of the proposed action's potential effects on the endangered

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[2] Under the pre-construction agreement, the City will complete Basis of Design, preliminary and final design for Advanced Treatment Facilities; groundwater investigations for recharge elements and well design; Treatment Wetlands conceptual and final design; concentrate disposal feasibility, conceptual and final design; permitting activities (including Engineers Report, Report of Waste Discharge and Endangered Species permitting); and development of CEQA/NEPA analysis and documentation (Reclamation electronic communication, May 2, 2022).

Southern California Distinct Population Segment (DPS) of steelhead (50 CFR 224.101[3]) and designated critical habitat (50 CFR 226.211[4]) for this species. As such, formal consultation was initiated on December 29, 2021.

1.3. Description of the Proposed Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Reclamation proposes to fund the planning and design activities, which will result in the construction and operation of the City's new Advanced Water Purification Facility. Specifically, Reclamation is providing federal funds to the City for planning, design, and pre-construction costs of the VenturaWaterPure Project, a recycled water project that will reduce or eliminate an existing discharge to the Santa Clara River Estuary in Ventura County, California. The proposed action will divert tertiary-treated wastewater from the existing Ventura Water Reclamation Facility to the new Advanced Water Purification Facility for treatment and conveyance to new groundwater injection wells. Waste concentrate from the advanced water purification process will be discharged to the Pacific Ocean through a new ocean outfall pipeline. The planning, design, and pre-construction of the VenturaWaterPure Project make up the components of the proposed action in this biological opinion.

Currently, the City's existing Ventura Water Reclamation Facility releases tertiary treated water to the Santa Clara River Estuary. Under the proposed action, these releases would be reduced over time and, instead, directed into the City's new Advanced Water Purification Facility. Waste concentrate will be discharged to the Pacific Ocean through a new outfall. The proposed action is driven by the City's goal to pursue environmentally protective, sustainable, and integrated water-supply and wastewater-discharge practices, including infrastructure options for reclamation and rerouting of tertiary-treated water (Consent Decree 2012[5]).

The proposed action will be implemented according to a two-phase schedule.[6] Phase 1a is scheduled to begin by 2025 and will reroute an annual average of approximately 2.8 MGD (a 60 percent discharge reduction) to the new purification facility, leaving an average annual continued discharge level of 1.9 MGD to the Santa Clara River Estuary. By 2030, Phase 1b will reroute an annual average of approximately 4.2-4.7 MGD, maintaining an average annual continued discharge level of 0 to 0.5 MGD to the Santa Clara River Estuary as informed by results generated under the Monitoring, Assessment, and Adaptive Management Program. NMFS estimates the lifespan of the proposed action to be approximately sixty years based on the

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[3] https://www.ecfr.gov/current/title-50/chapter-II/subchapter-C/part-224/section-224.101
[4] https://www.ecfr.gov/current/title-50/chapter-II/subchapter-C/part-226
[5] *Wishtoyo Foundation/Ventura Coastkeeper, et al. v. City of San Buenaventura*, Tertiary Treated Flows Consent Decree and Stipulated Dismissal, U.S. District Court, Central District of California, Case No.: CV 10-02072-GHK (PJWx), judgment entered in accordance with the consent decree on March 30, 2012.
[6] Los Angeles Regional Water Quality Control Board, Order No. R4-2020-0024 (NPDES CA 0053651, CI-1822) requires the City to incorporate a phased approach to the proposed reduction in discharge, consistent with the recommendations from the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife.

anticipated lifespan of the average ocean-outfall structure[7] prior to anticipated major repairs. Key elements of the proposed action are as follows.

Concentrated Effluent Ocean Outfall

The new outfall will be installed north of Ventura Harbor by directional drilling from Marina Park, emerging on the ocean floor approximately 2,500 to 3,000 feet offshore, and will deliver concentrated effluent, which contains several times the concentration of salts as the influent water. The outfall site is within Essential Fish Habitat (EFH) for Groundfish, Coastal Pelagic Species, and Highly Migratory Species. NMFS will evaluate potential effects to EFH in a separate consultation decision document.

Construction includes vessel anchoring, dredging, riprap reconfiguration, and pile driving. The dredged footprint would be approximately 200 feet long by 110 feet wide, and include excavation to a maximum depth of 10 feet. Approximately 2,000 cubic yards of ocean-floor material may be dredged to incorporate approximately 0.5 acre of hard substrate (concrete coat) to ensure the outfall pipe's negative buoyancy and adhesion to the seafloor. Once the outfall pipe emerges, a steel pipe would be attached and placed along the ocean floor for an additional 2,500 to 3,000 feet, until the end of the pipe reaches approximately a water-column depth of 50-feet. A diffuser will be installed at the end of the outfall with discharge portals to maximize efficient dilution and to comply with California Ocean Plan water-quality standards for ocean discharge.

The City will prepare a Marine Oil Spill Response Plan, which would apply to all powered vessels used that support construction of the ocean outfall in the unlikely event of an offshore spill of hazardous material (see details in Biological Assessment, Section 3.7.1.4 Water Quality and Marine Habitats). Prior to the initiation of offshore pile-driving activities for the ocean outfall, the City will prepare a Construction Plan outlining the details of the piling installation approach, if piles are required (see details in Biological Assessment, Section 3.7.1.5 Underwater Noise). The results of these calculations will be presented to NMFS to verify noise levels are acceptable. Hammer pile-driving sound in the marine environment will maintain an intensity level of less than 183 and 120 dB. Construction operations include a sound-attenuation reduction and monitoring plan, which will detail the sound-attenuation system, methods to monitor and verify sound levels during pile-placement activities, and best management practices.

After construction, typical outfall maintenance would entail the inspection and maintenance of valves and corrosion control. Cleaning the diffuser would be conducted by divers using hand-held tools. Additionally, effluent-quality limits and ongoing monitoring of effluent discharges are required by the Regional Water Quality Control Board (RWQCB) for outfall operations pursuant to the Clean Water Act under the National Pollutant Discharge Elimination System (NPDES) permit (Los Angeles Regional Water Quality Control Board, Adopted Order No. R4-2020-0024, NPDES CA0053651, CI-1822, February 28, 2020), which regulates operation of the Ventura Water Reclamation Facility.

[7] San Elijo Powers Authority, San Elijo Reclamation Facility. 2020. Outfall Integrity Report (Final). Carollo Engineers, Inc. January. 455 pp.

Advanced Water Purification Facility

All construction activities for the new Advanced Water Purification Facility, including conveyance pipelines, pumping systems, groundwater injection wells, and upgrades to the existing Ventura Water Reclamation Facility will occur in developed or vacant upland areas, such as the existing treatment plant site and street right-of-way areas.

Operation and treatment capacity of the proposed facility will involve ozone/biologically active carbon filters, ultrafiltration, reverse osmosis, ultraviolet, and advanced oxidation for indirect potable reuse (groundwater recharge). For direct potable reuse, these treatments will be followed by additional ultrafiltration, storage buffer tanks, and blending at existing water-conditioning facilities, which will incorporate additional disinfection. The facility will have a 6 MGD design capacity, producing 4.7 MGD of purified water for aquifer injection and 1.2-1.7 MGD of concentrate for ocean disposal.

Monitoring and Adaptive Response Management

To address uncertainties about how aquatic habitat will change in response to the proposed action, the action includes a proposed monitoring and adaptive-response management program. That program specifies measures for evaluating ecosystem conditions within the Santa Clara River Estuary prior to and during a portion of the phased approach. Reference the *Ventura Water Supply Project: Pre-Construction Assessment Program and Monitoring, Assessment, and Adaptive Management Plan* (June 2021) for details on monitoring methods, implementation, data management, assessment, reporting, and adaptive management.

To that end, the proposed management program described above includes two individual though related programs: a pre-construction assessment program (PCAP), and a monitoring, assessment, and adaptive-management program (MAAMP).

The PCAP outlines data-collection activities to establish the existing baseline conditions before implementation of Phase 1a. That program includes a 3-year monitoring plan to update existing baseline hydrogeological, chemical, and biological conditions of the Santa Clara River Estuary.

The MAAMP will continue data collection in the Santa Clara River Estuary during implementation of Phase 1a. The program includes a 5-year monitoring plan starting after the Phase 1a begins and will monitor and respond to unexpected ecological effects of the proposed action, if such effects occur. The MAAMP will identify action criteria and management measures as appropriate that will guide implementation of Phase 1b reductions in discharges (to an average annual of 0 - 0.5 MGD). Under the proposed action, the City will submit to NMFS annual MAAMP reports, which compile the data collected for a period of five years.

The PCAP and MAAMP include fish-population monitoring in the Santa Clara River Estuary using seines to understand fish populations' response to changes in estuarine water quality as a result of the proposed action. Fish surveys will be conducted up to four times per year. Dip nets may be used in areas where seining is infeasible. All captured steelhead will be removed from the net and immediately placed in buckets of ambient water or aerated coolers. All steelhead individuals will be released back to the place of capture.

The NPDES permit for the facility also requires the PCAP and MAAMP be developed and refined in coordination with California Department of Fish and Wildlife (CDFW), U.S. Fish and Wildlife Service (USFWS), NMFS, Heal the Bay, and Wishtoyo Foundation's Ventura Coastkeeper Program, and submitted to the RWQCB. Both the PCAP and MAAMP will be implemented in coordination with USFWS, NMFS, CDFW, and the RWQCB to ensure reduction in tertiary-treated discharge minimizes adverse effects to endangered steelhead and designated critical habitat within the Santa Clara River Estuary.

Consideration of Potential for Other Activities

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not. With respect to the Biological Assessment's section, *6.3.2 Construction of New Treatment Wetland Point of Discharge*, the construction of new treatment wetlands and point of discharge is a conceptual alternative if all else fails (Figure 10 in the Biological Assessment, page 3-19). Design details, site plans including dimensions for a new concrete weir structure along the streambank, and streambank minimization measures have not been drafted; thus, they are unavailable for review. As a result, there is insufficient information regarding the construction of a new treatment wetland point of discharge and any potential effects to listed species and critical habitat to consider in this biological opinion. If this conceptual alternative becomes necessary and more detailed, and sufficient information for ESA Section 7 consultation regarding this alternative is provided to NMFS (see 50 CFR 402.14(c)), then reinitiation of consultation may be necessary under 50 CFR 402.16.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, then section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion also relies on the regulatory definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation of critical habitat for endangered Southern California (SC) DPS of steelhead uses the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion, we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, then suggest a reasonable and prudent alternative to the proposed action.

In addition to the approach described above, we use additional resources, tools, studies, and memorandums from independent experts on predicted changes to estuarine water quality and potential impacts to estuarine-habitat types (e.g., modeled predictions characterizing how physical and biological features may change over time). Below we identify some of the information sources and documents in the record of this consultation, which contributed to our analysis of the effects of the proposed action.

The City funded a series of scientific assessments (termed Special Studies) of the Santa Clara River Estuary to evaluate hydrology, geohydrology, and biological processes in the estuary. The studies were conducted over several years to evaluate whether and to what extent the existing tertiary-treated wastewater discharge to the estuary may be beneficial to biological resources (see NMFS November 7, 2013, letter to Los Angeles Regional Water Quality Control Board). The Special Studies were finalized in 2018.

The Special Studies were peer reviewed by two independent teams of technical experts: a Technical Review Team (TRT 2017-2018)[8], convened by Wishtoyo Foundation, Ventura Coastkeeper, and Heal the Bay; and the Scientific Review Panel. The Scientific Review Panel prepared a Technical Memorandum dated June 25, 2018, which summarized the Phase 3 analysis and derived additional conclusions and recommendations (Revell et al. 2018).

An Environmental Impact Report (SCH #2017111004) was completed in 2019 to evaluate the proposed action under the California Environmental Quality Act. Project design features were identified to avoid or minimize effects to endangered steelhead and other marine resources.

In our analysis, including our evaluation of the environmental baseline, we further considered how the City's 64-years of effluent discharge into the Santa Clara River Estuary (started as early as 1958, Ambrose and Anderson 2011, whereas others estimate since 1960, Nautilus Environmental 2005) influences the quantity and extent of steelhead-accessible habitat in the action area.

Additionally, NMFS considered results from the Final Phase 3 Study (Stillwater Sciences 2018a), which included a suite of assumptions to inform beneficial-use assessments, determination of enhancement, maximum ecologically protective diversion volume, and continued discharge recommendations. NMFS considered information from the Santa Clara River Estuary Scientific Review Panel (Revell et al. 2018), which included a suite of assumptions as well as concerns and disagreements with past assumptions made by Stillwater Sciences (2018a).

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also informs the description of the species' "reproduction, numbers, or distribution" for the jeopardy analysis. The opinion examines the condition of

[8] Technical Review Team (TRT). 2017 - 2018. C. Hammersmark, M. Podlech, M. Josselyn and D. Chase. Comments on the City of Ventura Special Studies - Phase 3: Assessment of the Physical and Biological Conditions of the Santa Clara River Estuary, Ventura County, California. Dec. 8, 2017, and March 9, 2018. 48 pp.

critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments, which make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

Status of the Species

The endangered SC DPS of steelhead extends from the Santa Maria River in Santa Barbara County to the Mexican border (inclusive). NMFS characterized the abundance of steelhead in the DPS when the species was originally listed (62 FR 43937; August 18, 1997) and cited this and updated information as the basis for the current listing of the DPS of steelhead as endangered (71 FR 834; January 5, 2006). Estimates of historical (pre-1960s) and more recent (1997) abundance show a precipitous drop in numbers of spawning adults for major rivers in the SC DPS of steelhead. An updated status report states the chief causes for the numerical decline of steelhead in southern California include urbanization, water withdrawals, channelization of creeks, human-made barriers to migration, and the introduction of exotic fishes and riparian plants (Good et al. 2005), and the most recent viability assessments and status reviews indicate these threats continue (NMFS 2011; Williams et al. 2011; NMFS 2016a; Williams et al. 2016). Historical data on steelhead numbers for this region are sparse. The historic and recent steelhead abundance estimates, and percent decline are summarized in Table 1. The run-size estimates illustrate the severity of the numerical decline for the major rivers within range of the endangered SC DPS of steelhead (Good et al. 2005; NMFS 2011; Williams et al. 2011; NMFS 2016a; Williams et al. 2016).

Table 1. Historical and recent abundance estimates of adult steelhead in the Southern California DPS. Data are from Good et al. 2005, NMFS 2011, and NMFS Southern California redd surveys 2009-2011.

	Pre-1950	**Pre-1960**	**1990s**	**2000s**	**Percent Decline**
Santa Ynez River	20,000-30,000		< 100		99
Ventura River		4,000-5,000	< 100	< 100	96
Santa Clara River		7,000-9,000	< 100	< 10	99
Malibu Creek		1,000	< 100		90

Stream surveys undertaken well over a decade ago that document the species' pattern of occurrence concluded that of the 46 watersheds surveyed, which steelhead occupied historically, *O. mykiss* occupied between 40% to 50% of the watersheds (Boughton et al. 2005). Fish surveys by NMFS's Southwest Fisheries Science Center, direct observations by NMFS biologists, and anecdotal information from local biologists working on major rivers and creeks throughout the range of the DPS suggest although steelhead populations continue to persist in some coastal watersheds, the population numbers are exceedingly small (Good et al. 2005; Williams et al. 2011; Williams et al. 2016). Within the Santa Clara River watershed, steelhead juveniles continue to occupy the tributaries, and have been observed in Santa Paula Creek, Sisar Creek, Sespe Creek, and Piru Creek (S. Glowacki, NMFS, 2006-2009; and K. Mull, NMFS, 2011-2012, personal observation).

On a positive note, there have been observations of steelhead recolonizing vacant watersheds during years with abundant rainfall, notably San Mateo Creek and Topanga Creek. California Department of Fish and Wildlife discovered an adult female steelhead (TL 57.46 cm) on April 26, 2013, during a flow-rate survey in Conejo Creek (Camarillo, California). Recent documented observations of *O. mykiss* occurred in San Mateo Creek (August 2017[9]), San Juan Creek upstream from Doheny State Beach (State Parks, January 2018), Sandia Creek, which is a tributary to Santa Margarita River (United States Geological Survey, May 2021), and the Santa Margarita River mainstem below the fish-passage facility operated by the U.S. Marine Corps Base Camp Pendleton (July 2021).

NMFS reviews the status and viability of the endangered SC DPS of steelhead on the basis of available information (including new information) about the species abundance, population growth rate, spatial structure, and diversity (McElhany et al. 2000) every five years as required by the ESA. In the last two status reviews, NMFS concluded the risk of extinction of the DPS was unchanged (NMFS 2011, 2016).

Life History and Habitat Requirements

The major freshwater life history stages of steelhead involve freshwater rearing and emigration of juveniles, upstream migration of adults, spawning, and incubation of embryos (Shapovalov and Taft 1954; Barnhart 1991; Meehan and Bjornn 1991; Moyle 2002). Distinctly different than other Pacific salmonids, steelhead adults can survive their first spawning and return to the ocean to reside until the next year to reproduce again. For returning adults, the specific timing of spawning can vary by a month or more among rivers or streams within a region, occurring in winter and early spring. The spawning time frames depend on physical factors such as the magnitude and duration of instream flows and sand-bar breaching. Once they reach their spawning grounds, females will use their caudal fin to excavate a nest (redd) in streambed gravels where they deposit their eggs. Males will then fertilize the eggs and, afterwards, the females cover the redd with a layer of gravel, where the embryos (alevins) incubate within the gravel. Hatching time can vary from approximately three weeks to two months depending on surrounding water temperature. The young fish (fry) emerge from the redd two to six weeks after hatching. As steelhead begin to mature, juveniles or "parr" will rear in freshwater streams anywhere from 1-3 years. Juvenile steelhead can also rear in seasonal coastal lagoons or estuaries of their natal creek, providing over-summering habitat.

Juvenile steelhead emigrate to the ocean (as smolts) usually in late winter and spring and grow to reach maturity at age 2-4, but steelhead can reside in the ocean for an additional 2-3 years before returning to spawn. The timing of emigration is influenced by a variety of parameters such as photoperiod, temperature, breaching of sandbars at the river's mouth and streamflow. Extended droughts can cause juveniles to become landlocked, unable to reach the ocean (Boughton et al. 2006).

O. mykiss possess an exceedingly complex life history. Through studying the otolith (ear stone) microchemistry of *O. mykiss*, researchers further understand the complex and intricate life history of steelhead. Specifically, resident rainbow trout can produce steelhead progeny; likewise, steelhead can yield resident rainbow trout progeny (Zimmerman and Reeves 2000).

[9] National Marine Fisheries Service. 2017. Official correspondence to U.S. Marine Corps Base Camp Pendleton (MCBCP) regarding August 17, 2017, incidental capture event of endangered steelhead in San Mateo Creek. December 5. Federal Record: 151422WCR2017CC00292.

Additionally, evidence indicates sequestered populations of steelhead (e.g., above introduced migration barriers) can exhibit traits that are the same or similar to anadromous specimens with access to the ocean. Examples include inland resident fish exhibiting smolting characteristics and river systems producing smolts with no regular access for adult steelhead. This evidence suggests the ecological importance of the resident form to the viability of steelhead and the need to reconnect populations upstream and downstream of introduced migration barriers. The loss or reduction in anadromy and migration of juvenile steelhead to the estuary or ocean is expected to reduce gene flow, which strongly influences population diversity (McElhany et al. 2000; Munsch et al. 2022). Evidence indicates genetic diversity in populations of endangered SC steelhead is low (Girman and Garza 2006).

In southern California, adults immigrate to natal streams for spawning during December to March, but some adults may not enter coastal streams until spring, depending on flow conditions. Depending on the size of the watershed, adults may migrate several miles or hundreds of miles to reach their spawning grounds. Although spawning may occur during December to June, the specific timing of spawning may vary a month or more among streams within a region. Steelhead do not necessarily die after spawning and may return to the ocean, sometimes repeating their spawning migration two or more years.

Habitat requirements of steelhead in streams generally depend on the life history stage. Habitat for endangered SC steelhead consists of water, substrate, and adjacent riparian zone of estuarine and riverine reaches of coastal river basins and major rivers. Generally, streamflow volume, water temperature, and water chemistry must be appropriate for adult immigration and juvenile emigration. Low streamflow, high water temperature, physical barriers, low dissolved oxygen, and high turbidity may delay or halt upstream migration of adults and timing of spawning, and downstream migration of juveniles and subsequent entry into estuary, lagoon, or ocean environments. These factors affect steelhead within southern California watersheds to varying degrees, depending on watershed condition, environmental factors such as rainfall totals, and levels of anthropogenic disturbance in the watershed including disturbances such as high-wind events coming in contact with power lines[10], which started the Thomas Fire (December 2017) that, in turn, resulted in subsequent mud slides.

Suitable water depth, velocity, and substrate composition are the primary requirements for spawning, but water temperature and turbidity are also important. Dissolved oxygen concentration, pH, and water temperature are factors affecting survival of incubating embryos. Fine sediments, sand, and smaller particles may fill interstitial spaces between substrate particles, thereby reducing water-flow through and dissolved oxygen levels within a nest. The degree to which this is occurring in individual watersheds depends on the microhabitat conditions, and conditions within individual watersheds and their level of anthropogenic disturbance. Juvenile steelhead require different combinations of water depth and velocity for living space (e.g., pools, riffles, runs), shelter from predators and harsh environmental conditions, adequate food resources, and suitable water quality and quantity, for ontogeny and survival during summer and winter.

[10]https://vcfd.org/news/vcfd-determines-cause-of-the-thomas-fire/

Additionally, juveniles need abundant food sources, including insects, crustaceans, and other small fish. Habitat must also provide places to hide from predators, such as under logs, root wads and boulders in the stream, and beneath overhanging vegetation. Steelhead also need places to seek refuge from periodic high-flow events (side channels and off-channel areas), and may occasionally benefit from the availability of cold-water springs or seeps and deep pools during summer. Estuarine habitats can be utilized during the seaward migration of steelhead, as these habitats have been shown to be nurseries for steelhead. Estuarine or lagoon habitats can vary significantly in their physical characteristics from one another, but remain an important habitat requirement as physiology begins to change while juvenile steelhead become acclimated to a saltwater environment.

Population Viability

One prerequisite for predicting the effects of an action on a species (including establishing a point of reference for the effects analysis) involves an understanding of whether the broad population is likely to experience a reduction in the likelihood of being viable, i.e., the hypothetical state(s) in which extinction risk of the broad population is negligible and full evolutionary potential is retained (Boughton et al. 2006, 2007). By definition, a viable salmonid population (VSP) is an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation (random or directional), local environmental variation, and genetic diversity changes (random or directional) over a 100-year time frame. Specifically, a viable population should meet four viability thresholds for each of the four criterion types: mean annual run size, ocean conditions, population density, and the anadromous fraction (see Table 1 in Boughton et al. 2007). Other processes contributing to extinction risk (catastrophes and large-scale environmental variation) are also important considerations, but by their nature they need to be assessed at the larger temporal and spatial scales represented by the DPS.

The crux of the population definition used here is what is meant by "independent." An independent population is any collection of one or more local breeding units whose population dynamics or extinction risk over a 100-year time period is not substantially altered by exchanges of individuals with other populations. Generally, an independent population is contained within a distinct stream or possibly an entire watershed, and represents a subunit of the entire DPS. Independent populations are important for the long-term viability of the DPS because they are generally more resilient than smaller populations, and they may act as source populations for smaller steelhead populations in adjacent watersheds. The populations of steelhead within the Santa Clara River watershed would fit this criterion for being independent.

Four principal parameters are used to evaluate the long-term viability and conversely the extinction risk for the populations of salmonids that make up the endangered SC DPS of steelhead. They are: (1) population size; (2) population growth rate; (3) population spatial structure; and (4) population diversity. These specific parameters are important to consider because they are predictors of extinction risk and reflect general biological and ecological processes, which are critical to the growth and survival of steelhead populations, and they are measurable (McElhany et al. 2000). To assess viability of a salmonid population, guidelines or decision criteria have been defined for each of the four parameters to further the viability evaluation (McElhany et al. 2000). The bases for these criteria can be found in the many publications regarding population ecology, conservation biology, and extinction risk (e.g., Pimm et al. 1988; Berger 1990; Primack 2004; see also McElhany et al. 2000 and Boughton et al. 2007). Populations within the endangered SC DPS of steelhead must meet all of the following guidelines for VSP criteria to be considered viable. The four concepts and associated guidelines are outlined below.

Population Size.—Population size provides an indication of the sort of extinction risk that a population faces. In general, small populations are at a greater risk of extinction than large populations because the processes that affect populations operate differently in small populations than in large populations (e.g., Pimm et al. 1988; Berger 1990; Primack 2004). For example, variation in environmental conditions leading to low levels of species survival or fecundity for an extended time can cause extinction of small populations. This is not the case for large or broadly distributed populations, which typically exhibit a greater degree of resilience to these factors.

Population Growth Rate.—The productivity of a population (i.e., the number of individuals generated over a specified time interval) can reflect environmental conditions that influence the dynamics of a population and determine abundance over time. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany et al. 2000). Changes in environmental conditions, including ecological interactions, can influence a population's intrinsic productivity or the environment’s capacity to support a population, or both. The greater the productivity of a steelhead population the greater its ability to recover from environmental disturbance and the greater its viability. Because of the very low abundance of returning adult steelhead in southern California and highly variable flow conditions that can prevent migration into productive spawning areas, their population growth rates (see Primack 2004 for discussion on population size and growth rates) are reduced, making the populations within the DPS less resilient to disturbance. When populations are less resilient (e.g., Munsch et al. 2022), there is increased risk of further reducing the long-term viability of the DPS as a whole.

Population Spatial Structure.—Understanding the spatial structure of a population is important because the population spatial structure can affect evolutionary processes and, therefore, alter the ability of a population to adapt to spatial or temporal changes in the species’ environment (McElhany et al. 2000). Populations that are thinly distributed over space are susceptible to experiencing poor population growth rate and loss of genetic diversity (Boughton et al. 2007). A population’s spatial structure consists of both geographic distributions of individuals in a population and processes that generate that distribution. A population’s spatial structure depends fundamentally on habitat quality, spatial configuration, and dynamics as well as dispersal of individuals in the population. Within the endangered SC DPS of steelhead, anthropogenic activities such as the introduction of migration barriers have substantially reduced the number of watersheds (or portions of watersheds) that are currently accessible to steelhead. This significantly reduced the spatial structure of populations in the DPS (Boughton et al. 2005).

Population Diversity.—Steelhead possess a suite of life history traits, such as anadromy, timing of spawning, emigration, and immigration, fecundity, age-at-maturity, behavior, physiological and genetic characteristics. The more diverse these traits are (or the more these traits are not restricted), the more likely the species is to survive a spatially and temporally fluctuating environment. Factors (natural or anthropogenic) that constrain the full expression of life history traits are expected to affect the diversity of a species (McElhany et al. 2000). All of the basins which historically had the largest steelhead populations (e.g., Santa Maria River, Santa Ynez River, Ventura River, Santa Clara River) now possess complete barriers (in some cases multiple barriers) precluding steelhead from a substantial amount of their historical habitat, and as a result there is loss of anadromy in a substantial number of basins within the DPS (Boughton et al. 2006). Activities that affect evolutionary processes (e.g., natural selection) have the potential to alter the diversity of the species; the widespread effects of anthropogenic activities in southern California are believed to have contributed to a decline in genetic diversity of endangered SC steelhead (Girman and Garza 2006).

When considering prescriptive viability at the DPS level, biological diversity and life-history diversity are criterion types each with separate viability thresholds (see Table 1 in Boughton et al. 2007). Biological diversity includes consideration of the actual number of viable populations, the ability to inhabit watersheds with drought refugia, and spatial distribution. Life-history diversity includes considering to what extent populations exhibit all three life-history strategies (e.g., fluvial-anadromous, lagoon anadromous, freshwater resident).

In summary, the populations that comprise the endangered SC DPS of steelhead have been, and continue to be, severely impacted by anthropogenic factors, and this negatively affects the numbers, reproduction, and distribution of the species. This has led to a decline of over 95 percent for the species (Good et al. 2005; Williams et al. 2011; Williams et al. 2016). Applying the foregoing evaluation and the guidelines as described by McElhany et al. (2000) suggests the endangered SC DPS of steelhead is currently not viable and is at a high risk of extinction. This finding is consistent with conclusions of past and recent technical reviews (Busby et al. 1996; Good et al. 2005; Williams et al. 2011; NMFS 2016a; Williams et al. 2016), and the listing determination for the species (NMFS 1997, 2006).

Conservation Value of Watershed-Specific Population Units

The endangered SC DPS of steelhead is divided into five Biogeographic Population Groups (BPGs): Monte Arido Highlands, Conception Coast, Santa Monica Mountains, Mojave Rim and Santa Catalina Gulf Coast (NMFS 2012). Each BPG is characterized by a unique combination of physical and ecological characteristics that potentially present differing natural selective regimes for steelhead populations utilizing the individual watersheds. The separate watersheds comprising each BPG are generally considered to support individual *O. mykiss* populations (i.e., one watershed = one steelhead population).

The DPS is geographically broad, but individual population units are distributed sparsely and unevenly throughout the DPS with extensive spatial area existing between nearest-neighbor populations (Boughton et al. 2005; NMFS 2005; Boughton et al. 2006). Widespread population unit extinctions have been observed as well as contraction of the southern extent of the species' range (Boughton et al. 2005; Gustafson et al. 2007). One reason for extensive spatial gaps between neighboring population units and range contraction involves man-made barriers to fish migration (Boughton et al. 2005). Four Monte Arido Highlands population units (Santa Maria, Santa Ynez, Ventura, and Santa Clara Rivers) possess a high and plausible likelihood of being viable and independent (when restored to an unimpaired state), and all population units within this recovery planning area are important to viability and recovery of endangered steelhead.

The recovery-planning process (NMFS 2012) indicates while the endangered SC DPS of steelhead comprises several watershed-specific population units, only a relative few population units possess a high and biologically plausible likelihood of becoming viable and independent. Populations within the Recovery Planning Area are identified as core 1, core 2, or core 3. The core-1 populations are those populations identified as the highest priority for recovery actions. Core-2 populations form a key part of the recovery implementation strategy and contribute to the set of populations necessary to achieve recovery criteria. Core-3 populations are an integral part of the overall biological recovery strategy by promoting connectivity between populations and genetic diversity across the DPS. Streams classified as Core-1 Populations are essential for recovering the DPS as a whole. Therefore, reducing the likelihood of survival and recovery of a Core-1 Population, would have adverse consequences for the survival and recovery of the DPS as a whole. The core designations (Table 7-1 in NMFS 2012) are based on the expected contribution of the waterway to steelhead recovery when restored to an unimpaired state.

The Santa Clara River steelhead population is a “Core 1” population essential for the successful recovery of endangered SC steelhead. This is, in part, due to the watershed’s large size, availability of spawning habitat, and relatively reliable winter river discharge (Boughton et al. 2006). Additionally, the steelhead population in the Santa Clara River was evaluated by NMFS’ Technical Review Team as having a high potential for being independently viable, and ranked second among endangered SC steelhead watersheds for overall viability, based on watershed habitat conditions, reliable flows, and amount of habitat present.

Contribution of the Santa Clara River Steelhead Population Unit to DPS Viability and Recovery

Population Units.—The endangered SC DPS of steelhead comprises several population units (steelhead-bearing watersheds). The Santa Clara River Watershed is a population unit within the DPS that possess the characteristics needed to be both viable and independent (Boughton et al. 2006), predominantly due to large amounts of over-summering habitat, a large network of tributaries, and reliable winter discharge. Due to these features, the Santa Clara River steelhead population unit is important to the viability and recovery of the endangered SC DPS of steelhead, as described in further detail below.

Independence of the Santa Clara River steelhead population.—The Santa Clara River population is considered to be an independent population (Boughton et al. 2006), and is therefore, once recovered, expected to support steelhead in several adjacent population units via steelhead straying into adjacent watersheds. The creation and maintenance of populations in several adjacent population units effectively increases the number of individuals in the broad population. Given the risk of extinction that small populations face (e.g., Pimm et al. 1988; Primack 2004), a larger number of individuals decreases the risk that the broad population would have weakened viability.

One reason why the Santa Clara River population unit is considered to be an independent population is because, once recovered, they can withstand environmental stochasticity (referred to as "stability") (Boughton et al. 2006). Populations in strictly coastal or inland areas of the DPS do not appear to be different in terms of their innate stability over the long term (Boughton et al. 2006), but some population units exist in areas where surface water can be perennial and where winter discharge (and therefore migration opportunities for steelhead) is more dependable. This has led to the identification of certain population units in the DPS that are expected to be more stable over the long term than other units not sharing such environmental features. The Santa Clara River was identified as one such population unit (Boughton et al. 2006), and due to these characteristics, recovery of steelhead within these basins is considered to be important for recovery of the entire endangered SC DPS of steelhead.

The value of the Santa Clara River population unit to the DPS is further highlighted by its ecologically significant attributes, which are not found in most other population units within the DPS. The Santa Clara River population unit represents a large distributional component of the overall range of the DPS, and this population unit is one of the largest steelhead-bearing watersheds in the DPS. Without this population unit, the number of large population units in the DPS would be reduced. The remaining units are primarily small coastal populations, which, by themselves, do not appear to favor viability and recovery of the DPS due to their small population size and susceptibility to environmental stochasticity (Boughton et al. 2006).

The Santa Clara River population unit is an inland population, whereas the vast majority of population units are coastal. The value of inland populations lies in their innate habitat characteristics and conditions. Inland population units extend into areas that are drier and warmer than those experienced by coastal population units, and inland population units also have longer migration routes and cover a larger area. Such environmental features are expected to promote diversity (genetic, phenotypic, and ecological) and specific life-history traits (e.g., the ability to migrate long distances, and tolerate elevated temperatures and low flows during the dry season) that favor survival of the species. Additionally, the Santa Clara River population appears to have been one of the largest in the DPS, particularly during favorable water years (Boughton et al. 2007). These features increase the overall viability of the recovered Santa Clara River population unit, which makes it crucial to the recovery of the broader DPS.

Regional Climatic Variation and Trends

The interaction of changing climate conditions with other stressors such as habitat fragmentation is likely to result in additional threats to natural resources (McCarty 2001; Barnett et al. 2008; Kadir et al. 2013; Moyle et al. 2013), including threats to the viability of steelhead populations (Moyle et al. 2017; Munsch et al. 2022). Southern California warmed three degrees (F) in the last century (EPA 2016). Compared to the modeled historical annual average maximum temperature of 72.5°F for the Los Angeles region[11], future model-average values under RCP8.5 are projected to increase to 75.1°F (70.7 - 80.7°F) by the early-21st century, 78.2°F (74.4 - 84.8°F) by the mid-21st century, and 80.9°F (76.9 - 87.8°F) by the late-21st century (see Figure

[11] Los Angeles region topography and boundary definition encompasses Los Angeles, Ventura, and Orange Counties, and adjacent urbanized portions of San Bernardino and Riverside Counties.

2 in Hall et al. 2018). These projections combine inter-annual variability and model variability; this suggests apparent increases in future variability for the region. High temperatures and overall drier conditions will become more common, indicating endangered SC steelhead may experience increased thermal stress (see Katz et al. 2012[12]) even though this species has shown to endure higher than preferable body temperatures (see Spina 2007).

Precipitation trends are also important to consider. Despite small changes in average precipitation, dry and wet extremes are both expected to increase in the future (Polade et al. 2014; Swain et al. 2018). By the late-21st century, the wettest day of the year is expected to increase across most of the LA region, with some locations experiencing 25-30% increases under RCP8.5 (Figure 6 in Hall et al. 2018). Extremely dry years are also projected to increase over southern California, potentially a doubling or more in frequency by the late-21st century (Swain et al. 2018).

Hydrology influences the timing and duration of passage conditions for the species (see Lang and Love 2014). The 'regional' median fish passage opportunity in 'Southern California' during wet years was similar to the 'regional' median fish passage opportunity in the 'Pacific Northwest' during dry years. A potential effect of dry extremes (i.e., no to minimal rainfall for consecutive years) is a higher frequency of low instream-flow conditions, which create passage delays particularly for small streams; low instream-flow delay was the largest factor affecting total fish passage opportunity across 16 watersheds. Additional potential impacts to the species include poor freshwater survival due to longer and warmer periods of drought (Hanak et al. 2001; Katz et al. 2012; Mastrandrea and Luers 2012).

A drought commenced in 2012 and included an exceptional drought period from January 2014 through January 2017. Under drought conditions, small population extirpations from stream reaches or segments may be due to loss of cold-water refugia (Cooper et al. 2015; Wilkin et al. 2016; Schultz et al. 2017). Forest-canopy water loss in southern California made the forest landscape more vulnerable to fire (Asner et al. 2015). The drought will likely delay recovery of riparian vegetation which will prolong the duration of effects from fire (Verkaik et al. 2013). The extended drought and drying conditions associated with projected climate change has the potential to cause local extinction of *O. mykiss* populations, and thus reduce the genetic diversity of fish within the Southern California Steelhead Recovery Planning Area (NMFS 2016a).

In summary, observed and projected climate-change effects are generally detrimental to the species, given the unprecedented rate of change and uncertainty about the ability to adapt. Unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. In general, climate change projections cannot be distinguished from annual and decadal climate variability for approximately the first 10 years of the projection period (see Cox and Stephenson 2007). While there is uncertainty associated with projections beyond 10 years, which increases over time, the direction of change is relatively certain (McClure et al. 2013; Hall et al. 2018).

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[12] Katz, J., P. B. Moyle, R. M. Quiñones, J. Israel, and S. Purdy. 2012. Impending extinction of salmon, steelhead, and trout (Salmonidae) in California. Environmental Biology of Fishes 96 (10-11): 1169-1186.

Status of Designated Critical Habitat

Critical habitat for endangered SC steelhead was designated on September 2, 2005 (70 FR 52488), and consists of the stream channels within the hydrologic units as described in 50 CFR 226.211. Critical habitat has a lateral extent defined as the width of the channel delineated by the ordinary high-water line as defined by the Corps in 33 CFR 329.11, or by its bankfull elevation, which is the discharge level on the streambank that has a recurrence interval of 1 to 2 years on the annual flood series (50 CFR 226.211(b)). PBFs for critical habitat for the SC DPS of steelhead (50 CFR 226.211(c)) include:

- **Freshwater spawning sites** with water quantity and quality conditions and substrate (i.e., spawning gravels of appropriate sizes) supporting spawning, incubation and larval development.
- **Freshwater rearing sites** with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
- **Freshwater migration corridors** free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
- **Estuarine areas** free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Streams designated as critical habitat for endangered SC steelhead contain the above PBFs in differing amounts and to varying degrees, depending on the particular stream, the characteristics of the watershed, and the degree that the watersheds are impacted by anthropogenic factors. During the summer many creeks become intermittent in sections or dry completely (in some cases instream drying is natural and in other cases it is due to anthropogenic factors), and stream temperatures may become a factor in terms of suitability for rearing steelhead. Overall, steelhead over-summering habitat is thought to have a restricted distribution more so than winter spawning and rearing habitat (Boughton et al. 2006).

Streams with high conservation value have most or all of the PBFs of critical habitat and extensive areas that are suitable for steelhead spawning, rearing, and migration (NMFS 2012). Streams with medium or low conservation value are less suitable for steelhead in terms of spawning, rearing, and migration, and have less of the PBFs necessary for steelhead survival growth and reproduction, generally due to anthropogenic factors. The Santa Clara River watershed has been found to have high conservation value for the survival and recovery of endangered SC steelhead. The spawning, rearing, and migratory habitat within the range of species are heavily impacted by dams, diversions, and human development. As a result, much of the available habitat has become severely degraded, and habitat degradation has been a main contributing factor to the current status of the species (Good et al. 2005). The most recent status reviews found these threats have remained essentially unchanged (Williams et al. 2011; NMFS 2016a; Williams et al. 2016).

Habitat for the species suffers destruction and modification, and anthropogenic activities reduce the amount of habitat available to endangered SC steelhead (Nehlsen et al. 1991; NMFS 1997; Boughton et al. 2005; NMFS 2006; Munsch et al. 2022). In many watersheds throughout the range of endangered SC steelhead, the damming of streams precludes steelhead from hundreds of miles of historical spawning and rearing habitats (e.g., Twitchell Reservoir within the Santa Maria River watershed, Bradbury Dam within the Santa Ynez River watershed, Matilija Dam within the Ventura River watershed, Rindge Dam within the Malibu Creek watershed, Pyramid Dam and Santa Felicia Dam on Piru Creek). These dams created physical barriers and hydrological impediments for adult and juvenile steelhead migrating to and from spawning and rearing habitats. Likewise, construction and ongoing impassable conditions of highway projects have rendered habitats inaccessible to adult steelhead (Boughton et al. 2005).

The number of streams that historically supported steelhead has been dramatically reduced (Good et al. 2005). Within stream reaches accessible to this species (but that may currently contain no fish), urbanization (including effects due to water use) has in many watersheds eliminated or dramatically reduced the quality and amount of living space for juvenile steelhead. Groundwater pumping and diversion of surface water contribute to the loss of habitat for steelhead, particularly during the dry season (e.g., NMFS 2005; see also Spina et al. 2006). The extensive loss and degradation of habitat is one of the leading causes for the decline of steelhead abundance in southern California (NMFS 1997, 2006).

A significant amount of estuarine habitat has been lost with an average of only 22 percent of the original estuarine habitat remaining within the range of endangered SC steelhead (Williams et al. 2011). The condition of these remaining wetland habitats is largely degraded, with many wetland areas at continued risk of loss or further degradation. Although many harmful practices have been halted, much of the historical damage remains to be addressed and the necessary restoration activities will likely require decades. Many of these threats are associated with the larger river systems such as the Santa Maria, Santa Ynez, Ventura, Santa Clara, Los Angeles, San Gabriel, Santa Ana, San Luis Rey, Santa Margarita, San Dieguito, and San Diego rivers, but they also apply to smaller coastal systems such as Malibu, San Juan, and San Mateo creeks. Overall, these threats remain essentially unchanged for the DPS as determined by the last status review (NMFS 2016a); however, some individual, site specific threats have been reduced or eliminated as a result of conservation actions such as the removal of small fish-passage barriers.

Environmental monitoring data indicate climatic trends have the potential to affect designated critical habitat for endangered SC steelhead (Feng et al. 2019). Southern California is experiencing an increasing trend in droughts, and currently Ventura County is in a moderate drought (U.S. Drought Monitor 2022[13]). January 2022 was the ninth driest January on record over the past 128 years with a reduction of 4.23 inches from normal rainfall amounts. In

[13] Accessed on February 28, 2022, https://www.drought.gov/states/california/county/Ventura

addition to riverine habitat, estuarine habitat is also highly susceptible to changes in climate. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia et al. 2002).

Wildfires periodically burn large areas of chaparral and adjacent woodlands in autumn and winter in southern California (Westerling et al. 2004). Increased wildfire activity over recent decades reflects sub-regional responses to changes in climate, specifically observations of warmer and earlier onset of spring along with longer summer-dry seasons (Westerling et al. 2004; Westerling and Bryant 2008). The Thomas Fire (2017) affected 11 percent of total designated critical habitat within the range of the species; burned critical habitat was mainly in the Ventura River Watershed (56 percent) and to a lesser degree in the Santa Clara River Watershed (18 percent). The fire burned nearly 80 miles of designated critical habitat.

In general, fire impacts include changes in geomorphology (e.g., sediment filled pools and riffles), decreased pool depth, increased solar radiation owing to losses in riparian cover, changes in water quality, increased dissolved nutrients and pH, and changes in pool-riffle ratios (Dunham et al. 2003; Earl and Blinn 2003; Aha et al. 2014; USFS 2018). However, these effects may be pronounced or muted depending on the fire-burn severity, timing of subsequent rainfalls (e.g., January 9, 2018, storm event), intensity and duration of ensuing rains, and volume of debris and sediment entering streams.

Debris flows are among the most hazardous consequences of rainfall on burned hillslopes (WERT 2018). The January 9, 2018, storm event trigged a debris flow when Matilija Canyon received approximately six inches of rain in 24 hours. This storm event initiated several debris flows within the Santa Ynez Mountains, and consequently inundated areas within Montecito and Carpinteria in Santa Barbara County. The overall peak runoff throughout impacted areas will likely increase relative to unburned areas for the 2-year and 10-year recurrence intervals. Indirect effects from the fire (e.g., mudflow, mudslides) likely increase the extent and amount of habitat destruction downstream to the estuary-ocean interface by altering PBFs essential to the conservation of a species including a delay in development of such features, which the species relies upon during various life stages.

Climate-driven changes to stream and estuarine environments have the potential to significantly impact critical habitat for endangered SC steelhead populations. Coupled with naturally stressful environments at the southern limit of the species distribution, multiple stressors are likely to be amplified by ongoing increases in temperature, changes in precipitation patterns, and decreases in snowpack (Mote et al. 2003; Hayhoe et al. 2004; Hall et al. 2018). Research suggests a change in climate would be expected to shift vegetation distributions as they expand in newly favorable areas and decline in marginal habitats (Kelly and Goulden 2008). When climate interacts with other stressors such as habitat fragmentation, additional threats to natural resources will likely emerge (McCarty 2001), including threats to the viability and resiliency of steelhead populations (see Munsch et al. 2022). In particular, seasonal access to perennial, cool water habitats, especially smaller streams at higher elevations, will likely become more important to endangered SC steelhead seeking refuge from unsuitable temperature and streamflow (Rogers et al. 2020).

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area has three parts: (1) the Santa Clara River Estuary and adjacent wetted mainstem habitat upstream of North Harbor Boulevard for approximately seven miles and south of McGrath State Beach; the exact dimensions south of McGrath State Beach is in constant flux because steelhead-accessible habitat shifts based on how the mainstem and estuary respond to morphological changes induced by high-magnitude storm events including seasonal instream flow fluctuations and the resulting distribution of wetted area (southern part), (2) alignment for the new concentrate outfall diffuser (northern part), and (3) alignment of proposed inland pipelines (eastern part) (Figure 1). The existing Ventura Water Reclamation Facility is at 1400 Spinnaker Drive on the north side of the estuary. The new Advanced Water Purification Facility will be constructed on the corner of Harbor Boulevard and Olivas Park Drive on an undeveloped agricultural parcel (APN 138-005-009), east of the Ventura Water Reclamation Facility. The new ocean outfall will be installed just north of Ventura Harbor, extending about 6,000 feet (approximately 1.1 miles) offshore.

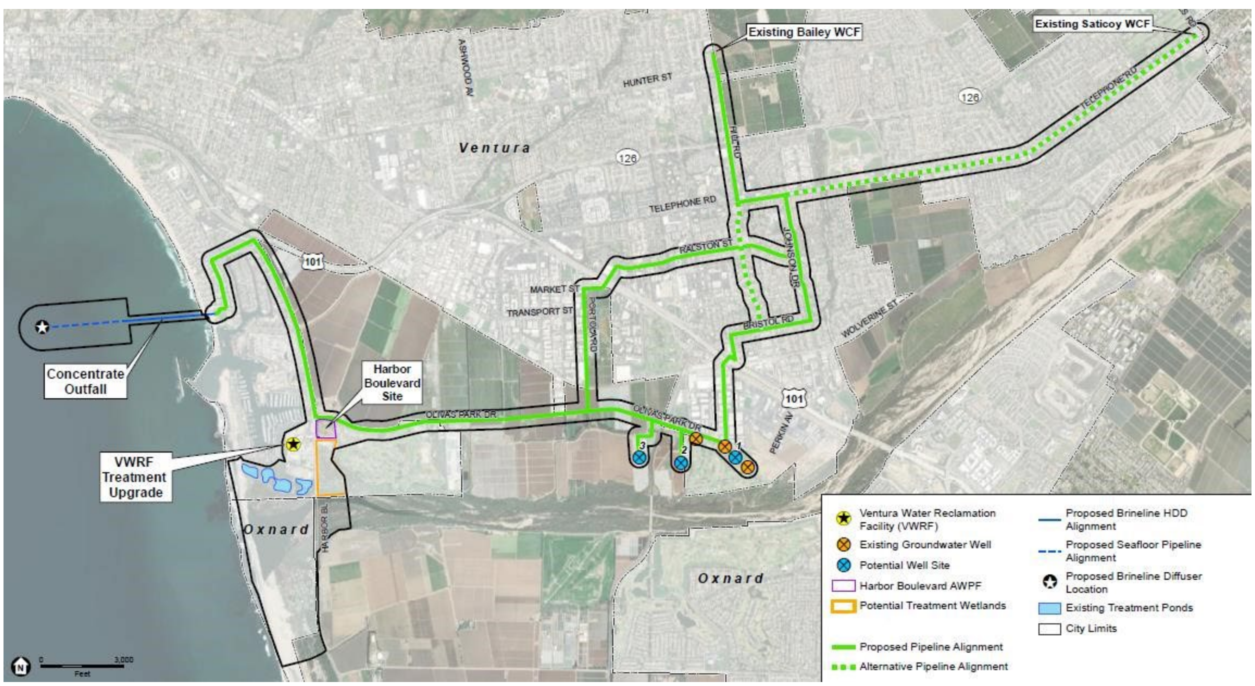

Figure 1. Action Area for the proposed action: (1) the Santa Clara River Estuary and adjacent wetted lower mainstem habitat (southern part), (2) alignment for the new concentrate outfall diffuser (northern part), and (3) alignment of proposed inland pipelines (eastern part). *Adapted from the Biological Assessment (BA 2021).*

2.4. Environmental Baseline

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

The action area includes the marine environment because of the proposed outfall. The ocean was surveyed to identify areas of kelp, seagrasses, and hard substrate to avoid or minimize construction and operational effects by anchors, buoys, cables, and dredging spoils during construction and maintenance. The ocean floor in the action area is soft bottomed with no hard rock reef, eel grass, or kelp forest (Reclamation 2021).

The action area includes the inland, developed landscape because of the proposal for new pipelines. The proposed pipeline alignment crosses and runs adjacent to land parcels zoned for agriculture, urban, and residential development. The proposed inland pipe system occurs in the City of Ventura and crosses no steelhead-accessible tributary to the Santa Clara River, thus there are no steelhead in this part of the action area. Designated critical habitat in the action area is the Santa Clara River inclusive of the Santa Clara River Estuary, thus there is no steelhead critical habitat in the developed landscape part of the action area.

Status of Steelhead in the Action Area

To access the areas of the Santa Clara River where they have been observed (see below), steelhead would have to pass through the action area. Prior to 1940, the abundance of adult steelhead in the Santa Clara River watershed was estimated to have been between 7,000 and 9,000, which is believed to have been the second largest steelhead migration in southern California (Good et al. 2005). While steelhead abundance within the watershed has decreased substantially based on monitoring (see Table 1), a few steelhead adults are observed on occasion in the Santa Clara River at the Vern Freeman Diversion[14] and in areas downstream of the diversion (Table 2). The most recent observations of three adult steelhead in the Santa Clara River occurred in April 2012 (D. Brumback, NMFS, personal communication). These counts probably underestimate the true number of adult steelhead due to various technical difficulties in operating the fish-passage facility and observing passing fish (NMFS 2011). Steelhead juveniles and smolts continue to be observed in the Santa Clara River. Trapping of smolts at the Vern Freeman Diversion indicates smolts emigrate from the watershed (Kelley 2008). An evaluation of passage opportunities between the estuary and the Vern Freeman Diversion during various

[14] The Vern Freemen Diversion is approximately three river miles upstream of the action area and influences the status of the species in the action area (NMFS 2008b; *Wishtoyo Foundation, et al., v. United Water Conservation District*, Order Re: Motions in Limine; Order Denying Without Prejudice Conditional Motion for Joinder and Motion to Dismiss for Failure to Join; Order Denying as Moot Renewed Motion for Preliminary Injunction; and Findings of Fact and Conclusions of Law Holding that Plaintiffs are Entitled to Declaratory and Injunctive Relief on Their Claim for Take of Southern California Steelhead, But Not on Their Claim for Take of Southwester Willow Flycatcher, U.S. District Court, Central District of California, Southern Division, Case No.: CV 16-3869-DOC (PLAx), September 23, 2018).

Vern Freeman operational scenarios revealed most passage opportunities occurred when there was no diversion activity or when the diversion schedule was carried out as described under the Biological Opinion for the operations of the Freeman Diversion by the United Water Conservation District's (NMFS 2008b) Reasonable and Prudent Alternative 2 (Stillwater Sciences 2016).

Table 2. Number of steelhead adults and smolts captured at the Vern Freeman diversion or observed in the Santa Clara River downstream of the Vern Freeman Diversion (sources: Bureau of Reclamation and United Water Conservation District 2004, United 2007, 2008, 2009, 2010, 2011, 2012, 2013, and 2014, Kelley 2008). A "na" indicates no attempt was made to detect individuals for this year.

Year	Adults	Smolts
1994	1	81
1995	1	111
1996	2	82
1997	0	414
1998	na	2
1999	1	3
2000	2	839
2001	2	119
2002	0	3
2003	0	41
2004	0	2
2005	na	na
2006	0	13
2007	na	14
2008	2	133
2009	0	160
2010	0	72
2011	0	19
2012	3	31
2013	0	0
2014	0	11

Status of Critical Habitat in the Action Area

The Santa Clara River Watershed represents a substantial proportion of critical habitat within the endangered SC DPS of steelhead (NMFS 2005). The Santa Clara River mainstem[15] is used by adult steelhead for migration into the upstream tributaries (i.e., Santa Paula Creek, Sespe Creek, Sisar Creek, Hopper Creek, and Piru Creek) and could have been used by juvenile steelhead for rearing because past accounts indicate water was present within sections of the mainstem during the dry season (USGS 2003). The Vern Freeman Diversion and Santa Felicia Dam continue to impede or completely block steelhead access to vast amounts of habitat within the mainstem and tributaries (NMFS 2008a, b). Dams, water diversions, and groundwater pumping have also altered the timing, frequency, magnitude, duration, and rate-of-change of surface flow in the mainstem. Impacts from agriculture, flood-control facilities, highways, bridges, and urbanization have cumulatively reduced the functional value of critical habitat in the action area,

[15] The action area includes approximately seven miles of Santa Clara River lower mainstem habitat and estuarine habitat (i.e., the Santa Clara River Estuary).

and in some portions some functions may have been eliminated (i.e., summer rearing may no longer occur in portions of the mainstem).

The aquatic habitat in the mainstem serves as a freshwater migration corridor. However, the mainstem below the Vern Freeman Diversion, including portions of the action area, may become dry for several miles during the dry season owing to anthropogenic activities. Riparian vegetation is present on the mainstem along the channel banks, within the active channel, and within the confines of levees, where present. The riparian zone is highly variable in terms of species, extent, height, and growth stage, with several types of riparian communities being present including willow riparian forest, cottonwood-willow riparian forest, mulefat scrub, and coyote brush scrub (Padre 2009). In the lower mainstem from the mouth to about five miles upstream (a large portion of the action area), the riparian zone is up to hundreds of feet wide and consists of mature willows, sycamores, and cottonwoods over 30 feet high with trunks up to 12 inches in diameter. The riparian zone in the remaining two miles of the action area measurably narrows due to agriculture, urban development, and the Santa Clara River North Bank Groins.

Portions of the wetted area in the estuary appear suitable for rearing. However, breaching of the estuary berm occurs episodically in response to both natural and anthropogenic influences (see Section 4.1.2.2 of the BA 2021). The occurrences of trenching were first noted in March 2016 and several times thereafter throughout the remainder of the year. The trenching was routinely on the north side of the lagoon (ESA 2018). The unauthorized breaching results in an estuary mouth open during drier years with open-mouth periods persisting many days longer than those during storm-induced periods (BA 2021).

The natural salinity changes in the estuary, observed during certain conditions (BA 2021), can be reduced by the tertiary-treated discharge from the Ventura Water Reclamation Facility (VWRF) when the sand berm is closed. The current salinity and freshwater profiles and observed trends, particularly during dry weather conditions, benefit invasive species, which prey upon and compete with endangered SC steelhead (BA 2021).

Factors Affecting Steelhead and Critical Habitat within the Action Area

Ocean conditions at the proposed outfall.—Marine habitats within the action area include the intertidal nearshore zone to deep subtidal open water habitat. The marine part of the action area is within the Southern California Bight (SCB) coastal environment, which extends more than 600 km from Point Conception (USA) to Punta Banda (Mexico) and represents a unique ecological resource. The SCB coastal region is physically affected by the cold, southward-flowing California Current mixing with the warm, northward-flowing Davidson Counter current (BA 2021 and references therein).

Pollutants enter coastal nearshore waters through river drainages, municipal and industrial wastewater discharges, dumping, air emissions, chemical spills, vessel discharges, and surface runoff (BA 2021). The predominant source of pollutant loading has shifted from point-source wastewater discharges to nonpoint-source urban runoff. Historical pollutant discharge has left contamination in nearshore waters and sediments often at levels of potential biological concern as reflected in the Clean Water Act (CWA) Section 303(d) listing for nearshore waters (BA

2021). Areas of the nearshore coastal waters off Ventura County, including those in the action area, are listed on the CWA Section 303(d) list as non-attainment for bacteria, arsenic, cadmium, DDT, Dieldrin, PAHs and PCBs (BA 2021 and references therein).

Dams and Water Diversions.—The action area is impacted by dams and surface-water diversions. The dams and diversions alter the natural flow regime in terms of the timing, duration, magnitude, and frequency of flows that reach the lower river and estuary; this alteration decreases the quantity and quality of critical habitat in the action area. Within the Santa Clara River Watershed on Piru Creek, Santa Felicia Dam impounds most of the natural flows from the upper watershed at Lake Piru (NMFS 2008a). The Vern Freeman Diversion on the lower Santa Clara River also diverts considerable amounts of water out of the mainstem during the year, and shunts the water to percolation ponds for groundwater recharge. This diversion is an impediment to adult and juvenile steelhead migration (NMFS 2008b).

Groundwater extraction wells exist on the Santa Clara River. Ecological consequences of dams and diversions and groundwater pumping on the Santa Clara River involve a severe reduction in steelhead migratory opportunities and reduction in the functional value of the aquatic habitat, including aquatic habitat in the action area, due to impacts to the natural hydrograph (NMFS 2008b). Other ecological consequences of dams and water diversions in the Santa Clara River involve habitat fragmentation, steelhead sub-population isolation, reduction in diversity, and disruption in spatial structure of the steelhead population due to the impediment to or elimination of volitional migration throughout the watershed. These ecological impacts reduce the viability of the steelhead population in the Santa Clara River Watershed and increase the risk of species extinction (Boughton et al. 2006).

Land Use and Urbanization.—Due to the increasing human population in southern California over the last several decades, there has been an increase in land-use activities and development of large tracts of land within the action area. Land-use activities include urban and industrial development, agriculture, ranching, gravel and sand mining, oil extraction, and road construction. Collectively, development in the watershed has changed the quantity and timing of water delivered to the estuary as well as the quality of that water (Anderson and Ambrose 2011; Beller et al. 2011).

Conversion of wildlands for agriculture in the watershed affects the action area. Agricultural and ranching activities increase runoff of nitrogen from fertilizers and animal waste, pesticides, and fine sediments into the lower Santa Clara River mainstem. An increase in agricultural runoff results in eutrophication (i.e., excessive nutrients) of mainstem and the estuary habitat (Weaver and Garman 1994; Bowen and Valiela 2001). Eutrophication can have negative effects on steelhead and critical habitat because it results in excessive blooms of algae and bacteria (Spence et al. 1996).

Increased human population densities adjacent and upstream of the action area has led to an increase in sewage treatment and treated effluent discharge into the Santa Clara River Estuary by the City of Ventura. What follows is a summary of the environmental baseline concerning the discharge of the VWRF effluent and associated consequences to the estuary, endangered SC steelhead, and designated critical habitat for this species. Specifically, we summarize (1) the historical and ongoing frequency, timing, duration, and volume of the effluent discharge relative to streamflow patterns in the action area, (2) the characteristics of the water quality discharged with implications for maintaining natural estuarine dynamics and water quality, and (3) the consequences of the effluent discharge for designated critical habitat and endangered steelhead.

For approximately 62 years to date, the discharge from the VWRF into the Santa Clara River Estuary continues to alter natural estuarine processes through water quantity changes resulting in a shift away from historical hydrology (Figure 2). Discharge moves from the VWRF via the effluent transfer station (ETS) to the Wildlife/Polishing Ponds and then to the estuary via the Parshall flume (Site D-1 or NPDES M-001A). ETS and D-1 discharge typically differ by approximately two cfs, which is attributed to water loss from the ponds via evaporation and groundwater seepage to the estuary and the semi-perched aquifer (Stillwater Sciences 2018a). Specifically, the discharge alters berm-breach morphology given the following: (1) the discharge is frequently the only source of freshwater contributing to the estuary during extended dry-weather periods; (2) the discharge increases the likelihood of berm breaches during summer, and (3) the discharge is a continuous source of water when the lagoon drains after a breach.

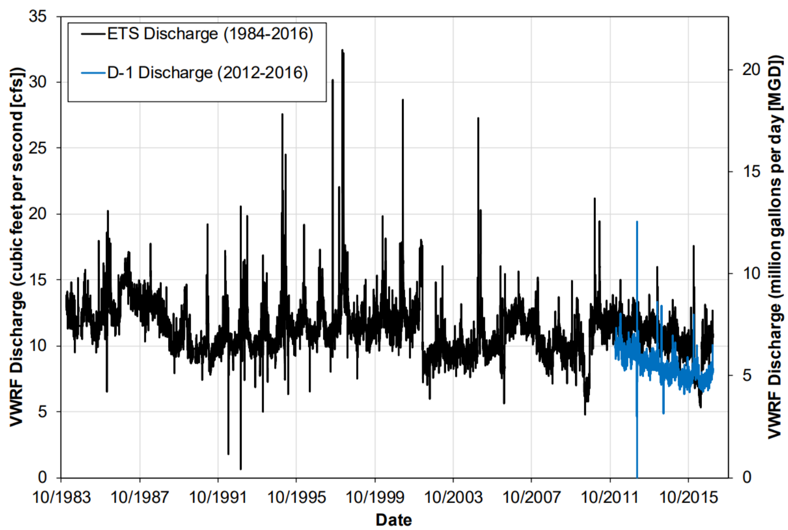

Figure 2. VWRF daily mean discharge measured at the ETS (1984–2016) and D-1 (2012–2016) monitoring stations (Source: Figure 3-13, in Stillwater Sciences 2018a).

The discharge alters local hydrology by increasing the total inflow volume, and constitutes the dominant freshwater, surface flow to the Santa Clara River Estuary, particularly during dry weather when streamflow is low (Figure 3). Historically, streamflow in the action area is typically low during summer and fall in most years (Revell et al. 2018 and references therein). Stillwater Sciences (2018a) compared VWRF discharge with Santa Clara River discharge; this comparison revealed a similar seasonal pattern with the greatest flow occurring in February and the least in the summer months. In wetter months, the effluent discharge (at D-1) has been about one-tenth compared to the Santa Clara River discharge; in contrast, during late summer (August–September), the monthly mean VWRF discharge into the estuary (at D-1) has been an order of magnitude greater than the Santa Clara River discharge.

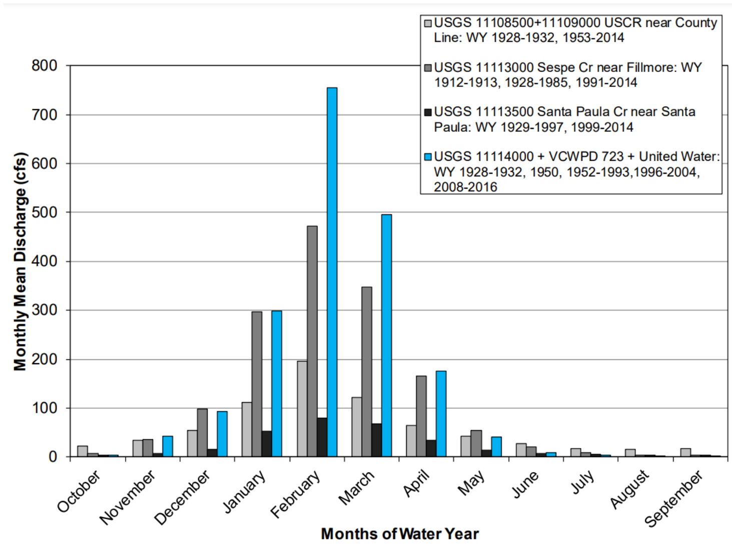

Figure 3. Monthly mean streamflow of lower Santa Clara River watershed based on compilation of available long-term gaging records through water year 2016 (Source: Figure 3-9, in Stillwater Sciences 2018a).

Nutrient loading from VWRF discharge likely contributes to algal blooms and algae-mediated dissolved oxygen variations (Stillwater Sciences 2018a,b). Past and current nutrient related water-quality conditions indicate significant eutrophication and extremely low dissolved-oxygen concentrations for extended periods. With respect to nitrogen and phosphorus loads and observed levels of each in the estuary, the dominance of the discharge in the summer relative to other inflow sources to the estuary suggests nitrogen and phosphorus loading from the discharge contribute to high nutrient concentrations levels. The interactions, particularly during dry-weather conditions (summer/fall), between nutrients in the discharge and algal growth conditions, are influencing dissolved oxygen trends and do not support the estuarine ecosystem (e.g., Kennish et al. 2014; Adams et al. 2020; Brooker and Scharler 2020; Stein et al. 2021).

The ongoing VWRF discharge precludes the maintenance of natural habitat characteristics and condition for endangered SC steelhead (Anderson and Ambrose 2011; Stillwater Sciences 2018a,b; Revell et al. 2018). There are at least a few consequences from the discharge to the estuary: (1) the estuary is more likely to breach during the summer and fall, (2) there is more water (and more water surface area) in the estuary than we would expect given the extant upstream water diversions, (3) the benthic community (invertebrates) is dominated by freshwater species due to the generally lower salinity as compared to typical estuarine communities; the lower salinity reduces marine taxa, (4) the anthropogenic dry-season breaching increases the potential for detrimental and lethal impacts[16] to steelhead (Swift et al. 2018), and (5) the predominance of freshwater in the estuary throughout the year, and particularly during summer and fall, benefits invasive species, which prey upon and compete with steelhead.

[16] For example, the September 17, 2010, breach killed seven steelhead and thousands of tidewater gobies (TRT 2017-2018).

A portion of the VWRF discharge[17] is wastewater derived from the Ventura River or its tributaries stored in Lake Casitas for service to the western portion of the City of Ventura—the amount varying depending on the amount of water available from these sources. The discharge derived from either the Ventura River or its tributaries (including water stored in Lake Casitas) would not historically have been part of the estuary's freshwater inputs (Revell et al. 2018). In addition, a portion of the VWRF discharge originating from the eastern area of the City of Ventura is derived from deep groundwater aquifers in the Santa Clara River watershed—the amount varying depending on the amount of water available from these sources (see Figure 4-1 in Stillwater Sciences 2018a). While these deep groundwater sources would not contribute directly to the estuary's freshwater inputs, there is an important (and overlooked) relationship between the extensive groundwater extractions and related surface diversion/groundwater recharge program in the Santa Clara River valley and the amount and pattern of surface flows to the Santa Clara River Estuary (NMFS 2021, 2022).

Furthermore, studies indicate the Santa Clara River Estuary is hydrologically connected to the upper aquifers within the Oxnard Subbasin (whether semi-perched or simply shallow groundwater aquifers). According to a water-balance assessment conducted by Stillwater Sciences (2011a, 2011b) for the fall/winter period of 2010, "groundwater was estimated to contribute approximately 15% of the inflow volume . . ." For the summer/spring 2010 period, "the groundwater contribution was estimated at 10 percent . . .". The Stillwater study also indicates in the "Santa Clara River reach upstream of the estuary, groundwater provides the dry summer baseflow, if it exists, and is a quarter of the winter flow, based on the 2010 water year assessment."

In an effort to retain functional values of estuarine habitat, Revell et al. 2018, make the following assumption based on the existing practice of placing discharge into an estuary:

> *...zero discharge from the VWRF (i.e., 100% discharge diversion) is ecologically preferred unless there is evidence to the contrary. The rationale is that under "natural" hydrologic conditions, the Santa Clara River would be a seasonally flashy system, with most discharge events occurring in the winter and early spring, and low or no surface water discharge in summer… Any VWRF discharge volumes recommended… would be based on mimicking the SCRE natural hydrology to support species migration or life cycle needs* (page 4).

It should be recognized, however, VWRF wastewater discharged directly to the Santa Clara River Estuary does not support the same ecological functions as surface flow to the estuary originating upstream; such surface flows support transitional habitats and can provide cues important to the movement of aquatic species, including endangered SC steelhead.

In summary, anthropogenic changes to freshwater inputs alter natural distribution and characteristics of the estuarine ecosystem and reduce the quality of available living space for

[17] The VWRF provides treatment services to approximately 98% of City residences, thus inputs that make up the discharge come from a variety of service locations. Approximately 9 million gallons of wastewater are generated per day and are carried by more than 375 miles of sewer mains and 14 lift stations to the VWRF.

endangered SC steelhead. The behavior, ecology, and survival of steelhead are inextricably linked to the natural streamflow regime (Richter et al. 1996, Richter et al. 1997, Lytle and Poff 2004, NMFS 2016b). Thus, the Santa Clara River Estuary is currently functioning in ways less than optimal for steelhead health and survival.

Flood-control Facilities.—Land-use activities and increased development led to the need for flood-control facilities starting in the 1900s, including the construction of levees and other flood-control facilities (e.g., modified ephemeral channels, debris basins, bank groins, drain outlets, and stream gauges) along the Santa Clara River mainstem in the action area to protect human infrastructure. Flood-control facilities such as levees and stabilized banks negatively affect steelhead habitat in several ways (NMFS 2013; 2014a, b; 2017; 2019; 2020). Levees have been shown to alter fundamental natural processes, which allow habitat in rivers to form and recover from disturbances such as floods, landslides, and droughts. Among the physical and chemical processes basic to habitat formation and salmonid persistence are floods, sediment transport, nutrient cycling, water chemistry, woody debris recruitment, and floodplain processes (Brookes 1988). Levees and bank stabilization restrict and alter these processes, thereby reducing aquatic habitat diversity, complexity, and quality for steelhead (NMFS 2020). Cumulatively, these impacts simplify habitat structure with limited available cover and reduce the functional value of migratory and rearing habitat for steelhead in the action area.

Traditional flood-control methods preclude the natural behavior of channels by deepening, smoothing, and straightening, thus speeding the movement of high-flow events, and unfortunately sediment bedload, out to sea (see NMFS 2014a). The effects on steelhead habitat are observable in the action area, and appear to be most acute in areas where the levees are in close proximity to the active channel. Because levees on the Santa Clara River are either covered with grout or rock riprap, riparian vegetation is unable to establish on levees. Consequently, riparian shade, cover, and channel roughness (e.g., woody debris) is negligible where levees are present near the mainstem. Also, there are riprap-stabilized banks, riprap-protected bridges, and rock groins present along the mainstem in the action area, specifically the six existing bank groins on the north bank of the lower Santa Clara River (see Table 4 in NMFS 2019).

The largest facilities in the action area are levees within the floodplain necessitated by urban and agricultural encroachment along the Santa Clara River mainstem. The Ventura County Watershed Protection District (VCWPD) recently finished the "scoping" process of determining the focus and content of the Environmental Impact Report on a levee-realignment project (SCR-1 Levee[18]). Consequently, this re-alignment is expected to maintain the existing levee in the action area including improvements to meet certification standards and extend the useful life of the structure in a meaningful way, and thus would perpetuate ongoing effects of the existing levee into the future (Tetra Tech 2015).

[18] The SCR-1 system, which was designed by the U.S. Army Corps of Engineers in 1958, to control the standard project flood discharge of 225,000 cfs, is in the city of Oxnard and unincorporated areas of Ventura County, California. SCR-1, owned and operated by the VCWPD, is 4.72 miles along the southeast bank of the Santa Clara River between U.S. Highway (Hwy) 101 and Saticoy. See details on the Santa Clara River Levee Rehabilitation Project (SCR-1 CEQA): https://www.vcpublicworks.org/wp/santa-clara-river/santaclarariverlevee/scr1ceqa/.

Invasive Species.—Potential impacts from non-native, invasive species (NIS) include reduced growth, reproductive output, and abundance of native individuals; increased probability of native population extinction; and depressed ecological functioning of the estuarine community as a whole (Anderson and Ambrose 2011). Most NIS are either direct or indirect competitors with endangered SC steelhead. Many of the predatory NIS fish such as carp (*Cyprinus carpio*) and green sunfish (*Lepomis cyanellus*) refuge in the deeper-water habitat out of range for avian predators. The lower salinity trends within the estuary due to VWRF discharge is likely contributing to sustaining water-quality conditions that support reproduction, growth, and stability of NIS populations in the action area.

Climate change.—NMFS considers the impact of climate change predictions and forecasts within this section by referencing back to climate discussions within the Status of the Species (see sub-section *Regional Climatic Variation and Trends*). In summary, temperatures are likely to increase in the action area during this century, and flash floods are likely to increase in frequency. Thus, baseline conditions during the next 60 years are not likely to mirror past conditions. The magnitude and frequency of droughts, severe floods, and fires have been increasing and are likely to continue to increase over time. Finally, the "signal" of climate change in projections can't easily be distinguished from the "noise" of natural climate variability over short-time periods (e.g., 10 years) (Deser et al. 2012; McClure et al. 2013).

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

<u>Exposure-Response Framework</u>

We analyzed whether endangered SC steelhead and their designated critical habitat would be exposed to the effects of the proposed action, including construction of the Facility and changes to conditions in the estuary resulting from reduced discharge from the VWRF. If this species and critical habitat would be exposed to the effects of the proposed action, we predicted their response. In this context, we analyzed the discharge withdrawals (i.e., reduced discharge) from the Santa Clara River Estuary to predict the potential consequences of the withdrawals for the availability and quality of living space for steelhead.

There will be no effects to the species or critical habitat from upland construction because construction will utilize existing disturbed or developed sites to avoid disruption to existing sensitive resources and eliminate all adverse effects to sensitive, natural habitat; specifically, the work sites completely avoid estuarine habitat including the river channel.

For construction and offshore discharge effects in the marine environment as a result of the proposed ocean outfall, there is no available movement or tracking studies to inform our understanding of where endangered SC steelhead go once they leave the Santa Clara River Estuary. There is no data on the densities of endangered SC steelhead offshore from the Santa Clara River, although we expect endangered SC steelhead adults to be present offshore during the late fall and winter as they arrive to migrate upstream to spawn, and we expect smolts present offshore when the Santa Clara River Estuary is open to the ocean.

Exposure to discharge of concentrated effluent from the outfall or turbidity when the outfall is constructed would be extremely unlikely as steelhead could easily avoid elevated turbidity. In addition, ocean currents and swimming behaviors will likely dominate steelhead movement so it is unlikely the species will remain stationary near the outfall as ocean survival heavily depends on efficient and directed movements between or among distant habitats and oceanic foraging grounds. Steelhead would likely avoid work boats and other equipment if they encountered them because there is plenty of equally suitable habitat nearby, thus resulting in no consequences to their fitness.

The seasonal consideration represented in our effects analysis emphasizes the dry season because the potential effects of the discharge withdrawals from the estuary would be most pronounced when river flows (and therefore inflows to the estuary) are lowest. We don't expect more than negligible effects from the proposed discharge withdrawals during the wet season because the proposed reduced discharge is not expected to alter the magnitude, frequency, or duration of the Santa Clara River's storm hydrograph. During the wet season, changes to the estuary (water-surface elevation, surface area, volume, salt concentrations, dissolved oxygen, etc.) are expected to be largely a result of storm flows; wastewater discharge has only miniscule impacts on these parameters at this time.

<u>Effects on Designated Critical Habitat</u>

Natural breaching.—Natural breaching frequency is a critically important physical process of the action area (Ambrose and Anderson 2011; Revell et al. 2018). Increasing the volume of water stored in an estuary through artificial supplementation can dramatically increase the number of times an estuary breaches in summer. Baseline conditions include increased breaching of the lagoon (over what would likely occur naturally) due to current VWRF discharge. This increased breaching currently results in a rapid change in lagoon water-surface elevation and changes the lagoon from freshwater to brackish water within hours. The effects of the proposed action would include avoiding these sudden changes in water level and salinity. The proposed phased wastewater withdrawals (reduction in discharge) will allow water levels in the lagoon to gradually lower as the lagoon transitions to summer, dry-period conditions. Because, under the proposed action, the VWRF would contribute less (phase 1) and eventually almost no wastewater (phase 2) to the lagoon, the proposed action would minimize the likelihood and decrease the frequency of artificial breaches during typical summer, dry-period conditions. Thus, the proposed action, when added to the environmental baseline, is expected to result in a beneficial shift toward a more natural breaching regime. However, other detrimental habitat conditions identified above in the Environmental Baseline section are likely to remain (channelization due to levees, for example) as they are unaffected by the amount of VWRF discharge.

Nutrient loading.—As described above, the current VWRF discharge influences the ecological function of the action area via changes to water-surface elevation and salinity. In addition, nutrient loading as a result of the existing discharge contributes to the extent, frequency, and intensity of algal blooms and associated periods of extremely low dissolved oxygen conditions for steelhead in the action area (Stillwater Sciences 2018b). The proposed action, by reducing and then largely eliminating wastewater discharge to the lagoon, would avoid the potential to artificially accelerate algal growth rates and is not expected to influence the duration of low dissolved oxygen levels. Reducing VWRF discharge to 0.5 MGD or less would minimize nutrient loading and reduce the probability and duration of hypoxia that has been observed in the estuary (Revell et al. 2018). Much less potential remains for hypoxia going forward as a result of the proposed action because the proposed action is expected to be a beneficial shift toward optimal water-quality conditions important for maintaining functional estuarine habitat for rearing juveniles and migrating smolts.

Salinity stratification.—The current discharge inhibits salinity stratification in the action area. NMFS expects the proposed action, by reducing the amount of wastewater discharged into the estuary, especially during the summer months, will shift the estuary toward a more brackish (saline) environment (e.g., Cravo et al. 2022). This shift is expected to increase spatial heterogeneity creating a mosaic of vertical and longitudinal physicochemical conditions (e.g., Quintana et al. 2018; Largier et al. 2019; Bond et al. 2021). Consequently, a brackish environment helps create habitat refugia for steelhead by stabilizing the lagoon food web (e.g., Young et al. 2022); this refugia also reduces competition and predation risk from invasive and/or predatory species (Hayes et al. 2008, 2011; Revell et al. 2018; Clark and O'Connor 2019). Thus, the proposed action is expected to help create refuge-habitat conditions important for rearing juvenile steelhead and migrating smolts.

Habitat quantity and quality.— The presence of a natural, properly functioning estuary in a watershed is crucial for allowing juvenile steelhead to pursue variable life-history pathways that favor growth and increase the likelihood of smolt-to-adult survival (Bond et al. 2008). The existing steelhead-accessible habitat is approximately 91 acres, and is predicted to be reduced to 69 acres under Phase 1a, and further reduced to 24-32 acres under Phase 1b (Stillwater Sciences 2018a). Collectively, the phased approach will result in a maximum reduction (or loss) of 67 acres of steelhead-accessible habitat; 26 percent of the existing steelhead-accessible habitat will remain.

With regard to habitat quality, the available information indicates the current habitat formed under baseline conditions through the effluent discharge may not be suitable living space for steelhead (Anderson and Ambrose 2011; Stillwater Sciences 2011b; Revell et al. 2018). It is clear the historical and ongoing inputs of the effluent can and do negatively impact the quality of physical and biological features of the estuary (TRT 2017-2018; Stillwater Sciences 2018a,b).

To this end, although the expected reduction and ultimate elimination of effluent discharge will likely result in reduced steelhead-accessible habitat, the elimination promotes restoration of natural estuarine characteristics and condition, which favors the creation and maintenance of habitat that is not only accessible to steelhead, but contains many, if not most, of the features needed for healthy juvenile steelhead growth including a mosaic of habitat types[19] likely present prior to the introduction of the VWRF discharge (see Table 5-5 in Stillwater Sciences 2018a).

Habitat response to climate under the proposed action.—Overall, climate predictions including projected changes in streamflow and stream temperature suggest an increase in the frequency and intensity of drier conditions, flooding events, and precipitation extremes with shrinking suitable habitat for steelhead (Pagán et al. 2016; Mallakpour et al. 2018; Rogers et al. 2020). Collectively, these anticipated shifts including future wetland loss due to sea level rise (SCWRP 2018; Stein et al. 2020) may further reduce the availability and quality of estuarine habitat over the approximated 60-year lifespan of the proposed action. In this regard, we anticipate water-quality alterations, chiefly an increase in temperature and salinity, would be observed, particularly given extended dry periods with more frequent berm closures according to climate projections (Harvey et al. 2020). In addition, reduced freshwater streamflow has the potential to decrease the availability of steelhead living space in both the estuary and the lower mainstem of the Santa Clara River. These responses are not expected to influence the effects of the proposed action on habitat given the proposed action's phased approach over the next eight years is intended to mimic more natural conditions under which the species evolved.

Monitoring and Adaptive Response Management.—The proposed action includes sweeping a sein through the water column at various locations within the action area. This activity can disturb bottom substrate and create temporary periods of elevated turbidity. However, based on the frequency, duration, and distribution of seining efforts these effects are expected to be localized and at an extremely low magnitude dissipating within 1-2 hours. The proposed seining methods will likely result in temporary and negligible changes to physical and biological features of designated critical habitat.

The proposed analyses and management of data annually will ensure documentation of status and trends in response to Phase 1a discharges relative to existing conditions documented during PCAP monitoring. The proposed annual communication of findings to NMFS will help determine if and when to adjust management actions and/or monitoring to improve project performance and inform future actions. Following Phase 1a discharge reduction implementation, the City will coordinate with NMFS on evaluating data and trends to determine whether reducing discharge below 1.9 MGD would avoid adverse effects to designated critical habitat as expected.

If the information and analysis provided by the MAAMP indicates reducing the average annual discharge flows below 1.9 MGD would result in adverse effects to endangered SC steelhead, then the actions described in the MAAMP would be implemented to avoid and minimize the adverse effects resulting from the phased approach. The following three indicators (see Table 8 in PCAP 2021) will help determine if the phased approach is resulting in unanticipated adverse effects to designated critical habitat: (1) increase in unseasonal breaching, (2) degraded water

[19] Habitat-type categories described in the Biological Assessment (2021) that will change in acreage given the reduction in open water habitat under the proposed phased approach in reducing effluent discharge: open beach, tidally exposed mudflat, freshwater wetland, riparian, and riparian riverwash.

quality, (3) loss of steelhead habitat suitability, and (4) increase in non-native fish and amphibian assemblage.

The specific response actions to unexpected adverse effects as guided by the MAAMP are not yet drafted given the NPDES permit for the facility requires the MAAMP be developed and refined in coordination with CDFW, USFWS, NMFS, Heal the Bay, and Wishtoyo Foundation's Ventura Coastkeeper Program. The MAAMP will be implemented in coordination with USFWS, NMFS, CDFW, and the RWQCB to ensure reduction in tertiary-treated discharge minimizes adverse effects to endangered steelhead and designated critical habitat within the Santa Clara River Estuary. If unexpected adverse effects are observed or documented, then the City will, in consultation with the RWQCB, either implement measures to avoid adverse effects or terminate the monitoring program and not implement Phase 1b.

Effects on Endangered Steelhead

We determined juvenile steelhead, including smolts, that may seasonally rear or temporarily hold in the lower river and estuary are likely to be affected by the proposed action. We do not expect adult steelhead to be affected by the proposed VWRF discharge withdrawals because this life stage migrates during rain-induced periods of elevated winter and spring river flows. The withdrawals are not expected to have more than a miniscule impact on estuarine volume or flow as elevated river flows entering the estuary will control estuarine flushing and volume during winter (e.g., Largier et al. 2019).

Estuary breaches.—Unseasonal breaching (manipulating water-surface levels to encourage a breach earlier than it would naturally) creates rapid change in water-surface levels for the species. Unseasonal breaching results in stranding, premature transport out of the estuary, and exposure to high salinities in the estuary when juveniles are not physiologically prepared, which induces stress. The proposed action will reduce unnatural overfilling and cease the practice of abnormally increasing water-surface levels, and consequently, decrease the risk of potentially lethal effects from unseasonal breaches to migrating smolts and juvenile steelhead rearing in the action area. Ultimately, manipulating water-surface levels from discharge inputs will be avoided, thus we expect a beneficial shift toward a breaching frequency under which the species evolved.

Nutrient loading.—Low dissolved oxygen proximate to the discharge point during warm, summer months reduces habitat quality because respiring algal biomass robs the water column of oxygen (Ambrose and Anderson 2011). Low dissolved oxygen adversely affects species growth rates, reduces food-conversion efficiency, and adversely affects swimming performance particularly at higher water temperatures (see Carter 2005). Under the proposed action, the reduction in discharge is not expected to contribute or perpetuate low dissolved oxygen areas in the estuary, thus we do not expect adverse effects to steelhead from low dissolved oxygen levels as a consequence of the proposed action. We expect a beneficial shift toward a nutrient loading regime, which approximates historic conditions under which the species evolved.

Salinity stratification.—Under the proposed action, the anticipated salinity stratification that would likely occur would support juvenile steelhead growth and fitness by increasing the likelihood of survival. Recently in a central California coastal lagoon, investigators observed high juvenile Central California Coast (CCC) steelhead abundance and growth rates during late summer despite strong stratification gradients and a substantial reduction in favorable freshwater rearing habitat (see Bond et al. 2021). During spring and summer when the estuary is partially open and freshwater and saltwater become stratified, the salinity gradient helps provide rearing habitat for juveniles who are not yet fully acclimated to higher salinities, thus the shift to natural seasonal and spatial variations in salinity is not expected to slow growth rates or limit fitness of individuals utilizing the action area prior to a natural breach (e.g., Largier et al. 2019; see Table 1 in Clark and O'Connor 2019). During later summer and fall as salinity increases from wave overtopping, under the proposed action, juveniles have the ability to physically adapt to ocean salinity prior to a natural breach. The seasonal increase in salinity will also reduce the likelihood of invasion by aggressive, nonnative plant or animal species (TRT 2017-2018; Revell et al. 2018), thus the proposed action is not expected to reduce individual fitness levels of juveniles or increase predator abundance.

Habitat use.—The expected reduced quantity of steelhead-accessible habitat that is formed by the unnatural effluent discharge under the proposed action is not likely to limit juvenile steelhead rearing or preclude access to food sources (e.g., benthic macroinvertebrates, drifting invertebrates) prior to ocean entry. Although the overall acreage may be reduced, the capacity of the living space to support steelhead rearing is promoted by maintaining mouth-closed conditions for as long as possible during the summer rearing period (Revell et al. 2018). Based on the expected type, amount, and extent of beneficial shifts to natural features of designated critical habitat, we anticipate the proposed action would create additional prospects in the action area for growth and survival of juvenile steelhead to the smolt stage in the action area.

The reduction and ultimately elimination of the effluent from the estuary will favor a return to more natural physical and biological features and estuarine dynamics, which more closely align with historical conditions including less introduced, invasive fish predators and food-source competitors for steelhead. Consequently, the proposed action is not expected to reduce individual fitness of juvenile steelhead. Ultimately, steelhead life history strategies did not include a dependence on anthropomorphic discharges of tertiary-treated wastewater to estuarine habitats (TRT 2017-2018).

Monitoring and Adaptive Response Management.—The proposed action includes fish-collection methods for two purposes: (1) confirm and update the existing baseline hydrological, chemical and biological conditions, and (2) record the ecological response of fish populations to changes in the quality of the habitat following wastewater withdrawals (i.e., reduced discharge). Proposed seining will result in adverse effects to the species when incidental capture occurs. Although the proposed action contains measures to minimize effects on steelhead, our experience with general fish-collection methods indicates injury and death of a small number of juvenile steelhead is possible and probable. NMFS expects the number of juveniles that will be injured or killed as a result of entanglement or crushing during seining activities is extremely low, typically less than 1 to 2-percent of the total number captured (B. Struck, NMFS, 2012-2022, personal observation). We do not anticipate injury or lethal effects to adults based on the following: larger body size, better swimming capabilities, and extremely low likelihood of encounter based on the proposed frequency and duration of seining activities.

The proposed 8-year seining period is for monitoring effects expected to occur within approximately 13% of the proposed action's duration based on the approximate lifespan of the ocean outfall upon construction (60 years). Seining frequency will occur up to four times per year, thus capture of individuals at both the juvenile and adult life stage is possible. Therefore, NMFS anticipates up to ten juvenile steelhead would be captured four times a year and one adult steelhead would be captured every year owing to the likelihood of life stage present during each season, and no more than one individual juvenile would be injured or killed each year during the seining activities.

The anticipated magnitude of adverse effects is based on past unseasonal breaching resulting in lethal effects, and our familiarity with the action area, including abundance of steelhead, which may be highly variable each year given abundance and species composition of estuarine fish assemblage can change in response to high-flow events (e.g., Weitkamp et al. 2012). Our review of the available information, all previous studies and reports on the estuary, and consideration of climate variability and steelhead population variability over the next sixty years (i.e., storm/rainfall timing; amount and frequency of elevated flows; predictions of larger, more intense storms with periods of longer more intense droughts) indicates no more than 320 juvenile steelhead and eight adult steelhead would be adversely affected throughout the duration of the proposed 8-year seining period. Additionally, we expect a total of eight juvenile steelhead to experience injury and possibly death as a result from the seining-capture-handling-release process.

The proposed seining-capture-handling-release process can induce stress and temporary disorientation. Direct injury and mortality can result from physical trauma from contact with humans or machinery. Specifically, direct injury may impair fish movement, feeding, and survival. Fish collecting gear, whether passive (Hubert 1996) or active, has some associated risk to fish, including stress, disease transmission, injury, or death. To minimize the risk of injury or mortality the City proposes seining along with aeriated buckets for capturing and releasing individuals. Anticipated level of injury is based on risks associated with handling steelhead in addition to other factors such as exposure to elevated water temperature and low dissolved oxygen prior to being incidentally captured. NMFS expects lethal effects to one juvenile every year. This is based on the spatial distribution and frequency of proposed seining activities in the action area.

There are several process-related details absent from the proposed monitoring efforts that would further minimize adverse effects to the species such as injury throughout the seining period. The City does not specify the areas of expertise required of a biologist who will be capturing, handling, and releasing the species. The proposed action does not include the number of biologists to carry out activities associated with capture, handling, and releasing. An insufficient number of biologists to carry out such activities lowers efficiency during the seining effort and likely exposes the species to a higher risk of injury. Also, the City does not specify the activities the biologist should be doing while seins are in the water or once captured individuals are temporarily placed in buckets, nor does the City propose a mechanism to quickly identify and address entanglement issues during the seining process. The proposed action does not include reporting the number of steelhead observed and captured in the seined area, the number of steelhead released, and the date and time of the collection and release. Also, the proposed action doesn't include specific details as to what would be included in the proposed annual report such as measurements on the physical and biological features of critical habitat present at the time of capture or documentation of potential smolting characteristics of captured individuals; these observations inform the ecological interaction between proposed changes in salinity and physiological traits of steelhead during their time in the estuary.

During the seining period, the proposed action includes a notification to NMFS by the City if steelhead become entangled in nets. This would allow NMFS to recommend additional measures to reduce future entanglement for the remainder of the monitoring season.

Species response to climate under the proposed action.—Endangered SC steelhead will be responding to changes in water quality and the biological communities in the action area; these changes are anticipated to continue to evolve as the projected drying climate will generate areas of poor flushing and high salinity (e.g., Huang et al. 2020). For example, investigators tracked late fall upstream movement of CCC steelhead in the Pescadero Intermittent Estuary (Huber and Carlson 2020). Movement allows fish to escape lethal water quality conditions coincident with the transition from closed to open estuary; movement behaviors like this have been observed before in a seasonally closed estuary in central California (Hayes et al. 2008, 2011) and likely remains a response strategy to enhance population resiliency during extended sandbar-closed conditions (Huber and Carlson 2020). This proposed action is not expected to influence Santa Clara River discharge to the estuary, thus will not limit or restrict the opportunity for upstream movement in the action area. This opportunity supports this species response strategy of moving between freshwater and estuarine habitats seasonally and adjusting their osmoregulatory physiology (Hayes et al. 2008, 2011). Because the proposed action will likely provide higher quality estuarine habitat for steelhead, it will help increase Santa Clara River steelhead resilience during years when habitat shrinks and becomes less available in the future. This is because improved estuarine rearing is likely to increase the overall survival of Santa Clara River steelhead, bolstering their numbers and distribution to help withstand climate change impacts.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation [50 CFR 402.02 and 402.17(a)]. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Other impacts identified in the Environmental Baseline section (e.g., agriculture, urbanization, flood-control structures) will continue to impact the species and designated critical habitat in the action area. Anthropogenic changes to freshwater inputs alter natural distribution and characteristics of the estuarine ecosystem and change the quality of available living space for endangered SC steelhead. These landscape changes to the riparian corridor simplify habitat structure with limited available cover and reduce the functional value of migratory and rearing habitat for steelhead in the action area.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of environmental baseline (Section 2.4) and the effects of the action (Section 2.5).

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

Status of the species summary.—The larger river systems were the historical foundation for endangered SC steelhead. The Santa Clara River watershed is such a system because of its large size, spawning and rearing habitat quality, relatively reliable winter flows, and potential for being independently viable (Boughton et al. 2007). This watershed is among the largest steelhead-bearing watersheds within the SC DPS of steelhead. Up to the late-1940s, the Santa Clara River Watershed was estimated to support an annual run of 6,000 to 8,000 (Titus et al. 2010).

However, the abundance of steelhead in this watershed, like other drainages throughout the DPS, has been dramatically reduced due to a variety of anthropogenic alterations to the watersheds. Presently, the number of steelhead in the Santa Clara River watershed is small. Likewise, the number of steelhead comprising the DPS is small. The viability of small populations is especially tenuous, and such populations are susceptible to prompt decreases in abundance as a result of natural (e.g., post-fire mudslides) or anthropogenic disturbances (e.g., long-standing dams and barriers), and possess a greater risk of extinction relative to large populations (Pimm et al. 1988, Berger 1990, Primack 2004).

The species and its critical habitat are currently subject to extended drought conditions with projections of even warmer temperatures in the future. Although average rainfall projections have high uncertainty, projections seem confident in more frequent, more intense storm events through 2060 (Swain et al. 2018). For southern California relative to northern California, wildfires will continue to occur more frequently with greater intensity. When considering the natural climate variability (e.g., precipitation and ocean processes driven by climate), it probably influences the large fluctuations in run sizes that are reported anecdotally. Observed and predicted climate change effects are generally detrimental to the species, so unless offset by improvements in other factors, the status of the species is expected to be at an elevated risk of worsening over time due to climate change alone.

Given the consequences of past actions and the decreased viability of current steelhead populations, activities that substantially reduce the quality of habitats are expected to considerably reduce the abundance, productivity, reproduction, and survival of steelhead individuals, in turn decreasing the viability of the overall population (McElhany et al. 2000). Based on the importance of the Santa Clara River watershed to the conservation of endangered SC steelhead, activities that harm steelhead or destroy critical habitat within large watersheds with steelhead population units have implications for viability of the entire DPS. Overall, the DPS continues to have low viability and is at a high risk of becoming extinct in the foreseeable future.

Environmental baseline summary.—Evidence indicates past and present anthropogenic activities degrade living space for steelhead within the Santa Clara River Estuary. Anthropogenic activities are believed to have contributed to declines in steelhead abundance within the Santa Clara River mainstem, including the action area. Because dams and diversions have blocked or challenge the capabilities of steelhead to access much of the upstream historical spawning and rearing habitat, and water diversions have severely reduced amounts of surface discharge in the mainstem, abundance of this species decreased in the mainstem of the Santa Clara River. Additionally, surface diversions, subsurface diversions, and well-field pumping collectively extract large quantities of water on a yearly basis from the lower Santa Clara River, including in the action area, and this continues today. The ongoing VWRF discharge precludes the maintenance of natural habitat characteristics and condition for endangered SC steelhead (Anderson and Ambrose 2011; Stillwater Sciences 2018a,b; Revell et al. 2018). Current observations and projections for warmer air temperatures and rainfall variability will continue to stress suitable habitat for steelhead and may prolong the time it takes the Santa Clara River steelhead populations to recover in the action area and watershed as a whole.

Effects analysis summary.—Reduced wastewater discharge in the Santa Clara River Estuary as a result of the proposed action will shift habitat quality toward conditions that mimic physical and biological features, which are expected to be beneficial to steelhead and their critical habitat. Because the proposed action is fundamentally restorative in nature, the implementation and minimization measures (i.e., phased-reduction approach) are expected to significantly reduce the potential risk and/or degree of impact from a gradual 67-acre reduction in steelhead-accessible habitat over the duration of the phased approach (see *Natural breaching* and *Habitat quantity and quality* discussion under Effects on Designated Critical Habitat section). NMFS anticipates the reduction in wastewater discharge will elevate the conservation value of physical and biological features that make up designated critical habitat in the action area.

With regard to steelhead, the proposed action is expected to restore prospects for growth and survival of juvenile steelhead to and during the smolt stage. The proposed action will increase natural opportunities for feeding and growth, contributing to larger size at ocean entry and increasing the likelihood of higher adult returns. The change in habitat distribution should support juvenile and smolt growth prior to ocean entry, thus increasing the likelihood for long-term survival of a Core 1 population and recovery of the DPS as a whole.

Although the proposed action is for the purpose of rehabilitating degraded estuarine habitat and creating high-quality living space for steelhead, adverse effects to SC steelhead are expected in the form of short-term behavioral changes with small amounts of mortality at the juvenile life history stage. Monitoring activities, which require seining and potential capture of individuals will account for the single largest effect to steelhead in the action area. Juvenile steelhead present during the implementation of monitoring may be injured or killed by seining activities, and, at a minimum, steelhead will be subject to capture, handling, and related stresses. Anticipated injury or mortality amounts from seining activities are expected to be one juvenile per year for a total of eight years, thus, cumulatively, we expect injury or lethal effects to eight juvenile steelhead based on the proposed duration of the PCAP/MAAMP. Overall, these steelhead would be injured or lost at a low frequency and represent a small fraction of the entire SC steelhead DPS. Therefore, it is unlikely the low-level of injury or mortality of steelhead NMFS anticipates from seining will have a significant impact on the DPS level.

Habitat and species response to climate change with the proposed action.—A warming climate is expected to continue throughout the duration of the proposed action and all related consequences (60 years). We expect to see progressively less frequent precipitation, particularly in the fall and spring, and greater precipitation extremes (SIO 2020). Warmer temperatures will lead to drier seasonal conditions even in years with historically average precipitation. Additionally, seasonal dryness could become prolonged, with soils drying earlier in spring and persisting longer into fall and sometimes winter. Unseasonal estuary breaches seem unlikely under the proposed action and particularly unlikely given climate change induced alterations of streamflow (Rogers et al. 2020). The proposed action does not preclude upstream movement, which likely remains a species response strategy to enhance population resiliency during extended sandbar-closed conditions (Hayes et al. 2008, 2011; Huber and Carlson 2020). The improved estuarine rearing conditions that would result from the proposed action are likely to increase the overall survival of Santa Clara River steelhead, bolstering their numbers and distribution to help them withstand climate change impacts.

Therefore, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of SC endangered steelhead by reducing their numbers, distribution, or abundance, and are not likely to appreciably diminish the value of designated critical habitat as a whole for the conservation of this species.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of the endangered Southern California DPS of steelhead, and is not likely to destroy or adversely modify designated critical habitat for this species.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). “Harass” is further defined by interim guidance as to “create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering.” “Incidental take” is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1. Amount or Extent of Take

In the biological opinion, NMFS determined incidental take is reasonably certain to occur. Incidental take would be in the form of capture and handling, including injury and death, of steelhead during seining activities.

Based on the information described above in the biological opinion, NMFS anticipates the following amount of incidental take on an annual basis for the eight years given the proposed duration and survey frequency of the monitoring programs (PCAP/MAAMP): capture, handling, and release of up to ten juvenile steelhead (four times a year) and one adult steelhead each year, and no more than one individual juvenile would be injured or killed each year during seining activities. The summary of take is reproduced below (Table 3).

Table 3. Anticipated take under the proposed action over the next eight years for steelhead (Life Stage) including the type of take (Take Method), climate condition (Water-Year Type), extent of adverse effects (Take Amount), annual number of injured individuals out of total amount captured (Injured Individuals), and lethal take amount on an annual basis (Lethal Take).

Program Activity	Anticipated Stressor	Life Stage	Take Type	Water-Year Type	# of Fish Captured (per year)	# of Fish Injured or Killed (per year)	
Seining as proposed under the PCAP/MAAMP	Entanglement, handling	Juvenile	Capture	All water-year types	40	1 individual	
Seining as proposed under the PCAP/MAAMP	Entanglement, handling	Adult	Capture	All water-year types	1	0 (None)	0 (None)

2.9.2. Effect of the Take

In the biological opinion, NMFS determined the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

1. Undertake measures to avoid or minimize injury to steelhead resulting from capture, and reconcile any condition that could harm or injure steelhead during the seining process.
2. Prepare and submit a detailed report to document the effects of capture activities during the proposed monitoring programs, efficacy of minimization measures including phased-reduction of discharge, and the overall performance of seining surveys in the action area.

2.9.4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. Reclamation or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, then protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1; the City shall ensure compliance with the following terms and conditions:
   a. The City shall retain qualified fisheries biologists with expertise in the areas of salmonid biology and ecology; fish/habitat relationships; biological monitoring; and,

handling, collecting, and releasing salmonid species. A minimum of three qualified fisheries biologists shall be present to facilitate seining activities. One or more of the following methods shall be used to accomplish survey objectives: seine, dip net, and by hand. The seine mesh shall be adequately sized to ensure fish are not "gilled" during capture and handling activities. If a steelhead becomes entangled in the nets, then this shall be reported on the day of entanglement to NMFS biologist Brittany Struck (909-235-9905) for the purpose of developing a plan to further minimize injury to steelhead.

b. The City-retained biologists shall contact NMFS (Brittany Struck, 909-235-9905) and the Reclamation point of contact immediately upon making a determination that authorized take levels are likely to be exceeded.

c. The City-retained biologists shall note the number of steelhead observed in the seined area, the number of steelhead captured, and the date and collection timestamp and release timestamp to ensure handling is efficient and minimized. Steelhead shall be handled with extreme care and kept in water to the maximum extent possible once detected. All captured steelhead shall be kept in cool, shaded, aerated water and protected from excessive noise or jostling any time they are removed from the estuary until released back into the estuary.

d. All captured steelhead shall be categorized and released prior to each subsequent pass with the seine. Steelhead that are unintentionally captured, collected, or trapped within the seine, or found during survey work, shall be digitally photographed, measured to the nearest mm (FL), and examined for evidence of smolting (absence of parr marks, external silvering and blackened fin margins, large head, slender body and long caudal peduncle). Evidence of smolting shall be documented to inform relationship between shifts in salinity trends and documented cases of smolting.

e. Dead steelhead shall be collected and placed in an appropriately sized whirl-pack or zip-lock bag; labeled with the date and time of collection, weight, fork length, location of capture, condition of the individual, and suspected cause of injury or death; and then frozen as soon as possible. If a steelhead mortality occurs, then the City-retained biologist shall coordinate with NMFS (Brittany Struck, 909-235-9905) to ship the carcass as soon as possible on dry ice through overnight express mail to NMFS (Brittany Struck, 501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802).

2. The following terms and conditions implement reasonable and prudent measure 2:

a. The City shall provide NMFS (Brittany Struck, Brittany.Struck@noaa.gov) with a yearly seining report no later than 30 days following the completion of seining and monitoring activities for each survey season. The report shall include the methods used during the monitoring efforts, location and description of the habitat where steelhead were observed or captured, number of steelhead observed but were not captured, number of steelhead captured due to seining, number of steelhead mortalities, a description of the equipment and methods used to collect and hold steelhead prior to release, a description of any problems which may have arisen during the seining activities and a statement as to whether or not the activities had unforeseen effects, and the following other pertinent information related to the monitoring and seining activities: color photographs taken of survey areas during, before and after survey activity; documentation of age class/length and color photographs taken for each captured steelhead; the amount of streamflow (cfs) into the estuary during seining activities; water temperature at 0.3m above substrate; GPS location; time of day; dissolved oxygen; conductivity; and amount and type of cover present including presence of large woody debris or riparian vegetation.

b. The data collected as required by term and conditions 1(c) and (d) and 2(a) shall be recorded on standardized data sheets, and then entered and saved into an electronic spreadsheet (Microsoft Office Excel). The City shall transmit the electronic spreadsheet to an electronic address of NMFS staff (Brittany Struck, Brittany.Struck@noaa.gov) in the Southern California Branch no later than 30 days following the completion of seining and monitoring activities for each survey season. Details of various aspects of the data collection, including schedules and the specific information to be collected, and how it will be reported on the electronic spreadsheet, shall be developed by the City in cooperation with and agreement from NMFS prior to collecting data as required by terms and conditions 1(c) and (d) and RPM 2(a).
c. The report in term and condition 2(a) shall document unanticipated effects or unanticipated levels of effects on steelhead and their habitat, a description of all measures taken to minimize those unanticipated effects and a statement as to whether or not the unanticipated effects impacted steelhead or designated critical habitat.
d. The City shall allow NMFS employee(s) or other person(s) designated by NMFS, to access the action area during the seining period for the purpose of observing monitoring activities, evaluating estuary conditions, monitoring water quality, collecting fish samples, or performing other monitoring/studies. NMFS will notify the City at least 48 hours prior to a site visit and will contact the City personnel prior to entering the estuary.

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, “conservation recommendations” are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). NMFS has no conservation recommendations for this proposed action.

2.11. Reinitiation of Consultation

This concludes formal consultation for the funding, planning, design, and pre-construction of the VenturaWaterPure Project in the City of San Buenaventura (Ventura), California.

Under 50 CFR 402.16(a): “Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

3. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

3.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are Reclamation. Other interested users could include the City of Ventura and the Los Angeles Regional Water Quality Control Board. Individual copies of this opinion were provided to Reclamation. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

3.2. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

3.3. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, and ESA regulations, 50 CFR 402.01 et seq.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style (see *Transactions of the American Fisheries Society* format).

Review Process: This consultation was drafted by NMFS staff with training in ESA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

4. References

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