FINAL BIOLOGICAL OPINION

AGENCY: U. S. Bureau of Reclamation, Sacramento, California

ACTION: Approve United Water Conservation District's Proposal to Operate the Vern Freeman Diversion and Fish-Passage Facility

CONSULTATION CONDUCTED BY: National Marine Fisheries Service, Southwest Region

DATE ISSUED: July 23, 2008

ADMINISTRATIVE RECORD FILE #: 151422SWR01PR6149

I. CONSULTATION HISTORY

The consultation history for the Vern Freeman Diversion Dam, owned and operated by United Water Conservation District (United), includes a previous consultation with the Army Corps of Engineers' (Corps) regulatory office in Ventura. On June 1, 2001, NOAA's National Marine Fisheries Service (NMFS) concluded consultation with the Corps and United. The consultation scope was confined to sediment flushing and trapping and trucking of smolts for the 2001 steelhead (*Oncorhynchus mykiss*) migration season on the Santa Clara River, Los Angeles County. Diversion of surface water and related effects on endangered steelhead were not considered in the consultation. The June 1, 2001, biological opinion concluded United's 2001 trap-and-truck and sediment-flushing operations were not likely to jeopardize the continued existence of the Southern California steelhead ESU, or result in destruction or adverse modification of critical habitat for this species.

Beginning in May 2005, NMFS has been in formal consultation with the Bureau of Reclamation (Bureau) regarding operation and maintenance of the Vern Freeman Diversion Dam. On September 30, 2005, NMFS completed an analysis of how diversion operations (including the existing fish ladder) affect endangered steelhead and critical habitat, and issued a draft biological opinion to the Bureau and United. The draft biological opinion concluded that operation of the diversion dam is likely to jeopardize the continued existence of endangered steelhead and is likely to destroy or adversely modify critical habitat for this species. Following issuance of the September 30, 2005, draft biological opinion, there has been numerous communications, including information exchanges, between United, the Bureau, and NMFS, which are documented in the administrative record for this consultation. The intent of the communications was to develop a proposed action that would be expected to minimize adverse effects of diversion operations on endangered steelhead and critical habitat for this species. In early September 2007, the collaboration between NMFS and United resulted in a revised proposed action (Bureau of Reclamation 2007a, United Water Conservation District 2007a). This revised proposed action forms the basis of the current consultation.

On November 1, 2007, NMFS formally received the revised proposed plans from the Bureau's south-central California office in Fresno (Bureau of Reclamation 2007a), at which time formal consultation was initiated. The Bureau is considering for approval United's proposed plans to operate the Vern Freeman Diversion Dam and existing fish ladder. The proposed plans involves operation of the Vern Freeman Diversion Dam, the existing fish ladder, and implementation of a panel process to review the performance of the existing fish ladder. Formal consultation on the proposal was to conclude on January 29, 2008, owing to the 90-day requirement for concluding consultation (50 CFR §402.14(e)). Ongoing discussions with United were leading to refinements of the proposed conduct of the fish-ladder review, and in a letter of January 25, 2008, to the Bureau, NMFS requested a 60-day extension in the duration of the formal consultation to allow such discussions to conclude and NMFS sufficient time to duly consider the refinements. The Bureau did not respond to NMFS' request. Since receipt of the proposed plans on November 1, 2007, United has twice modified the proposal to conduct the fish-ladder review, most recently with the revision of March 4, 2008 (United Water Conservation District 2008a). The March 4, 2008, proposal to review the existing fish ladder, and the November 1, 2007, proposal to operate the diversion dam and existing fish ladder were submitted by United to NMFS and the Bureau and are the basis of this biological opinion.

On April 22, 2008, NMFS completed and transmitted to the Bureau a draft biological opinion. The draft biological opinion concluded the proposed plans are likely to jeopardize the continued existence of the endangered Southern California Distinct Population Segment (DPS) of steelhead, and is likely to destroy or adversely modify critical habitat for this species. The draft biological opinion included a reasonable and prudent alternative that is necessary and appropriate to avoid the likelihood of jeopardizing the continued existence of the DPS and destroying or adversely modifying critical habitat. The draft biological opinion did not contain a draft incidental take statement because the reasonable and prudent alternative was in draft form. On May 22, 2008, NMFS, the Bureau, and United held a teleconference, the purpose of which was for the Bureau and United to provide a brief overview of their comments on the draft biological opinion. During the teleconference, United requested that NMFS provide a draft of the incidental take statement for review and comment. On June 17, 2008, the draft incidental take statement was transmitted to the Bureau. By letters of May 19, 2008, and May 23, 2008, United and the Bureau transmitted their comments on the draft biological opinion to NMFS. The Bureau's and United's comments on the draft incidental take statement were provided to NMFS by letters of July 3, 2008, and June 26, 2008.

To produce this final biological opinion, the draft biological opinion was revised in response to the comments received from the Bureau and United on the draft biological opinion, including the incidental take statement and reasonable and prudent alternative. The responses to the comments we provide in this biological opinion often include reference to the specific source (e.g., United Water Conservation District 2008b, Bureau of Reclamation 2008a) and page number of the comment, for ease of understanding how NMFS responded to particular comments. When making minor editorial changes to this biological opinion in response to the comments, for example to clarify a misunderstanding of a particular concept, we generally do not refer to the specific source of the comment. This biological opinion is based on the best scientific and commercial data available, including descriptions of the proposed diversion operations (Bureau of Reclamation 2007a, b, United Water Conservation District 2007a, United Water Conservation District 2008a), NMFS' observations of the river, much of the watershed, the diversion, and existing fish ladder, expected effects of the proposed diversion operations on the Southern California steelhead DPS, and the ecological literature. A complete administrative record for this consultation is maintained on file at NMFS' Southwest Regional Office (501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802). The specific information that United claims is not considered in the draft biological opinion (page 5, United Water Conservation District 2008b) (e.g., correspondence and information provided by United to NMFS and the Federal Energy Regulatory Commission in connection with the relicensing and section 7 consultation for Santa Felicia Dam), is already contained in the administrative record for this consultation. We cite the final documents in this biological opinion, and the final documents reflect responses to the subject information United references in their comments, and which was considered during the draft or formulative phases of the documents. Therefore, the subject information was considered in the draft (and this final) biological opinion.

This biological opinion recognizes the Bureau's ongoing discretion over operation of the Vern Freeman Diversion Dam terminates on December 31, 2011. The effective life of this biological opinion therefore ceases when the Bureau's discretion ends on December 31, 2011. Incidental take of endangered steelhead beyond December 31, 2011, is still of concern because aspects of the operation of the Vern Freeman Diversion Dam are expected to cause take of endangered steelhead long after the Bureau's discretion ceases. For this reason, United is expected to pursue and acquire a Section 10(a)(1)(B) incidental take permit from NMFS to cover take of steelhead related to operation of the Vern Freeman Diversion Dam. NMFS believes the reasonable and prudent alternative and terms and conditions identified in this biological opinion would provide much, if not most, of what would be expected to form the conservation program that is the basis of an application for an incidental take permit. Implementation of the reasonable and prudent alternative and terms and conditions is therefore expected to further acquisition of an incidental take permit for operation of the Vern Freeman Diversion Dam according to the provisions specified under the proposed plans.

II. DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

A. Description of the Federal Action and the Proposed Action

The Federal action is the Bureau's approval of United's proposed operation of the Vern Freeman Diversion Dam and fish ladder. Under the authority of the Small Reclamation Project Act of 1956, the Bureau entered into contract (#7-07-20-WO615, dated June 26, 1987) with United for a loan to construct the Vern Freeman Diversion Dam. The Bureau expects the loan to be repaid by year 2011. The contract gives the Bureau discretion to examine and approve operation of the Vern Freeman Diversion Dam, and to assist United in determining the adequacy of the operation and maintenance.

The proposed action involves United's September 20, 2007, supplement to, and including, the January 12, 2007, biological assessment (Bureau of Reclamation 2007a, b, United Water Conservation District 2007a) for operation of the Vern Freeman Diversion Dam and fish ladder. The description of the proposed action received from the Bureau is too extensive for reproduction here, but a summary list is as follows. In short, the proposed action involves implementation of eight elements: (1) an adaptive management plan, (2) a plan to minimize take of steelhead, (3) fish-ladder operating criteria, (4) downstream fish-passage operating criteria, (5) rescue surveys for stranded steelhead, (6) a review and analysis of upstream fish passage, (7) maintenance activities at the diversion, and (8) fish-handling protocols and monitoring procedures. This biological opinion considers these specific activities, hereafter collectively referred to as *proposed action* (note that the phrases *diversion operations* and *proposed action* are used synonymously throughout this biological opinion). The larger purpose of the proposed action is to divert water for groundwater recharge and agricultural users (Bureau of Reclamation and United Water Conservation District 2005).

The proposed action NMFS received from United and the Bureau (Bureau of Reclamation 2007a, b, United Water Conservation District 2007a) does include four additional elements: (1) modification of the fish-ladder baffles, (2) an upgrade to the auxiliary water-pipe intake, (3) formation of a biological advisory committee, and (4) a monitoring and scientific data-collection program. The proposal to modify the fish-ladder baffles for improving the ability of the fish ladder to pass steelhead efficiently is conceptual and lacks the information necessary for NMFS to develop a clear understanding of the element and consequences for steelhead and critical habitat. The proposal to upgrade the auxiliary water-pipe intake is conceptual and vague, and provides nothing about the specific action that would be implemented. Under the proposed action, United only proposes to "…undertake a redesign of the auxiliary water pipe entrance to maximize its flow capacity, to the extent feasible and cost-effective." The biological advisory committee does not appear to have discretion over operation of the Vern Freeman Diversion. Any recommendation or advice the committee provides to United would only be "considered" and is not expected to result in a material change to the proposed diversion operations that are the basis of this biological opinion. The monitoring and scientific data collection program proposes primarily observational (visual) studies that are not expected to result in adverse effects to steelhead or takings of this species under the U. S. Endangered Species Act (ESA). While this element specifies collection of emigrating steelhead when volitional passage is possible (top of page 38, Bureau of Reclamation 2007b), the proposed collection has no research context and does not appear to represent a bona fide and necessary or desirable scientific purpose. After carefully considering the content and intent of these elements, NMFS determined these elements do not warrant further consideration in this biological opinion. Note that we are not omitting from consideration the monitoring aspect related to the proposed action, only the aspects related to the "scientific data collection program" for the reasons previously described.

B. Interrelated and Interdependent Actions

When considering the "effects of the action" on a species or critical habitat, NMFS is required to consider the direct and indirect effects of the action "together with the effects of other activities that are *interrelated* or *interdependent* [emphasis added] with that action" (50 CFR §402.02). "Interrelated actions" refers to those activities "that are part of a larger action and depend on the larger action for their justification," whereas "interdependent actions" refers to activities "that have no independent utility apart from the action under consideration" (50 CFR §402.02). Elements of operation of Pyramid Dam (a feature of the California Aqueduct Project) on the mainstem Piru Creek upstream of Santa Felicia Dam, and operation of Santa Felicia Dam are interrelated with the proposed action. This determination is based on the fact that elements of operation of Pyramid Dam and Santa Felicia Dam are part of a larger action to maintain groundwater recharge in the over-drafted Santa Clara River basin, which is the primary purpose of the Vern Freeman Diversion Dam. This rationale is explained more fully below.

With regard to operation of Pyramid Dam, the California Department of Water Resources and the City of Los Angeles (licensed operators of Pyramid Dam) are under contract to deliver water to United at Lake Piru (Federal Energy Regulatory Commission 2007a). Santa Felicia Dam, which forms Lake Piru, supplies water to downstream users at levels that would not otherwise exist if not for Pyramid Dam. For instance, surface water that would not be captured and stored in Lake Piru (e.g., in the case of high-flow events exceeding storage, causing spills) can be stored in Pyramid Lake for later delivery to United at Lake Piru (Federal Energy Regulatory Commission 2007a). United operates Santa Felicia Dam to deliver large quantities of stored water during the dry season downstream to the Vern Freeman Diversion Dam (Bureau of Reclamation and United Water Conservation District 2005, Federal Energy Regulatory Commission 2007b). The Vern Freeman Diversion Dam is operated to redirect surface water from the Santa Clara River to nearby percolation ponds for recharging the over-drafted groundwater basin and to surface-water users in the Oxnard Plain (Bureau of Reclamation and United Water Conservation District 2005).

Operations of Santa Felicia Dam (and the interrelated activity, operation of Pyramid Dam) are the subject of a consultation between NMFS and the Federal Energy Regulatory Commission. The effects due to the operations and ongoing impassable effects of these dams on steelhead and critical habitat for this species are fully described in a separate biological opinion. The effects due to the operation of these dams are summarized in this biological opinion, however. On May 5, 2008, NMFS issued a final biological opinion to the Commission regarding the effects of operations of Santa Felicia Dam (NMFS 2008). The final biological opinion concluded the operations of the dam, and effects due to interrelated activities, are likely to jeopardize the continued existence of the Federally endangered Southern California steelhead DPS, and destroy or adversely modify critical habitat for this species. Both this biological opinion and the biological opinion for the Santa Felicia Project acknowledge the interrelationship between the projects and together can be viewed as a detailed assessment of the entirety of the larger action.

Some of the groundwater pumping in the service area is interdependent with operation of the diversion because the groundwater pumping is allowed to continue at levels exceeding those that would occur without the diversion (United Water Conservation District and Castaic Lake Water Agency 1996, Bureau of Reclamation and United Water Conservation District 2005). The effects on steelhead and critical habitat that are due to groundwater pumping are considered in this biological opinion.

C. Description of the Action Area

The action area considered in this biological opinion involves (1) the portion of the mainstem Piru Creek inundated by Pyramid Lake and Pyramid Dam, (2) the mainstem Piru Creek extending from Pyramid Dam downstream to Lake Piru, (3) the mainstem Piru Creek inundated by Lake Piru and Santa Felicia Dam, (4) the mainstem Piru Creek extending from Santa Felicia Dam downstream to the confluence with the Santa Clara River, and (5) the Santa Clara River extending from the mouth of Piru Creek downstream to the ocean including the estuary (Figure 2-1). Physical and biological characteristics of the Santa Clara River watershed, including portions of the action area, can be found in Mann (1975), Bell (1978), Schwartzberg and Moore (1995), Paybins (1998), Reichard *et al*. (1999), Bureau of Reclamation and United Water Conservation District (2004), Kelley (2004), Bureau of Reclamation and United Water Conservation District (2005), Federal Energy Regulatory Commission (2007a, b), and Densmore *et al*. undated.

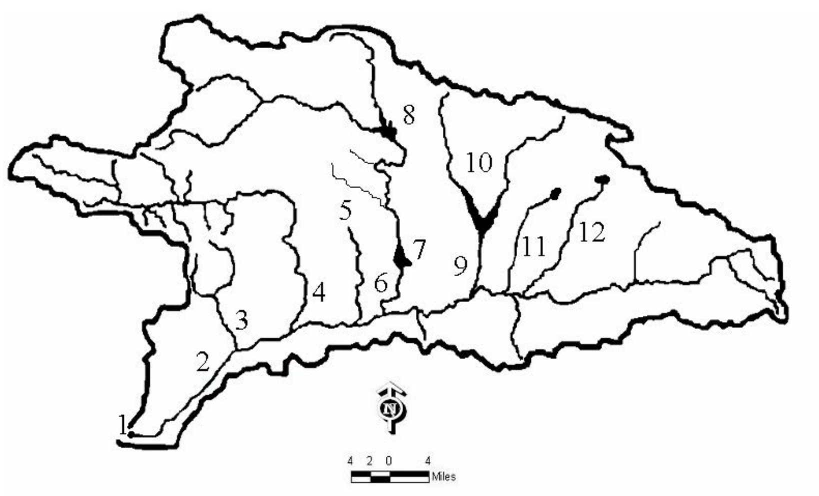

Figure 2-1.—The Santa Clara River watershed and action area. The action area generally involves the mainstem Piru Creek inundated by Pyramid Lake and dam downstream through the Santa Clara River extending from the mouth of Piru Creek downstream to the ocean including the estuary. This map exceeds the action-area boundary to allow the reader to locate activities disclosed in this biological opinion that, while outside the action area, influence steelhead habitat conditions within the action area. The principal features are: 1=estuary, 2=Vern Freeman diversion, 3=Harvey diversion dam within the Santa Paula Creek sub-basin, 4=Sespe Creek sub-basin, 5=Hopper Creek sub-basin, 6=Piru Creek sub-basin, 7=Lake Piru formed by Santa Felicia Dam, 8=Pyramid Lake formed by Pyramid Dam, 9=Castaic Creek sub-basin, 10=Castaic Lake formed by Castaic Dam, 11=Dry Canyon and 12=Bouquet Canyon reservoirs.

Although the Bureau commented that NMFS' delineation of the action area, and associated interrelated and interdependent actions, are larger than is appropriate (page 1, Bureau of Reclamation 2008a), the boundary of the action area, including the interrelated and interdependent activities, is consistent with regulatory requirements (50 CFR 402). The foundation for delineating the action area is detailed in the sections *Description of the Federal Action and the Proposed Action* and *Interrelated and Interdependent Actions*. Contrary to suggestion (page 1, Bureau of Reclamation 2008a), the biological opinion does not consider operation of Pyramid Dam and Santa Felicia Dam as the federal action. The biological opinion in the section *Description of the Federal Action and the Proposed Action* clearly defines the federal action as the "Bureau's approval of United's proposed operation of the Vern Freeman Diversion Dam and fish ladder." We here restate that when considering the effects of the action on a species or critical habitat, NMFS is required to consider the direct and indirect effects of the action "together with the effects of other activities that are *interrelated* or *interdependent* [emphasis added] with that action" (50 CFR §402.02). "Interrelated actions" refers to those activities "that are part of a larger action and depend on the larger action for their justification," whereas "interdependent actions" refers to activities "that have no independent utility apart from the action under consideration" (50 CFR §402.02). Elements of operation of Pyramid Dam (a feature of the California Aqueduct Project) on the mainstem Piru Creek upstream of Santa Felicia Dam, and operation of Santa Felicia Dam are interrelated with the proposed action. Whether the Bureau has the "…authority to affect, directly or indirectly, the Santa Clara River watershed above the [Vern Freeman Diversion Dam]…" is irrelevant when considering the "effects of the action" on a species or critical habitat, as is required by the regulations governing interagency coordination (50 CFR 402).

III. STATUS OF THE LISTED SPECIES AND CRITICAL HABITAT

A. Overview of the Listed Species and Terminology

Oncorhynchus mykiss exhibit two principal life-history forms: "anadromous" and "resident." The anadromous form spends a portion of its overall life history in the ocean before returning to freshwater for spawning. The resident form spends its entire life in freshwater. Only the anadromous form and their progeny downstream of impassible barriers to upstream migration are protected under the ESA (NMFS 2006a). The terms "steelhead" and "anadromous *O. mykiss*" are often used to describe the anadromous form, including their progeny, and in this regard are used in this biological opinion.

Through the construction of dams and other man-made barriers to steelhead migration, steelhead that historically migrated to the ocean, matured, and returned to their natal freshwater stream for spawning, are now confined to freshwater. Because these individuals are sequestered to freshwater upstream of impassable barriers, they are termed "residualized" or "non-listed steelhead" in this biological opinion because they exist upstream of an impassible barrier and are therefore not protected under the ESA (NMFS 2006a). The resident form within the action area is neither listed under the ESA nor under the jurisdiction of NMFS (NMFS 2006a), but is important to the viability of steelhead because the resident form can give rise to the anadromous form and vice versa (see NMFS 2008 and references therein). Although the analysis contained in this biological opinion does not focus on the resident form, brief mention of the resident form is included here because United provided several comments that pertain to the resident form.

The listed unit of anadromous *O. mykiss* is termed a "distinct population segment" or DPS (NMFS 2006a), and the listed unit contains several individual or fish-bearing watersheds. The DPS recognizes only the anadromous *O. mykiss*, whereas the term "evolutionarily significant unit," or ESU, refers to both the non-anadromous (or resident) and anadromous (or residualized) *O. mykiss*. In accordance with the listing decision, this biological opinion solely uses the DPS terminology and provides NMFS' conclusion as to the likelihood of jeopardy to the species based only on effects to the listed species.

B. Description of the Listed Species

Steelhead are short lived and native to Pacific coast streams extending from Alaska to northwestern Mexico (Moyle 1976, Behnke 1992, NMFS 1997, Good *et al*. 2005). The geographic range of this steelhead DPS extends from the Santa Maria River, near Santa Maria, to the California–Mexico border (NMFS 1997, 2002, 2006a). NMFS listed southern California steelhead as an endangered species under the ESA on August 18, 1997 (NMFS 1997), and the endangered status was reaffirmed on January 5, 2006 (NMFS 2006a).

Steelhead show mixed age composition in freshwater (e.g., Spina 2003, Spina *et al*. 2005), and exhibit a polymorphic life history with some individuals not migrating to the ocean before maturing and reproducing (i.e., resident form), and some individuals (from both the anadromous and resident forms) giving rise to progeny that exhibit an anadromous reproductive cycle (e.g., Zimmerman and Reeves 2000, Thrower *et al*. 2004a, McPhee *et al*. 2007). Through the construction of dams that lack fish-passage facilities (i.e., migration barriers), steelhead trapped as juveniles have matured and reproduced in freshwater, and many reservoirs in California contain "residualized" steelhead, as determined through genetic analyses (Nielsen *et al*. 1997, Girman and Garza 2006, Boughton and Garza 2008). Some reservoirs are known to contain juveniles that smolt and migrate to the ocean and return as adults to the base of barriers to natal areas (Thrower *et al*. 2004a, b). Again, the term "residualized" steelhead is used specifically in this biological opinion to mean the steelhead trapped as juveniles behind dams lacking a fish-passage facility (page 2, Attachment C, United Water Conservation District 2008b), though we recognize that the resident form can give rise to anadromous progeny and vice versa (NMFS 2008 and references therein).

C. Natural Presence of Steelhead in the Santa Clara River Watershed

Despite the suggestion that contemporary populations of steelhead in the Santa Clara River watershed are the result of historical out-of-basin transfers of anadromous *O. mykiss* (e.g., United Water Conservation District 2007b, c, d, page 5, Attachment E, United Water Conservation District 2008b), there is much reliable genetic and ecological evidence indicating this species naturally occurred and reproduced in the watershed. A summary of this evidence is as follows. Readers wishing more extensive treatment of this topic should refer to pages 10-17 in NMFS (2008) and references therein.

Findings of genetic studies.**—**The findings of Carpanzano (1996), Nielsen *et al*. (1997) and Girman and Garza (2006), which are largely based on the collection of juvenile *O. mykiss* from freshwater habitats in southern California, including the Sespe Creek and Piru Creek drainages, indicate that native southern California steelhead exist and dominate reproducing populations of *O. mykiss* in the Santa Clara River watershed. The fish are largely or entirely descended from relic steelhead populations that ascended the watershed, including steelhead that accessed Piru Creek prior to construction of Santa Felicia Dam (Girman and Garza 2006, Boughton *et al*. 2007a, Boughton and Garza 2008, Garza undated). While a planting program resulted in the annual stocking of thousands of young steelhead in the Santa Clara River watershed between the late 1890s and early 1900s (United Water Conservation District 2007b, c, d), the genetic investigations have distinguished the planted steelhead from the native ancestral stock of southern California steelhead. If the steelhead present in the watershed were largely or entirely descended of planted steelhead from Fillmore Hatchery or northern California hatcheries, one would expect genetic similarity between the planted steelhead and the Santa Clara River populations of steelhead. This expectation was not observed. Rather, the findings indicate the Santa Clara River populations of *O. mykiss* are closely related to other steelhead populations native to southern California (e.g., Girman and Garza 2006, Boughton *et al*. 2007a, Boughton and Garza 2008, Garza undated).

Reports of steelhead.**—**Besides the foregoing genetic studies indicating that native southern steelhead ascended the watershed, and steelhead ancestry still exists in the watershed, steelhead have been observed in the drainage. For instance, several large adult steelhead were taken from Agua Blanca Creek prior to the construction of Santa Felicia Dam (Figure 3-1). United (United Water Conservation District 2007b) reports on a note describing a conversation between a California Department of Fish and Game employee (B. Evans) and an angler (L. Kellan) who reportedly "fished Piru Creek for many years." According to United's report, "Kellan told Evans he had observed steelhead in the Gold Hill area [of Piru Creek] in 1944-45." Given the findings of the genetic studies and the adult steelhead caught (and then photographed) in the Piru Creek drainage before construction of Santa Felicia Dam, Kellan's observations appear reliable. During 1982 through 1984, the California Department of Fish and Game documented immigration and emigration of steelhead within the Santa Clara River watershed, and captured three adult steelhead and a few steelhead smolts in Sespe Creek while operating a fish trap (Puckett and Villa 1985). In 1987 and 1988, several adult steelhead were observed by personnel of the U. S. Fish and Wildlife Service (Kaufman 1989 as cited in Comstock 1992). In spring 1999, seven steelhead smolts were observed in Santa Paula Creek a few miles upstream of the confluence with the Santa Clara River (A. Spina, pers. obs., NMFS, fishery biologist).

Contrary to suggestions (page 3, Attachment C, United Water Conservation District 2008b), a careful review of the administrative record (and final biological opinion, NMFS 2008) for the formal consultation that was undertaken as part of the Santa Felicia Dam Hydroelectric Project specifically indicates the natural production of steelhead in the Piru Creek drainage was questioned, and United continues to pose this contention (page 5, Attachment E, United Water Conservation District 2008b). The "historical" number of native steelhead that may have migrated into and out of the Santa Clara River has been considered in other documents including NMFS (2008), Boughton *et al*. (2006), and Boughton *et al*. (2007b), which are part of the administrative record for this formal consultation with the Bureau.

D. Life History and Habitat Requirements of Steelhead

The life history of steelhead generally involves rearing in freshwater for one to three years before migrating to the ocean, usually in the spring and fall, where they may remain for up to four years. The timing of emigration appears to be influenced by photoperiod, streamflow, and temperature. In some drainages, immature steelhead may rear in a lagoon or estuary for several weeks prior to entering the ocean. Steelhead grow and reach maturity at age two to four while in the ocean. Adults generally immigrate to natal streams for spawning (but may also enter non-natal streams) during winter; some adults may not enter coastal streams until spring. Adults may migrate several miles to reach their spawning grounds. Steelhead have evolved to migrate deep into the extreme fringes of a watershed to exploit the environmental conditions that favor production of young (e.g., Montgomery *et al*. 1999). Although spawning may occur in late winter and early spring, 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 one or more years. Female steelhead excavate a nest in the streambed and then deposit their eggs. After fertilization by the male, the female covers the nest with a layer of gravel, and the embryos incubate within this gravel pocket. Hatching time varies from about three weeks to two months depending on water temperature. The young fish emerge from the nest two to six weeks after hatching. Additional details about steelhead life history can be found in Shapovalov and Taft (1954), Barnhart (1986, 1991), Bjornn and Reiser (1991), and Quinn (2005).

Figure 3-1.—Several large adult steelhead captured from Agua Blanca Creek, tributary to Piru Creek, upstream of the present location of Santa Felicia Dam (*c*. 1915). Photograph courtesy of Ed Henke, Historical Research, Ashland Oregon.

Habitat requirements of steelhead in streams generally depend on the life history stage (Cederholm and Martin 1983, Bjornn and Reiser 1991). Generally, discharge, water temperature, and water chemistry must be appropriate for adult and juvenile migration. Low discharge, high water temperature, physical barriers, low dissolved oxygen, and turbidity[1] (high levels) may delay or halt upstream migration of adults and timing of spawning, and downstream migration of juveniles and subsequent entry into the estuary, lagoon, or ocean. Suitable water depth and 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 sediment, sand and smaller particles, can fill interstitial spaces between large substrate particle types, thereby reducing waterflow and dissolved oxygen levels within a nest. Juvenile steelhead require living space (different combinations of water depth and velocity), shelter from predators and harsh environmental conditions, food resources, and suitable water quality and quantity, for growth and survival during summer and winter. Juvenile steelhead rear in riffles, runs and pools (*e.g.*, Roper *et al*. 1994, Spina *et al.* 2005) during much of a given year where these habitats exist, but can show specific habitat requirements as indicated by the similarity of microhabitat use despite changes in microhabitat availability in some streams (Spina 2003). Steelhead in southern

[1] Defined as "suspended particulate matter affecting the amount of light that is scattered or absorbed by a fluid." With regard to the influence of turbidity on migration of steelhead, the peer-reviewed ecological literature provides no unequivocal causal relationship between turbidity and migration. Challenges related to developing a clear understanding of whether turbidity influences upstream migration of adult steelhead includes (1) the relationship between turbidity and discharge, which can be positively related to one another (i.e., as discharge increases, turbidity can increase), and (2) discharge alone has been found to influence migration.

California streams can tolerate warm water, remaining active and feeding at temperatures that exceed the upper heat tolerance reported for the species as a whole (Spina 2007).

E. Population Viability

One prerequisite for predicting the effects of a proposed 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)[2]. Four principal parameters were used to evaluate the extinction risk (here the converse of long-term viability) for the endangered Southern California DPS of steelhead: abundance, population growth rate, population spatial structure, and population diversity. These specific parameters are important to consider because they are predictors of extinction risk and reflect general biological and ecological processes that are critical to the growth and survival of steelhead (McElhany *et al*. 2000). Guidelines or decision criteria are defined for each of the four parameters to further the viability evaluation, and these guidelines were considered and are ***emphasized*** for ease of reference in the following evaluation. Because some of the guidelines are related or overlap, the evaluation is at times necessarily repetitive. Note that the terms "broad population" and "DPS" are used synonymously throughout this discussion and differ from "population unit" which here means an individual steelhead-bearing watershed.

Before proceeding with the evaluation, some common understanding of the concept of population viability is needed. Population viability is based on a few key concepts, which provide the basis for judging the persistence of a population in the wild. The bases for these concepts 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*. 2006). Comprehending these concepts is essential for understanding the basis for NMFS' conclusion regarding the current level of viability of the endangered Southern California DPS of steelhead. There are three basic concepts (adapted from Boughton *et al*. 2006) and these have been deliberately simplified for ease of understanding. This summary is concluded with a discussion of how these concepts apply to the endangered Southern California DPS of steelhead.

The first concept is that for a population to persist indefinitely, on average each adult fish in the population must give rise to at least one adult fish in the next generation (i.e., the population of adults must replace itself year after year). In nature, population abundance fluctuates for a variety of reasons including random changes in environmental conditions (often referred to as *environmental stochasticity*). If the fluctuations are large enough, the number of individuals in the population can fall to zero, even though the population may be relatively large initially. There are certain traits that reduce the likelihood that a population would be driven to extinction by these random events, which leads us to the second concept.

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[2] We equate this concept with the likelihood of both survival and recovery for the ESA Section 7(a)(2) jeopardy standard (50 CFR §402.02). The contention (page 2, Bureau of Reclamation 2008a) that "the jeopardy standard referred to in this footnote has been declared invalid by three separate Circuit Courts of Appeal, including the 9th Circuit (*Gifford-Pinchot Task Force v. USFWS*, August 2004)" is incorrect. Only the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR §402.02 was affected by the subject case law, not the "jeopardy standard."

The second concept involves the size of the population. The larger the population, the less likely the population is to become extinct. In nature, the number of births, deaths, and matings are important to the viability of a population. Essentially, the likelihood of extinction is reduced if the birth rate is high (the population is replacing itself – the first concept). In the case of death rates, the larger the population, the less likely that random deaths will cause large reductions in the number of individuals in the population. High birth rates and low death rates favor persistence of the population. In the case of matings, the larger the population, the larger the number of potential mates and the reduced likelihood that individuals will fail to locate a mate. Similarly, the larger the population, the less likely that all mates will fail to produce eggs. Large population size is the single most important trait to protect a population from being driven to extinction due to random events.

The third concept involves the relationship of vital events (e.g., births and deaths). The more correlated that vital events tend to be across the population, the larger the population must be to reduce the likelihood of extinction. For instance, if environmental stochasticity causes a more or less similar change in death rates across the population, we would say that the death rates are correlated (not independent). Similarly, if random perturbations cause birth rates to likewise increase across the population, we would say that the birth rates are also correlated. Now here is the point: if vital events are correlated across the population, we would expect, for example, the death rates across the population to decrease in synchrony (i.e., death rates would decrease across the habitats in which the species exist, not just in localized areas). This is different than a situation where the vital events are not correlated, in which case we would not expect, for example, the death rates across the population to simultaneously decrease. Rather, we would expect that abundance of some individuals in some areas would not decrease. Therefore, if vital events are correlated across a population, a sufficiently large population is needed to reduce the likelihood that chance fluctuations would reduce the number of individuals to zero.

With regard to how these concepts are expected to apply to the endangered Southern California DPS of steelhead, the largest populations are needed to support an effective recovery strategy. The role of the largest populations in recovery is based on population theory, which suggests the largest populations would have the highest viability if restored to an unimpaired condition (Boughton *et al*. 2006). The influence of environmental stochasticity on the DPS is expected to be high, and because environmental stochasticity increases extinction risk to the population, and to compensate for the environmental influences, the Southern California DPS therefore needs to have a larger average size than a broad population that is not as affected by chance fluctuations in environmental conditions (Boughton *et al*. 2006). The expected sources of environmental stochasticity in the Southern California DPS involve drought (and associated features such as high temperatures, low streamflow, lack of sandbar breaching at the mouths of rivers), floods, and wildfire. What follows now is the evaluation of viability for the endangered Southern California DPS of steelhead, beginning with the abundance parameter.

***Abundance*.—**Information about population size provides an indication of the sort of extinction risk that a population faces. For instance, 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., Berger 1990, Pimm *et al*. 1988, Primack 2004). Variation in environmental conditions leading to low levels of species survival or fecundity for extended time can cause extinction of small populations (a slightly expanded discussion of the extinction risk that small populations face is presented in the "Effects of the Proposed Action" section). What follows is an evaluation of the abundance of steelhead in the DPS in the context established by the guidelines for the abundance parameter (i.e., viable population size guidelines, McElhany *et al*. 2000). The endangered Southern California DPS of steelhead must meet all of the viable population guidelines to be considered viable with regard to the abundance parameter.

A population should be large enough to have a high probability of surviving environmental variation of the patterns and magnitudes observed in the past and expected in the future. Recent findings indicate 12,500 adult steelhead per generation (3 years for steelhead) (or 4,150 steelhead per year[3]) are needed for each individual population unit (steelhead-bearing watershed) for the Southern California DPS to be viable over the long term (Boughton *et al*. 2007b). The historical run size of adults within the Southern California steelhead DPS (based on combined estimates for the Santa Ynez, Ventura, and Santa Clara rivers, and Malibu Creek) was roughly estimated to be at least 32,000 to 46,000; recent total run sizes for the same four waterways was estimated at less than 500 adults (Busby *et al*. 1996, Good *et al.* 2005). With regard to the Santa Clara River, few adult steelhead have been reported there during the past several years (see Table 4-1 of this biological opinion). The number of streams currently supporting the endangered Southern California DPS of steelhead has been greatly reduced from historical levels, and watershed-specific extirpations of steelhead have been documented (Boughton *et al*. 2005, Gustafson *et al*. 2007). Recent findings suggest widespread reductions in effective population size (see pp. 58 of McElhany *et al*. 2000 for definition and discussion) of southern California steelhead (Girman and Garza 2006). The broad population appears to be in a continued state of decline.

The comment that the "[draft biological opinion] uses this recovery criterion, or its variant of 4,150 steelhead per year, as the basis for determining that the steelhead population in the Santa Clara River is in jeopardy…" (page 2, Bureau of Reclamation 2008a) represents a misinterpretation of the population viability information and its role in this biological opinion. The population viability information, including the number of individual steelhead needed to ensure viability of the entire Southern California DPS, was specifically used to develop an understanding of the extinction risk for the endangered Southern California DPS of steelhead, not "jeopardy" (*sensu* 50 CFR §402.02) by comparing current abundance against that recommended as necessary for a viable population. The extinction risk of the endangered Southern California DPS of steelhead is a primary component of the status of the species (the reference point for determining if an action is likely to jeopardize a listed species through impacts to the extinction risk of that species), and the environmental baseline to which the effects of the proposed action are added to determine how the proposed action would affect the likelihood of survival and recovery for the Santa Clara River population unit of steelhead and the Southern California DPS of endangered steelhead. The statement that "[the biological opinion] uses DPS viability criteria – established to guide recovery planning – as a benchmark for jeopardy" (page 4, Attachment E, United Water Conservation District 2008b) is therefore inaccurate and misleading.

[3] The developers of this numerical prescription acknowledge the criterion may be biologically infeasible for some waterways, particularly small coastal basins (Boughton *et al*. 2006, page 2 Bureau of Reclamation 2008a).

A population should have sufficient abundance for compensatory processes to provide resilience to environmental and anthropogenic perturbations. The developers of the numerical population viability threshold arrived at the value of 12,500 adult steelhead per generation (or 4,150 adult steelhead per year) based on the expectation that the numerical threshold would be sufficient to, in part, combat influences of environmental variability (e.g., irregular inter-annual patterns of precipitation) on the risk of extinction, without consideration of other influences such as anthropogenic activities (Boughton *et al*. 2007b). Because abundance of adult steelhead in the endangered Southern California DPS is currently, and substantially, lower than the viability threshold, the current abundance of adult steelhead is not believed to be capable of withstanding influences of environmental fluctuations, let alone perturbations due to anthropogenic activities, which are widespread throughout the DPS.

A population should be sufficiently large to maintain its genetic diversity over the long term. Genetic variability is important because differing genetic traits favor a population being able to survive and reproduce under changing environmental conditions. With regard to the endangered Southern California DPS of steelhead, anthropogenic activities (including migration barriers) have selectively eliminated some steelhead populations from the broad population (e.g., Boughton *et al*. 2005, Gustafson *et al*. 2007), leading us to conclude that much of the genetic diversity of the species has been lost (e.g., Levin and Schiewe 2001). This conclusion is further supported by findings of empirical studies, which recently documented a decline in effective population size and genetic diversity in southern California steelhead (Girman and Garza 2006). That the Southern California DPS has low abundance is reason alone to expect a loss of genetic variability (loss of genetic traits that are needed to respond and adapt to a changing environment) because such is a problem inherent with small populations, Primack 2004).

A population should be sufficiently abundant to provide important ecological functions throughout its life cycle. The number of individuals required to provide such functions depend mostly on the structure of the species' habitat and biology (McElhany *et al*. 2000). Currently, the number of adults in the subject DPS (estimated at 500 individuals, Busby *et al*. 1996, Good *et al.* 2005) is considerably less than the minimum number of adults needed to maintain the viability of independent populations within the DPS (4,150 adults per independent population, Boughton *et al*. 2007b)[4]. The underlying basis for the minimum viability threshold includes the functional response of steelhead populations to environmental conditions and the species' biology, ecology, and genetics, as well as consideration of extinction risk (Boughton *et al*. 2007b). Consequently, the minimum viability threshold is expected to reflect the abundance required to support the expression of biological and ecological functions. With regard to the species' habitat, a variety of anthropogenic factors have reduced the quality and quantity of habitat for steelhead (Busby *et al*. 1996, Good *et al.* 2005), and certain habitat functions have been either eliminated or reduced (e.g., in the case of a dam blocking migration of steelhead to

[4] As stated elsewhere in this biological opinion (page 3, Attachment C, United Water Conservation District 2008b), the developers of this numerical prescription acknowledge the criterion may be biologically infeasible for some waterways, particularly small coastal basins (Boughton *et al*. 2006). We expect this criterion is feasible for the Santa Clara River watershed given its large size and number and length of major spawning and rearing tributaries. With regard to the suggestion (page 3, Attachment C, United Water Conservation District 2008b) that the viability discussion here "assumes 100% anadromy," this viability discussion reviews the best available scientific and commercial data available in the context of the VSP criteria (i.e., abundance, population growth rate, population spatial structure, and population diversity) to understand the likelihood for the listed DPS to achieving long-term viability, 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).

historical spawning and rearing habitats, or in the case of water releases from dams that are inadequate for steelhead habitat needs).

***Population Growth Rate*.**—The number of individuals generated over a specified time interval can reflect conditions, e.g., environmental conditions, that influence the dynamics of a population and determine abundance. 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).

A population's natural productivity should be sufficient to maintain its abundance above the viable level. Natural productivity can be measured as the ratio of naturally-produced spawners born in one broodyear to the number of fish spawning in the natural habitat during that broodyear. Under the foregoing scenario, the spawner-to-spawner ratio should fluctuate around 1.0 or higher to maintain abundance, i.e., cohorts should be replacing one another at least equally. Information regarding natural productivity of the Southern California DPS is lacking. However, the magnitude of the decline in the abundance of adult steelhead in the DPS (Busby *et al*. 1996, Good *et al.* 2005), by itself, indicates the number of spawners has not been replenished. Additionally, the number of adults in the subject DPS (estimated at 500 individuals, Busby *et al*. 1996, Good *et al.* 2005) is considerably less than the minimum number of adults needed to maintain the viability of independent populations within the DPS (4,150 adults per independent population, Boughton *et al*. 2007b).

A viable population that includes naturally spawning hatchery fish should exhibit sufficient productivity from naturally-produced spawners to maintain population abundance at or above viability thresholds in the absence of hatchery subsidy. NMFS is not aware of any evidence indicating naturally spawning hatchery steelhead are contributing progeny to the endangered Southern California DPS of steelhead. While extensive and widespread stocking of steelhead has occurred in southern California streams historically (e.g., United Water Conservation District 2007b, c, d), hatchery steelhead are not currently planted in the DPS except upstream of long-standing barriers to anadromy (Boughton *et al*. 2007b). Evidence indicates the historical plants from Fillmore Fish Hatchery and hatcheries from northern California have not contributed to the reproduction and perpetuation of native steelhead ancestry in southern California (Girman and Garza 2006, Boughton *et al*. 2007a, Boughton and Garza 2008, Garza undated). Hatchery fish or not, the natural productivity in the DPS is not sufficient to maintain abundance of the broad population above the minimum viability threshold.

A viable population should exhibit sufficient productivity during freshwater life-history stages to maintain its abundance at or above viable thresholds. The number of adults in the subject DPS (estimated at 500 individuals, Busby *et al*. 1996, Good *et al.* 2005) is considerably less than the minimum number of adults needed to maintain the viability of independent populations within the DPS (4,150 adults per independent population, Boughton *et al*. 2007b). Recent genetic studies document a decrease in effective population size and genetic diversity (Girman and Garza 2006), both of which indicate a reduction in freshwater productivity. Consequently, the level of production in freshwater (even if poor conditions have prevailed in the ocean) has not been sufficient to maintain abundance of the broad population above the minimum viability threshold.

A viable population should not exhibit sustained declines in abundance that span multiple generations and affect multiple brood-year cycles. Evidence indicates abundance of wild steelhead in the Southern California DPS has declined dramatically (Busby *et al*. 1996, Good *et al.* 2005), and many watershed-specific extinctions of this species have been reported (Nehlsen *et al*. 1991, Boughton *et al*. 2005, Gustafson *et al*. 2007). Recent efforts to monitor abundance of adult run sizes in some of the larger watersheds continue to show either no, or extremely low, numbers of returns over a period of several years (e.g., see Table 4-1 of this biological opinion) or multiple generations (assuming a 3-year generation for steelhead). The broad population is not currently viable because estimated run sizes (500 individuals, Busby *et al*. 1996, Good *et al.* 2005) are considerably less than the minimum threshold needed for the Southern California DPS to remain viable over the long term.

A viable population should not exhibit trends or shifts in traits that portend declines in population growth rate. The warnings have come and gone – population growth rate of the Southern California DPS of steelhead has declined to dangerously low levels. Evidence indicates abundance of steelhead in the DPS has declined dramatically (Busby *et al*. 1996, Good *et al.* 2005), and many watershed-specific extinctions of this species have been reported (Nehlsen *et al*. 1991, Boughton *et al*. 2005, Gustafson *et al*. 2007). Recent data show adult run sizes in some of the larger (or "core" populations, *sensu* Boughton *et al*. 2006) watersheds continue to show either no, or extremely low, numbers of returns (e.g., see Table 4-1 of this biological opinion). The decrease in effective population size noted for southern California steelhead (Girman and Garza 2006) suggest a decline in population growth rate.

***Population Spatial Structure*.—**Understanding the spatial structure of a population is important because the population structure can affect evolutionary processes, thereby altering 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.* 2007b).

Habitat patches should not be destroyed faster than they are naturally created. Anthropogenic activities have reduced the number of streams and amount of habitat available to steelhead, causing a net increase in the amount of steelhead habitat that is lost (Nehlsen *et al*. 1991, NMFS 1997, Boughton *et al*. 2005, Good *et al*. 2005, NMFS 2006a, b). Man-made barriers constructed on numerous streams in the Southern California DPS have rendered the streams unavailable to adult steelhead (Boughton *et al*. 2005). Many water-storage projects have eliminated hundreds of miles of spawning and rearing habitat for steelhead in this DPS. These projects include Twitchell Dam on the Cuyama River, Bradbury Dam on the Santa Ynez River, Casitas Dam on Coyote Creek, Matilija Dam on Matilija Creek, Santa Felicia Dam and Pyramid Dam on Piru Creek, and Rindge Dam on Malibu Creek (e.g., Good *et al*. 2005). Groundwater pumping and diversion of surface water contributes to the loss of habitat for steelhead, particularly during the dry season. The extensive loss and degradation of habitat is one of the leading causes for the decline of steelhead abundance in southern California and listing of the species as endangered (NMFS 1997, 2006a). Because human activities have decreased the total area of habitat or the number of habitats, a negative trend on population viability is expected (McElhany *et al*. 2000).

Natural rates of straying among subpopulations should not be substantially increased or decreased by human actions. While there has been no systematic attempt to assess straying of steelhead in southern California streams, information suggests anthropogenic activities have increased the potential of steelhead straying into non-natal streams. The rationale is based on the simple fact that because streams (or habitats needed for specific life-history functions) that used to support adult steelhead are no longer accessible to the species (Boughton *et al*. 2005), steelhead would need to enter non-natal streams that are in fact accessible. Dispersal of steelhead has been documented in the Southern California DPS, for instance in the case of Topanga Creek and San Mateo Creek (NMFS 2002, Boughton *et al*. 2006). Increased straying would be expected to reduce population viability, particularly if strays are accessing unsuitable habitat or are breeding with genetically unrelated individuals (McElhany *et al*. 2000).

The suggestion (page 2, Bureau of Reclamation 2008a) that the foregoing paragraph is "…assuming a greater degree of knowledge and volition on the part of steelhead than is warranted" is incorrect and misleading. Knowing the actual causal mechanism underlying straying is not requisite to acknowledge its existence; straying is real (e.g., Quinn 2005), and dispersal has been noted in southern California coastal streams.

<u>*Some habitat patches should be maintained that appear to be suitable or marginally suitable, but currently contain no fish.*</u> Generally, habitat for steelhead has suffered destruction, modification, and curtailment and is not being maintained (e.g., Nehlsen *et al*. 1991, NMFS 1997, Boughton *et al*. 2005, Good *et al*. 2005, NMFS 2006a). Construction and the ongoing impassable presence of man-made structures throughout the Southern California DPS have rendered many habitats inaccessible to adult steelhead (Boughton *et al*. 2005). Within stream reaches that are accessible to this species (but that may currently contain few or no fish), urbanization and exploitation of water resources has in many watersheds eliminated or dramatically reduced the quality and amount of living space for steelhead (e.g., Bureau of Reclamation and United Water Conservation District 2005, housing development on Pole Creek, tributary to the Santa Clara River, see below).

<u>*Source subpopulations (i.e., population units) should be maintained.*</u> The habitat supporting source populations is not being maintained. For example, a large housing development was recently constructed along lower Pole Creek, which is a tributary to the Santa Clara River, itself a "core" or "source" population (Boughton *et al*. 2006). The ecological effects of the development appear to include perpetuation of the long-standing migration problem for adult steelhead through the lower creek. Groundwater pumping and diversion of surface water is widespread in the Santa Clara River watershed and is known to reduce the quality and quantity of habitat for steelhead (Federal Energy Regulatory Commission 2007a, b, NMFS 2008). A detailed review of factors affecting steelhead in southern California streams noted widespread degradation, destruction, and blockage of habitat for steelhead, including habitats supporting source populations (Busby *et al*. 1996, Good *et al*. 2005, Boughton *et al*. 2006), indicating habitats for source populations have not been maintained.

We do not agree with the statement that "…each of those projects, including the housing development, is causing *jeopardy* [emphasis added] to the species" (page 3, Bureau of Reclamation 2008a). The term "jeopardy" in the context of a biological opinion is an analysis that is performed as part of the section 7 formal consultation process and looks specifically at whether a federal agency has insured that a proposed action is not likely to jeopardize a species (16 U. S. C. 1536(a)(2)). By contrast, the anthropogenic activities described here and elsewhere in this biological opinion are referenced because they are creating conditions that have increased the risk of extinction to endangered steelhead. When and where appropriate, NMFS notifies responsible parties of their responsibility for ensuring their activities are in compliance with the ESA (page 3, Bureau of Reclamation 2008a).

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, to mention a few. The more diverse these traits (or the more these traits are not restricted), the more likely the species is to survive a spatially and temporally fluctuating environment. Factors that constrain the full expression of a trait are expected to affect the diversity of a species (McElhany *et al*. 2000).

Human-caused factors such as habitat changes, harvest pressures, artificial propagation, and exotic species introduction should not substantially alter variation in species' traits. In the Southern California DPS, steelhead anadromy has been eliminated in many drainages due to a variety of anthropogenic factors including the construction of fish-passage impediments (Boughton *et al*. 2005, Good *et al*. 2005). All of the larger watersheds that historically supported steelhead now possess complete barriers precluding steelhead from a substantial amount of habitat (e.g., 71% of stream kilometers blocked in the Santa Maria Watershed, 58% of stream lies upstream of Bradbury Dam on the Santa Ynez River, Good *et al*. 2005). Most fish-passage barriers such as dams and reservoirs in the DPS do not possess the capability to facilitate safe migration of adult and juvenile steelhead (including remnant populations of non-listed steelhead that reside upstream of long-standing barriers) to and from spawning and rearing areas and the ocean. 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).

Natural processes of dispersal should be maintained – human-caused factors should not substantially alter the rate of gene flow among populations. The construction and ongoing impassable presence of many dams (e.g., Levin and Schiewe 2001) prevent adult and juvenile steelhead from reaching intended habitats and therefore have altered the rate of gene flow in the endangered Southern California DPS of steelhead. Adults that cannot access streams or upstream habitats are expected to migrate into and colonize non-natal streams (Boughton *et al*. 2006). Juvenile steelhead that are not allowed to engage in the spring emigration (e.g., Spina *et al*. 2005), as would be the case when a dam traps juveniles, are not expected to contribute to gene flow, thereby altering the pattern of natural gene flow. The numerous watershed-specific extinctions of steelhead in the Southern California DPS, many of which are related to anthropogenic activities (Nehlsen *et al*. 1991, Boughton *et al*. 2005, Gustafson *et al*. 2007), have altered gene flow. Each watershed-specific population of steelhead can be viewed as a distinct gene pool of individuals that are adapted to the specific environmental conditions and characteristics of its home watershed or sub-basin (see review by Nehlsen *et al*. 1991 and references therein, Hendry *et al*. 2002). Therefore, loss of a watershed- or sub-basin-specific population results in elimination of a substantial amount of genetic diversity and reduces gene flow throughout the broad population (Levin and Schiewe 2001). Evidence indicates genetic diversity in populations of southern California steelhead is low (Girman and Garza 2006), and we agree that this finding is in contrast to the subject finding reported in Nielsen et al. (1997) (page 4, Attachment C, United Water Conservation District 2008b).

Natural processes that cause ecological variation should be maintained. Habitat is the "templet" for ecological variation in a species (Southwood 1977), and, accordingly, when a species' habitat is altered, the potential for the habitat to promote ecological variation (e.g., in a species' ability to cope with fluctuating environmental conditions) is also altered. Much of the historical habitat for steelhead in southern California streams has been degraded, eliminated, simplified, and rendered inaccessible to the species (Nehlsen *et al*. 1991, Busby *et al*. 1996, Boughton *et al*. 2005, Good *et al*. 2005), and existing habitats are not being maintained. For instance, the alteration in the pattern and magnitude of discharge downstream of dams or diversions (e.g., Federal Energy Regulatory Commission 2007 a, b, NMFS 2008) has resulted in a shift in the timing of the freshwater migration corridor or a restricted migration window (e.g., NMFS 2008, this biological opinion). These effects are expected to translate into limited or no opportunities for steelhead to migrate during the wet season, the principal migration season. Loss or limited migration opportunities are expected to adversely affect the species' basic demographics and evolutionary processes, causing a reduced potential that the DPS can withstand environmental fluctuations. 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 southern California steelhead (Girman and Garza 2006).

In summary, the foregoing evaluation indicates the DPS is 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), and the formal listing determination for the species (NMFS 1997, 2006a).

F. Description of the Population Units

The Southern California DPS comprises several population units (steelhead-bearing watersheds). While 46 drainages support this DPS (Boughton *et al*. 2005), only 10 population units possess a high and biologically plausible likelihood of being viable and independent[5] (Boughton *et al*. 2006). Although the geographic area of the DPS is broad, the individual population units are sparsely and unevenly distributed throughout the DPS with extensive spatial breadth often existing between nearest-neighbor populations (Boughton *et al*. 2005, NMFS 2005, Boughton *et al*. 2006). Widespread extinctions of population units have been observed as well as contraction of the southern extent of the species' geographic range (Boughton *et al*. 2005, Gustafson *et al*. 2007). One reason for the extensive spatial gaps between neighboring population units and the range contraction involves man-made barriers to fish migration (Boughton *et al*. 2005). The Santa Clara River population unit involves Sespe Creek, Santa Paula Creek, Hopper Creek, and Piru Creek drainages (e.g., Moore 1980a, Puckett and Villa 1985, Titus *et al*. 2006). As described in the following section, the Santa Clara River population unit is important to the viability and recovery of the endangered Southern California DPS of steelhead.

[5]Independent population: a 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 (Boughton *et al*. 2006).

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

Here we describe the characteristics and conditions of the Santa Clara River steelhead population that contribute to the viability of the entire endangered Southern California DPS of steelhead. The characteristics and conditions include the "independence" of the Santa Clara River population, and the functional value of the steelhead-bearing sub-basins within the watershed.

Independence of the Santa Clara River population.**—**The Santa Clara River population is considered an independent population (Boughton *et al*. 2006), and is therefore expected to support formation of steelhead numbers in several adjacent population units (Figure 3-3). 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 possess weakened viability.

One reason why the Santa Clara River population unit is considered an independent population is because it 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 such a population unit (Boughton *et al*. 2006).

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. The population unit represents a large distributional component of the overall range of the DPS, and the Santa Clara River population unit is the largest steelhead-bearing watershed in the DPS. Without this population unit, the number of large population units would be reduced to two: the Santa Ynez River and the Ventura River. The remaining units are small coastal populations, which, by themselves, do not appear to favor viability and recovery of the DPS (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. 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 (for evidence of variation in life history traits and adaptations to environmental characteristics, see Withler 1966, Schaffer and Elson 1975, and review by Nehlsen *et al*. 1991). The inland populations appear to have been the largest particularly during favorable water years (Boughton *et al*. 2007b).

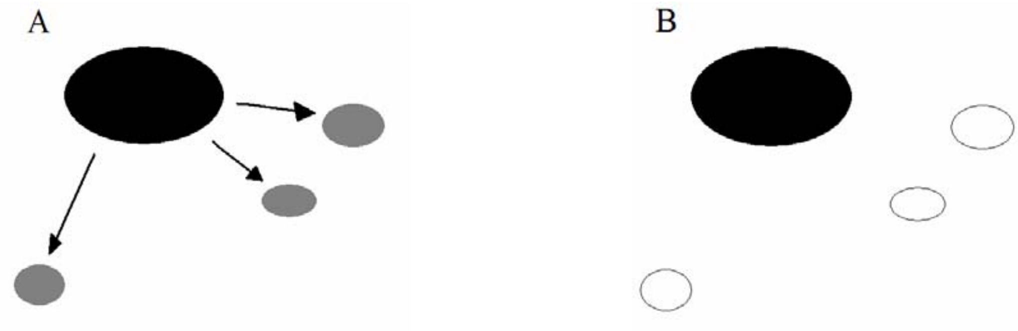

Figure 3-3.—Concept of source-sink dynamic (after McElhany *et al*. 2000, Primack 2004). Circles represent habitats (e.g., watersheds) with the size of the circle indicating the size of the population unit and habitat capacity (large circles represent source or core population units, whereas small circles represent sink or non-core population units). Shading represents population density: white indicates an empty habitat, black indicates high density, and grey indicates intermediate density. Arrows indicate migration. In favorable years, source populations show relatively stable numbers and several sink populations show arrival of immigrants (A). Populations in sink areas may become extinct in unfavorable years (B), but sinks or non-core populations can be recolonized by migrants from source populations when conditions are favorable.

Functional value of the steelhead-bearing sub-basins within the watershed.—The independence of the Santa Clara River population unit depends on subpopulations within the watershed (individual steelhead-bearing streams in the watershed) and the quality and quantity of habitats available for the subpopulations.[6] We have information (including information on fish abundance) on a few of the subpopulations (Sespe Creek and Piru Creek), and this information indicates the subpopulations possess certain attributes that signify their ecological importance to the Santa Clara River population unit[7]. These attributes must be represented and maintained to promote long-term viability of the species (Boughton *et al*. 2007b). A review of these attributes is as follows.

The Sespe Creek watershed is one of the largest steelhead-bearing drainages in the Santa Clara River basin, and reportedly provided over half of the historic spawning habitat for an estimated 20,000 steelhead (compare with Moore 1980a) that accessed the Santa Clara River basin (Blecker *et al*. 1997 and references therein). Given the large size of the Sespe Creek sub-basin and the amount of habitat for steelhead (47 miles, Comstock 1992), the sub-basin has the potential to produce a large number of steelhead, which favors survival of the species. Much of Sespe Creek lies on U. S. Forest Service land and within the "Sespe Wilderness", where anthropogenic activities are either not allowed or severely restricted. Much of the instream habitat is least disturbed and, with regard to abundance, Sespe Creek supports some of the highest densities of *O. mykiss* found in southern California steelhead streams (Carpanzano 1996, Blecker *et al*. 1997).

[6] Key concepts in population theory are presented in this biological opinion, including a detailed discussion of the concepts at the beginning of section III, subsection E. Understanding these concepts is crucial for appreciating the importance of the subpopulations to the viability of the population unit (and likewise the value of the population units to the viability or independence of the DPS), and the relationship among steelhead abundance, habitat quality and quantity, fluctuations in environmental conditions, and extinction risk.

[7] The "information on fish abundance" includes several sources as cited throughout this specific discussion regarding the functional value of the steelhead-bearing sub-basins within the watershed, not solely Blecker *et al*. 1997, as is suggested on page 4, Attachment C, United Water Conservation District 2008b).

The Sespe Creek drainage appears to be safeguarding the anadromous stock of *O. mykiss* in the Santa Clara River watershed. The species still reproduces in the drainage (Carpanzano 1996, Blecker et al. 1997) and the residual population of *O. mykiss* exhibit ancestral native steelhead genetics (Carpanzano 1996, Nielsen *et al*. 1997, Girman and Garza 2006). These fish probably still transform into smolts and migrate to the ocean (e.g., Thrower *et al*. 2004a), and smolts have been captured in this drainge (Puckett and Villa 1985). The foregoing characteristics suggest the Sespe Creek drainage is still able to contribute steelhead to the Santa Clara River population unit of steelhead. The Sespe Creek drainage is believed important to the viability of the Santa Clara River population unit of steelhead (Blecker *et al*. 1997).

The Piru Creek subpopulation is located farther inland than Sespe Creek, requiring that steelhead have the physical ability to migrate long distances (a feature that promotes population diversity). The subpopulation extends into an area that is drier and warmer than those subpopulations located closer to the coast (Boughton *et al*. 2006), and such environmental conditions are expected to promote formation of specific adaptations that favor survival of steelhead (genetic and ecological diversity). The Piru Creek subpopulation lies in the largest drainage in the Santa Clara River watershed; the potential for this sub-basin to produce an extremely large number of steelhead is therefore high (see pages 10-17, and elsewhere, in NMFS [2008] regarding the natural presence of steelhead in the Piru Creek drainage and response to the argument that steelhead did not exist naturally in the sub-basin, page 4, Attachment C, United Water Conservation District 2008b). Much of the subpopulation area lies on U. S. Forest Service land, where anthropogenic activities are either not allowed or severely restricted. As a result, much of the habitat is high quality and least disturbed (A. Spina, NMFS, pers. obs.). Several tributaries in the middle and upper watershed (e.g., Fish Creek, Agua Blanca Creek, Lockwood Creek, Buck Creek) provide much habitat (in some cases several miles) for steelhead to spawn and rear (e.g., Moore 1980b).

Like the Sespe Creek drainage, the Piru Creek sub-basin appears to serve as a refuge freshwater habitat that is safeguarding the anadromous species. This is based on the reproduction of *O. mykiss* that has been noted there (Moore 1980b, Deinstadt *et al*. 1990) and the finding of residual *O. mykiss* that exhibit ancestral native steelhead genetics upstream of Santa Felicia Dam and Pyramid Dam (Nielsen *et al*. 1997, Girman and Garza 2006). These fish probably still possess the ability to transform into smolts and migrate to the ocean (e.g., Thrower *et al*. 2004a). Large adult *O. mykiss* leave Piru Lake (and Pyramid Lake) and undertake migrations during winter and spring in Piru Creek and spawn in upstream tributaries (Bloom 2005, pers. comm., R. Bloom, CDFG, Sept. 18, 2007). The characteristics of the population upstream of both dams, and the quantity and quality of habitat, suggest the area could one day be maintained as a large and naturally reproducing population for the purpose of preserving this endangered species.

The Piru Creek watershed is expected to buffer the species against extirpation, particularly during periods of extended drought that are common to the region. Prolonged rain-free periods cause many streams to become intermittent, sometimes over extensive areas (e.g., Spina *et al*. 2005, Boughton *et al*. 2006, Boughton *et al*. 2007b). Migration of steelhead to and from spawning and rearing areas and the ocean does not occur under such conditions. Perennial waterways, which can exist within upper basins, can serve as refuges for fish during the drought conditions and may be the only place where reproduction of native steelhead is occurring. With regard to the Piru Creek drainage, the tributary streams in the upper drainage (e.g., Agua Blanca

Creek, Fish Creek, Buck Creek, Snowy Creek) can possess flowing water even during dry periods, and given that steelhead are produced in the habitats above Pyramid Dam and Santa Felicia Dam (currently "non-listed steelhead") (Moore 1980b, Nielsen *et al*. 1997, Girman and Garza 2006, Boughton *et al*. 2007a, Boughton and Garza 2008, Garza undated), such areas are expected to protect the species during prolonged dry periods.

H. Status of the Species' Critical Habitat

Critical habitat for the Southern California DPS was designated on September 2, 2005 (NMFS 2005). The designation identifies primary constituent elements that include sites necessary to support one or more steelhead life stages and, in turn, these sites contain the physical or biological features essential for conservation of the DPS. Specific sites include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas. The physical or biological features that characterize these sites include water quality, quantity, depth, and velocity, shelter/cover, living space, and passage conditions. Activities with the potential to affect critical habitat for the Southern California steelhead DPS include: (1) forestry, (2) grazing and related rangeland activities, (3) agriculture and associated water withdrawals, (4) road building and maintenance, (5) modifications of the creek channel or bank, (6) urbanization, (7) sand and gravel mining, (8) mineral mining, (9) dams, (10) irrigation impoundments and water withdrawals, (11) wetland (including estuaries) loss or removal, (12) introduction of exotic or invasive species, and (13) impediments to fish passage (NMFS 2005).

Anthropogenic activities have reduced the amount of habitat available to steelhead (Nehlsen *et al*. 1991, NMFS 1997, Boughton *et al*. 2005, Good *et al*. 2005, NMFS 2006a). In many watersheds throughout the Southern California DPS, the damming of streams has precluded 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 presence of highway projects have rendered habitats inaccessible to adult steelhead (Boughton *et al*. 2005). Within stream reaches that are accessible to this species (but that may currently contain no fish), urbanization has in many watersheds eliminated or dramatically reduced the quality and amount of living space for juvenile steelhead. The extensive loss and degradation of habitat is one of the leading causes for the decline of steelhead abundance in southern California and listing of the species as endangered (NMFS 1997, 2006a).

The critical habitat analytical review teams assembled as part of the effort to designate steelhead critical habitat ranked the conservation value of habitat for watersheds known to be occupied by steelhead (NMFS 2005). The conservation value was ranked "low" for 16 % of all drainages assessed in the DPS, whereas 41 % were ranked "medium" and 43 % were ranked "high". The conservation value of habitat within the Santa Clara River watershed was ranked high, meaning the habitat is currently (at the time of the evaluation) high quality and expected to be supportive of species recovery. We emphasize that this ranking is relative to the potential of the habitat; although habitat in the Santa Clara River watershed has been degraded, we conclude that the habitat is of high value for recovery of the species. Although the conservation value identified by the critical habitat analytical review teams does not capture the current condition of the critical habitat, we consider in this biological opinion the conservation condition (i.e., the current function) of the critical habitat. The action area possesses a considerable amount of critical habitat relative to the total amount in the Southern California DPS (see NMFS 2005 for illustrations that show the amount of critical habitat in the Santa Clara River watershed versus the amount of habitat available throughout the DPS).

IV. ENVIRONMENTAL BASELINE

In this section, we review the environmental baseline, which:

> "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 consultation, and the impacts of State or private actions which are contemporaneous with the consultation in process" (50 CFR §402.02).

A. Status of Critical Habitat and Steelhead in the Action Area

The historical function of the action area (in particular the mainstem Santa Clara River) could have included steelhead rearing for at least two reasons. First, past accounts indicate perennial surface flows were present in selected areas of the mainstem Santa Clara River (Outland 1971, Mann 1975), but not all areas of the mainstem were consistently wet. Second, the ecological literature indicates juvenile anadromous salmonids rear in mainstem habitats (Peterson 1982, Tschaplinski and Hartman 1983, Leider *et al*. 1986, Hartman and Brown 1987, Loch *et al*. 1988, Murphy *et al*. 1997, Bramblett *et al*. 2002, Spina *et al.* 2005). Today, due to a variety of anthropogenic activities (which include exploitation of surface and ground water resources) (Bureau of Reclamation and United Water Conservation District 2005), the functional value of critical habitat in the action area (e.g., the freshwater migration corridor) has been diminished, and some functions have been eliminated. Diversion of surface water alone has altered the timing, frequency, duration, magnitude, and rate-of-change of surface water in the action area (e.g., Harrison *et al*. 2006, NMFS 2008). While the reach of Piru Creek extending from Santa Felicia Dam to the confluence with the mainstem Santa Clara River has the potential to support spawning and rearing steelhead (Bureau of Reclamation and United Water Conservation District 2004), effects due to past and current dam-related flow alterations in the creek (as described elsewhere in this biological opinion) reduce the functional value of critical habitat in this area for steelhead.

We note that the Bureau's comment regarding the historical function of the mainstem (page 3, Bureau of Reclamation 2008a) is speculative, in part, because it lacks any corroboration that the historical condition of the mainstem channel downstream of the current location of the Vern Freeman Diversion Dam was dominated by, or composed entirely of, surficial sand.

Recent information on the abundance of steelhead in the action area is available. Fish-trapping activities at the Vern Freeman Diversion Dam[8] since 1994 (Bureau of Reclamation and United Water Conservation District 2004) show relatively few juvenile steelhead and even fewer adult steelhead (no more than 2 in any year) (Table 4-1). A survey of the Santa Clara River from the mouth of Sespe Creek to Fillmore during the wet season found no steelhead (Swift 2003). Despite installing an electronic fish-counting and video-surveillance system in the Vern Freeman fish ladder in 2002, no steelhead has been counted (United Water Conservation District, pers. comm., hydrologist, M. McEachron, 2005). The low number of adult steelhead noted passing the diversion dam is believed to be an artifact of the fish ladder, which steelhead are not expected

[8] Note that all steelhead entering or leaving the Santa Clara River watershed must pass this diversion.

to locate, particularly during periods of elevated flows that are sufficient to cause spills over the diversion dam. We do not believe that this statement regarding the attraction, or lack thereof, of steelhead to the fish ladder is speculative (page 5, Attachment C, United Water Conservation District 2008b), given the information and findings reported throughout this biological opinion and which are corroborated in the scientific literature. Additionally, we know that adult steelhead are return to neighboring streams upcoast and downcoast of the Santa Clara River, and smolts are emigrating from the Santa Clara River, both of which suggest adult steelhead should be returning to spawning and rearing tributaries in the Santa Clara River watershed. In addition to information presented in Table 4-2, two adult steelhead were observed downstream of the diversion dam in early 2008 (pers. comm., S. Howard, fishery biologist, United Water Conservation District). The origin of these fish is questionable because United reports (and provided color photographs to NMFS showing) both fish were missing the adipose fin, usually an indicator of domestication (page 5, Attachment C, United Water Conservation District 2008b).

Table 4-1.—Reported number of adult and smolt steelhead captured or observed (in the case of adults during 1999-2001) at the Vern Freeman diversion (Bureau of Reclamation and United Water Conservation District 2004).

Year	Adult	Smolt
1994	1	81
1995	1	111
1996	2	82
1997	0	414
1998	Not monitored	2
1999	1	3
2000	2	876
2001	2	75
2002	0	0

B. Threats to Steelhead and Critical Habitat in the Action Area

A number of past and present anthropogenic activities have reduced the quality and quantity of critical habitat within the action area and harmed steelhead. These activities involve construction and operation of water storage and diversion facilities, conversion of wildlands, wastewater release to the river, land-use activities, and groundwater pumping (Schwartzberg and Moore 1995, Bureau of Reclamation and United Water Conservation District 2004, Kelley 2004, Bureau of Reclamation and United Water Conservation District 2005). While some activities are physically outside the action area, the activities adversely affect critical habitat and steelhead in the action area (e.g., in the case of land-use activities causing input of sand and smaller particles to habitats within the action area, or in the case of a water storage or diversion facility altering the downstream pattern and magnitude of discharge in the action area). Such activities are considered in the discussion of factors affecting steelhead and critical habitat in the action area.

***Ongoing Impassable Presence of Dams*.—** The construction and ongoing impassable presence of dams in the action area is expected to have contributed to declines in steelhead abundance (e.g., Nehlsen *et al.* 1991, NMFS 2006a), owing to reported effects of dams on fish species and their habitat (Rieman and McIntyre 1995, Neraas and Spruell 2001, Rieman and Allendorf 2001, Morita and Yamamoto 2002). Within the action area, the damming of Piru Creek through construction of Santa Felicia and Pyramid dams blocks steelhead from historical spawning and rearing habitat because none of these dam allow fish passage. The amount of historical spawning and rearing habitats rendered inaccessible to this species in the action area due to the construction of dams is substantial (Moore 1980a); over 30 miles of stream lies between Santa Felicia Dam and Pyramid Dam alone and includes the mainstem Piru Creek and the principal tributaries Agua Blanca and Fish creeks.

Diversions in the action area can have adverse effects on fishery resources that are similar to the effects of dams, particularly when the diversion is large (*i.e.*, functions over a relatively broad range of discharges) and not designed to allow fish migration (Blahm 1976, Mundie 1991, Smith *et al*. 2000). Of the many diversions in the action area (Table 4-2) only the Harvey Diversion Dam and the Vern Freeman Diversion Dam have a ladder to allow fish migration through the localized area. The fish ladder at the Harvey Diversion Dam was damaged during the 2005 winter storms (Bureau of Reclamation and United Water Conservation District 2005), but was repaired in summer 2007 (pers. comm., S. Glowacki, fishery biologist, NMFS, April 1, 2008).

While the "effectiveness" of the fish ladder at the Vern Freeman Diversion Dam has been assessed (McEachron 2005), the findings and conclusions of the assessment are not reliable (see Appendix A of the original September 30, 2005, draft biological opinion). As an example, the assessment concluded that the fish ladder was effective in passing steelhead because Pacific lamprey (*Lampetra tridentata*) have been observed in the ladder. Such a conclusion is inappropriate because evidence indicates fish ladders can be species and size selective (Godinho *et al*. 1991, Bunt *et al*. 1999, Laine *et al*. 2002). Unlike steelhead, lamprey have an eel-like body and rely on different behaviors than steelhead to ascend a ladder. When migrating, lamprey use its oral disc to attach and hold onto surfaces between brief periods of burst swimming (Mesa and Moser 2004, Adams 2006, Zapel 2008). Because fish ladders can favor passage of some species and not others, inferring a species' ability to locate and ascend a fish ladder based on the ability of another species can lead to spurious conclusions (page 3, Attachment E, United Water Conservation District 2008b). While lamprey have been reported in the ladder (page 3, Attachment E, United Water Conservation District 2008b), such information is not evidence that this species located the ladder without delay and does not speak to the issue of attraction to the fish-ladder entrance. To our knowledge, the claim that "the ability of lamprey to use suction to climb the ladder does not help them *find* the ladder" (page 3, Attachment E, United Water Conservation District 2008b), has not been proven because no such information has been reported in the scientific literature. This claim is therefore unfounded.

Operation of unscreened surface-water diversions in the action area can disrupt migration of steelhead because such diversions increases the likelihood of entraining steelhead in diversions, canals, and conveyance pipes. The unscreened diversion on Santa Paula Creek is expected to entrain and prevent a large fraction of smolts from reaching the ocean (Bureau of Reclamation and United Water Conservation District 2005). United's diversion on Piru Creek downstream of Santa Felicia Dam has not been formally reviewed by NMFS to determine the adequacy of the fish screen (page 6, Attachment C, United Water Conservation District 2008b, page 7, Attachment E, United Water Conservation District 2008b), and may posses the potential for impinging or entraining juvenile steelhead (Bureau of Reclamation and United Water Conservation District 2005). The California Department of Fish and Game is also concerned with and not approved the fish screen (pers. comm., M. Larson, California Department of Fish and Game, June 25, 2008). At the Vern Freeman Diversion Dam, an earthen dike was constructed each year (beginning in early 1900 and ending with the construction of the current diversion dam in 1991) and was not screened. As a result, all migrating steelhead would have been diverted (email correspondence M. McEachron, 2005, United Water Conservation District), except during periods when high flows demolished the earthen berm.

***Alteration of the Natural Pattern and Magnitude of Streamflow*.—**Exploitation of surface water can adversely affect the physicochemical and biological characteristics of streams (Poff *et al*. 1997) and has contributed to the population decline of anadromous salmonids throughout much of their range (Mundie 1991, Hedgecock *et al*. 1994, Moyle 1994, NMFS 1997, NMFS 2006a). Because many primary constituent elements of critical habitat are flow related (NMFS 2005), an activity that affects the amount of water in streams increases the potential for impacts to steelhead critical habitat. Within the action area, many water diversions (Table 4-2) and reservoirs (Table 4-3) alter the pattern and magnitude of discharge in downstream tailwaters (Bureau of Reclamation and United Water Conservation District 2005, NMFS 2008).

Table 4-2.—Known water diversions in the Santa Clara River watershed (United Water Conservation District and Castaic Lake Water Agency 1996, Bureau of Reclamation and United Water Conservation District 2005, Nelsen 2006). Operators or diversions listed more than once are operating under a different license or permit. Note the source documents do not reference a known irrigation diversion on Sisar Creek. While many of these structures are upstream of the action area, effects of the diversions extend downstream into the action area. Where NMFS has knowledge indicating diversion activities are harming steelhead, the diversion operator has been notified (page 3, Bureau of Reclamation 2008a).

Stream	Operator or diversion name
Piru Creek	Piru Mutual Water Company
Piru Creek	Rancho Temescal
Piru Creek	United Water Conservation District
Hopper Creek	The Nature Conservancy
Hopper Creek	Robert Asimow
Pole Creek	Flying A Ranch
Pole Creek	Alfred A. and Francis L. Martinez
Sespe Creek	Sanford I. Drucker
Sespe Creek	Sanford I. Drucker
Sespe Creek	Sanford I. Drucker
Sespe Creek	Sanford I. Drucker
Sespe Creek	Sanford I. Drucker
Sespe Creek	Fillmore Irrigation District
Santa Paula Creek	Pajaro Partners, Inc.
Santa Paula Creek	Pajaro Partners, Inc.
Santa Paula Creek	Steven A. and R. Wigley Smith
Santa Paula Creek	Canyon Irrigation District
Santa Paula Creek	"Harvey Diversion Dam"
Santa Clara River	California Department of Fish and Game
Santa Clara River	Santa Clara Water and Irrigation District
Santa Clara River	Central Coast Production Credit Association
Santa Clara River	Camulos Ranch, "Camulos Diversion"
Santa Clara River	"12th Street Diversion"
Santa Clara River	United Water Conservation District, "Vern Freeman diversion"

Table 4-3.—Name and characteristics of water-storage facilities in the Santa Clara River watershed (sources: http://www.wrpinfo.scc. ca.gov/watersheds/sc/sc_profile.html, and http://endeavor.des.ucdavis.edu/newcara).

Name	Stream dammed	Surface area (acres)	Dam height (feet)	Year completed	Designed storage (acre feet)
Bouquet Canyon Reservoir	Bouquet Canyon Creek	628	190	1934	36,500
Dry Canyon Reservoir	Dry Canyon Creek	1,140	66	1912[a]	1,140
Castaic Lake	Castaic Creek	2,235	340	1973	324,000
Pyramid Lake	Piru Creek	1,360	386	1973	180,000
Lake Piru	Piru Creek	1,240	213	1955	88,340

[a] Other sources indicate this reservoir was placed in service in 1913 (United Water Conservation District and Castaic Lake Water Agency 1996). In January 1966, the reservoir was "taken out of service," but continues to impound water during storms.

The Vern Freeman Diversion Dam is a major water diversion in the action area, and is permitted to divert a maximum of 375 cfs from the Santa Clara River and no more than 144,630 acre-feet per water year. Briefly,[9] operation of the Vern Freeman Diversion Dam alters the pattern and magnitude of discharge, and therefore critical habitat, downstream of the diversion, and indirectly and directly affects juvenile and adult steelhead. Diversion operations (1) reduce the magnitude of discharge and sometimes eliminate flow entirely within a year, (2) cause fluctuating discharge, (3) increase the discharge recession rate, (4) abbreviate discharge duration within individual rain-induced discharge pulses, (5) reduce migration opportunity (i.e., favorable conditions that allow an individual to move between or among habitats) for adult and juvenile steelhead, and (6) increase the potential for stranding, delaying, and precluding migration. Live and dead steelhead have been found when tending to the Vern Freeman Diversion Dam (e.g., lowering flows to inspect or clean features of the diversion) or in the fish trap (Carpenter and Wise 1999, Kentosh 1999[10], United Water Conservation District 1999, United Water Conservation District 2006, email correspondence S. Howard, fishery biologist, United Water Conservation District, May 8, 2007). In the past, live steelhead collected at the diversion have been captured (a total of ten smolts and two "resident rainbow trout" were captured in 2007, see also Table 4-2) and then trucked and released in the Santa Clara River or Ventura River estuaries or upstream of the diversion in the Santa Clara River or Santa Paula Creek near 12th Street.

Many other surface-water diversions in the watershed (Table 4-2) (including some on Piru Creek downstream of Santa Felicia Dam) attenuate discharge peaks and reduce discharge in the action area (Bureau of Reclamation and United Water Conservation District 2005, Nelsen 2006). The amount of water diverted upstream of the Vern Freeman diversion can be substantial because United staff have observed decreased discharge in the Santa Clara River (upstream of Vern Freeman) when upstream diversions were operating. The "12th Street diversion" on Santa Paula

[9] A detailed description of how past diversion operations altered the pattern and magnitude of discharge downstream of the diversion is included in the administrative record for this consultation, for example, Appendix B of the original September 30, 2005, draft biological opinion.

[10] United claims the draft biological opinion "incorrectly cited observations of hatchery trout as if they were steelhead" (page 7, Attachment E, United Water Conservation District 2008b). This claim is false because the document referenced here (Kentosh 1999) states "a fisheries biologist from Entrix identified the fish as a female steelhead, with eggs" (page 1, Kentosh 1999). In 2006, a parr was found in the diversion fish trap (United Water Conservation District 2006), and this individual specimen may be the progeny of steelhead or capable of expressing anadromy.

Creek (tributary to the Santa Clara River) has been known to divert a magnitude of water that would make up more than 50 % of the discharge in Santa Clara River (Bureau of Reclamation and United Water Conservation District 2005). In addition to diversions listed in Table 4-2, other diversions consisting of hoses connected to pumps exist and are used for agricultural purposes (United Water Conservation District and Castaic Lake Water Agency 1996, Bureau of Reclamation and United Water Conservation District 2005). Altering the pattern and magnitude of discharge is of concern because primary constituent elements of critical habitat include freshwater migration corridors, which are water dependent.

Flow-related effects of Santa Felicia Dam operations have contributed to the current condition of critical habitat and status of steelhead in the action area (NMFS 2008). The operations of Santa Felicia Dam (1) eliminate the conservation value of freshwater rearing sites and freshwater migration corridor in the Piru Creek sub-basin, and appreciably reduce the conservation value of the freshwater migration corridor in the Santa Clara River, (2) create conditions that are not expected to support the formation and preservation of freshwater spawning sites in Piru Creek downstream of Santa Felicia Dam, (3) cause extensive habitat loss and fragmentation, and reduce the functional value of habitat characteristics and conditions for steelhead upstream of Santa Felicia Dam, (4) create obstructions in the steelhead migration corridor, and perpetuate the reduction in the amount of spawning and rearing habitats available to anadromy, (5) disrupt, if not eliminate, migration of steelhead into and out of Piru Creek, (6) reduce migration opportunities and success in the Santa Clara River, (7) preclude the anadromous component of the steelhead population from most of the Piru Creek sub-basin, (8) reduce straying and gene flow into and out of the watershed, (9) decrease recruitment of steelhead progeny (*i.e.*, density of age-0 steelhead) in the watershed, (10) reduce the likelihood that the Santa Clara River population unit of steelhead would survive, and (11) decrease the viability of the Southern California DPS and reduce the ability to recover the species.

***Conversion of Wildlands*.—**Changes in land use through conversion of lands can increase input rates of nitrogen and sand and smaller particles to receiving waters and therefore critical habitat for steelhead. This can lead to reductions in the quality of habitat and abundance of desirable aquatic species, and increased eutrophication of receiving waters such as estuaries and streams (Weaver and Garman 1994, Bowen and Valiela 2001, Quist *et al*. 2003). Consequently, the proliferation of urban areas within the Santa Clara River watershed and development of sewage-treatment plants discharging treated sewage to the river and estuary year round (United Water Conservation District and Castaic Lake Water Agency 1996, Bureau of Reclamation and United Water Conservation District 2005) are of concern.

Over the last several decades, numerous urban areas have developed within the Santa Clara River watershed (*e.g.*, Valencia, City of Fillmore, City of Santa Paula, Santa Clarita). The amount of urbanized acreage increased from 72,600 acres in 1969 to 121,870 acres in 1980 (Schwartzberg and Moore 1995) with many developments along and adjacent to the Santa Clara River. The past and ongoing conversion and development of lands have increased the potential for runoff of pollutants and sand and smaller particles to surface water and therefore steelhead critical habitat, and such increases have been observed. Increased concentrations of nitrates exceeding California's drinking-water standard (45 mg/l) have been detected in the mainstem Santa Clara River and are believed to be related to wastewater treatment (and agricultural practices) (United Water Conservation District and Castaic Lake Water Agency 1996).

With regard to the Santa Clara River estuary, evidence indicates this habitat has experienced alteration and loss of its natural form and function (Bureau of Reclamation and United Water Conservation District 2005, Nautilus Environmental 2005). Because changes in land use due to development of urban areas can increase rates of nitrogen loading to receiving waters and have undesirable effects on the aquatic environment (Bowen and Valiela 2001), urbanization within the Santa Clara River watershed and operation of sewage-treatment plants increase the potential for increased rates of nitrogen input to receiving waters and degradation of steelhead critical habitat including the estuary (Bureau of Reclamation and United Water Conservation District 2005). The historical loss of estuary habitat, and reduction in habitat quality, is expected to have caused a reduction in the amount and quality of estuarine habitat for steelhead. The loss of estuarine habitat within the Santa Clara River watershed is of concern because such habitats are a primary constituent element of steelhead critical habitat that contain features essential to the conservation of the species, and provide numerous values to anadromous salmonids (Smith 1990, Thorpe 1994), such as physiological transitions between fresh and saltwater for adults and juveniles, and feeding and growing areas for juveniles (NMFS 2005), including the "lagoon-anadromous" type of steelhead (Bond 2006).

Land-use Activities.—Activities such as agriculture, grazing, and sand and gravel mining have contributed to declines in steelhead abundance (Busby *et al*. 1996, NMFS 1997, Good *et al*. 2005, NMFS 2006a, see also Quist *et al.* 2003). Within the action area, agriculture is extensive along the riverbanks, and within the floodplain, and during the wet season probably contributes sediment-water slurry and residual pesticides to the mainstem Santa Clara River and critical habitat for steelhead. Much of the mainstem Santa Clara River is essentially a sandy wash, a condition presumed to reflect past and present disturbance of upland areas, resulting in exposed soil and input of sand and smaller particles to surface waters. If this presumption is true, it would mean that, historically, much of the river channel was not dominated by surficial sand (page 6, Attachment C, United Water Conservation District 2008b).

The cattle grazing observed in the Santa Clara River watershed is expected to create conditions that are harmful to steelhead and their habitat, given the reported effects of grazing on aquatic habitats (e.g., Hicks *et al*. 1991, Platts 1991, Wohl and Carline 1996). That cattle graze in the watershed is corroborated through observations of cattle in riparian areas and streams within the Santa Clara River watershed (including along Piru Creek downstream of Santa Felicia Dam) (pers. obs., A. Spina, fishery biologist, NMFS), as well as reports of formal cattle operations near the town of Piru and in Los Angeles County (Schwartzberg and Moore 1995). Observations of Pole Creek and selected areas in Piru Creek indicate the condition and characteristics of the streambanks and channel are consistent with those characteristics and conditions noted in streams where cattle grazing and bank trampling were prevalent.

Mining of sand and gravel in the Santa Clara River watershed has been undertaken since the early 1900s (Schwartzberg and Moore 1995), but has been recently curtailed. The early mining operations were probably performed with little regard for the aquatic environment given that regulations governing such mining did not come into existence until the early 1970s. Much of the early mining was confined to Montalvo, Saticoy, and Santa Paula. Mining caused extensive damage and alterations to the river channel, which included scarring of the river channel, removal of riparian vegetation, and creation of deep basins. The removal of sand and gravel was blamed for erosion and degradation of the channel bed noted in the river. Removal of sand and gravel has implications for fishery resources and steelhead critical habitat because the manner of removal is reported to adversely affect aquatic habitat and biota, including steelhead (Nelson *et al*. 1991, Weigand 1991, Brown *et al*. 1998, Harvey and Lisle 1998, Meador and Layher 1998). The extent that the effects of past mining activities are continuing to affect the quality and quantity of habitats in the action area today is not clear.

During the wet season, the Santa Clara River is turbid and can exceed 3,000 nephelometric turbidity units. Although the causes for the elevated turbidity are not known, anthropogenic activities throughout the watershed continue to expose extensive areas of soil, thereby increasing the potential for accelerated inputs of sand and smaller particles to surface waters. The high turbidity concentrations are of concern because reports suggest high turbidity levels (> 4,000 mg/l) may temporarily halt upstream migration of adult salmonids (Bjornn and Reiser 1991). If turbidity is impeding migration of adult steelhead, this would only exacerbate the existing conditions that are challenging conservation of the endangered Southern California DPS of steelhead and the quality and quantity of critical habitat for this species.

When and where appropriate, NMFS will notify private landowners or state and federal agencies if information indicates a particular land-use activity is creating conditions that are harming or injuring endangered steelhead (page 3, Bureau of Reclamation 2008a).

Groundwater Pumping.—A significant conclusion is that "…local groundwater pumping over the last 100 years has severely depleted groundwater basins and reduced the frequency and duration of surface flows, with subsequent effects on steelhead trout migration and rearing" (pp. 17, Bureau of Reclamation and United Water Conservation District 2005). Historical accounts indicate the mainstem Santa Clara River flowed year round (Mann 1975, Bureau of Reclamation and United Water Conservation District 2005), suggesting the availability of over-summering habitat (freshwater rearing sites) for juvenile steelhead in the mainstem. That juvenile steelhead historically reared in mainstem habitats would not be unexpected because such habitat use has been reported in studies conducted in Washington (Loch *et al*. 1988), British Columbia (Hartman and Brown 1987), Alaska (Johnson *et al*. 1994, Bramblett *et al*. 2002), and California (Spina *et al*. 2005). Given the functional value of mainstem habitats in the ecology of steelhead, loss of critical habitat such as freshwater rearing sites, through groundwater pumping, is considered unfavorable for the conservation of steelhead. Reductions in the frequency and duration of surface-flow connectivity between tributaries and the mainstem Santa Clara River, and within the river, increase the potential for disrupting emigration of juvenile steelhead (Bureau of Reclamation and United Water Conservation District 2004, 2005). The groundwater pumping in the Oxnard Plain, in upstream reaches (*e.g.*, Piru Basin), and in sub-basins (*e.g.*, City of Fillmore) increases percolation of surface water to groundwater and reduces surface flows in the Santa Clara River and in tributaries.

Environmental Stochasticity.—The influence of environmental stochasticity within the action area is expected to be high (Boughton *et al*. 2006). The expected sources of environmental stochasticity involve drought (and associate features such as high temperatures, low streamflow, lack of sandbar breaching at the mouths of rivers), floods, and wildfire. Extended rain-free periods, which are fairly common in southern California, can lead to dramatic reductions in the amount and extent of surface flow during both the dry and wet season. At times, the reductions can be severe enough to cause dewatering over extensive instream areas, intolerably low concentrations of dissolved oxygen, and kills of steelhead, based on NMFS' observations and experience (A. Spina, NMFS, pers. obs.). Wildfire can increase inputs of sand and smaller particles to streams, and reduce the amount of habitat available to steelhead (e.g., Spina and Tormey 2000 and references therein). Based on NMFS' experience and knowledge of the action area, wildfire is common, occurring on the order of what appears to be one or more fires every 3 to five years, and the wildfires vary in severity and intensity. In September 2006, the "Day Fire" burned about 162,000 acres of the Santa Clara River watershed. Climate change is expected to influence the action area, particularly through increases in air (and therefore water) temperature and decreases in precipitation (Hayhoe *et al*. 2004), which in turn may decrease the amount of suitable habitat for steelhead.

V. EFFECTS OF THE PROPOSED ACTION

This section describes the expected effects of the proposed action on the endangered Southern California DPS of steelhead and critical habitat for this species. To predict the effects, NMFS applied the methods described below.

A. Analytical Approach

As of this writing, the timeframe for the analyses that follow is 3 years 6 months (not 2 ½ years, page 3, Bureau of Reclamation 2008a) because the Bureau's discretion over operation of the diversion dam lapses on December 31, 2011.

Analysis of Discharge Records for the Santa Clara River.—There are two principal issues related to operation of the diversion dam: (1) the pattern and amount of water released downstream for migration of steelhead (the bypass flows), and (2) whether steelhead can volitionally migrate past the diversion dam in an upstream and downstream direction. In this regard, two groups of analyses were performed. The first group investigated how the proposed action would affect the pattern and magnitude of discharge downstream of the diversion dam. To this end, river discharge without and with the influence of the current operations of the diversion dam and discharge as expected under the proposed action (flow file obtained from M. McEachron, hydrologist, United Water Conservation District, September 12, 2007), were plotted, overlayed, and then inspected[11]. Effects on river discharge, and therefore the freshwater migration corridor for steelhead, due to the proposed action were assessed through direct graphical comparison of the three discharge conditions. Note that river discharge absent the influence of current diversion operations is not unimpaired because operations of Santa Felicia Dam, Pyramid Dam, and Castaic Dam contribute to alter the pattern and magnitude of discharge in the Santa Clara River (e.g., NMFS 2008).

The second group of analyses investigated when, within each period of elevated river discharge (rain-induced discharge pulses), a continuous freshwater migration corridor forms through the diversion dam. This is of interest because spills of water over diversion dams can prevent steelhead from detecting fishways, resulting in slowed and unsuccessful migration (e.g., Caudill *et al*. 2006, Caudill *et al*. 2007). With regard to operation of the Vern Freeman Diversion Dam, information indicates the diversion is obstructing the freshwater migration corridor because spills of water over the dam appear to prevent steelhead from locating the fish-ladder entrance. River

[11] In the subject analysis included in the draft biological opinion, we did not show the influence of the current operations of the diversion dam (Bureau of Reclamation 2008a, United Water Conservation District 2008) because the bypass flows as exist under current operations and the proposed action are perfectly correlated (r = 1, N = 6958). Including the bypass flows representing the current operations in the analysis with the proposed action would have been redundant. In addition, such an analysis would result in a failure to assess the full effects of the proposed action on the species (that is, the effects that result when adding the future operations of the facility to a condition unimpaired by those operations). However, in response to comments from United and the Bureau, the current conditions are now included as a level in the analysis performed as part of this final biological opinion, for a total of three levels: (1) total available river discharge ("unimpaired" condition, or the future portion of the environmental baseline minus the operations of the diversion dam), (2) bypass flows due to current (i.e., past and present) operations (the past and present portion of the environmental baseline), and (3) the bypass flows due to the proposed action. The first level provides an understanding of the flows that would be available in the absence of the discretionary proposed action. The second level provides an understanding of how the effects of past and ongoing factors have lead to the current conditions of the river and the species, and the third level provides an understanding of how the proposed action is expected to alter or maintain the conditions described by the first level.

discharges exceeding 375 cfs, the diversion capacity, produce a spill with higher discharge producing greater spill and turbulent water downstream. Observations suggests spills associated with river discharges of less than 500 cfs (typically producing spills of about 170 to 190 cfs, assuming a 120 cfs bypass flow at the fish ladder) may not obscure detection of the fish-ladder entrance (pers. comm., M. McEachron, hydrologist, United Water Conservation District) because such discharges produce only minor turbulence immediately downstream of the diversion dam. Our review of a reference library of color photographs of spills at the diversion dam suggests river discharges over 500 cfs, and related spills, can prevent detection of the fish-ladder entrance. Examination of the hydrology record (i.e., the total river discharge that would pass downstream of the Vern Freeman Diversion Dam if no water was diverted, page 3, Attachment D, United Water Conservation District 2008b) indicates many instances when river discharges of or about 500 cfs produce spills exceeding 200 cfs (maximum of 461 cfs), though there are occasional low-magnitude spills (less than 100 cfs to a minimum of 5 cfs). We expect that adult steelhead cannot adequately locate the fish-ladder entrance when river discharge exceeds 500 cfs. We note (and understood at the time of the analysis, page 3, Attachment D, United Water Conservation District 2008b) that the 500 cfs criterion was applied over periods when the diversion was and was not operating; operation of the diversion at full capacity (375 cfs) when total river discharge is 500 cfs would produce a spill of 125 cfs, whereas the entire 500 cfs would pass over the diversion dam if the diversion was not operating. How the 500 cfs criterion was used in the analysis is described below.

Flow-duration analysis was used to calculate the number of days that river discharge exceeded 500 cfs for each discharge pulse, each of which possessed periods of increasing and decreasing flows and a peak maximum flow. Polynomial regression was used to model the relationship between the number of days river discharge exceeded 500 cfs and the peak maximum river discharge ($\log_e [X + 1]$ transformed) for each pulse. The contribution of the quadratic term was assessed using the extra-sum-of-squares method (Montgomery and Peck 1992). The resulting regression model including the linear and quadratic term was significant ($P < 0.001$), and the quadratic term contributed for predicting the duration (in days) that river discharge exceeded 500 cfs ($P < 0.001$). The resulting quadratic function, $y = -7.6 + 0.064 \cdot b + 0.217 \cdot b^2$, calculated the duration of flows over 500 cfs for a given input peak discharge (e.g., the mean peak discharge). The duration of flows over 500 cfs was viewed as the time required for steelhead to detect the fish-ladder entrance.

Based on comments about how NMFS applied the 500 cfs threshold (e.g., page 3, Attachment D, United Water Conservation District 2008b), it is clear that application of this threshold criterion was misunderstood. We emphasize that the 500 cfs threshold is a *minimum* criterion, meaning that our analysis considered discharge pulses with peaks that *exceed* 500 cfs. A review of the hydrology record and findings presented in this biological opinion indicate discharge pulses commonly exceed 500 cfs. That United may be diverting water when flows are producing a spill has a negligible effect on the interpretation of the findings because river discharge (the discharge peak) commonly exceeds 500 cfs. That the color photographs represented different operating scenarios at the diversion dam (page 3, Attachment D, United Water Conservation District 2008b) is irrelevant for purposes of our analysis, and we understood that the water coming over the diversion crest as depicted in the photographs represent spill (i.e., crest flows are not total river discharge when United is diverting).

While it is true that the fish-attraction flow from the fish ladder at the Vern Freeman Diversion Dam (120cfs) is 60% of a 200 cfs spill (page 2, Attachment F, United Water Conservation District 2008b), spills of water over the dam crest commonly exceed 200 cfs (as described elsewhere in this biological opinion) whereas the magnitude of the attraction flow is limited to 120 cfs. It is therefore misleading to create the perception that the fish ladder at the Vern Freeman Diversion Dam is capable of passing steelhead based solely on the attraction flow. The attraction flows that emanate from the fish-ladder entrance and auxiliary pipe are expected to be effective in guiding steelhead to the fish ladder only when spills are not sufficient to mask detection of the fish-ladder entrance. Specifically focusing on an analysis of the possible effectiveness of the fish ladder based on the proportion of the attraction flow relative to a 200 cfs spill is misleading.

One comment on the draft biological opinion stated NMFS is speculating "…that steelhead cannot find the existing Freeman fish ladder when river flows are above 500 cfs" (page 2, Attachment E, United Water Conservation District 2008b). Investigators have shown that high flows and spills of water can preclude steelhead from detecting fishways (e.g., Caudill *et al*. 2006 and references therein). With regard to the existing fish ladder at the Vern Freeman Diversion Dam, high flows and the resulting spills of water over the diversion-dam crest can swamp the fish-ladder entrance, as our observations indicate. Given the migratory behavior and ecology of steelhead, we expect the high flows and spills will guide steelhead upstream to the base of the diversion dam and away from the fish-ladder entrance at the extreme southern edge of the diversion dam. United itself has acknowledged the influence of the high flows and spills of water on passage of steelhead at the diversion dam. For instance, United stated that 3,000 cfs represents the near upper limit for steelhead locating the fish-ladder entrance, though this flow threshold is based exclusively on observations of lamprey (pers. comm., J. Kentosh, United Water Conservation District, January 25, 2008). While our original draft analysis used the 500 cfs threshold, we felt it informative and reasonable in this final biological opinion to expand the original analysis to include 1,000 cfs and 3,000 cfs thresholds, the findings of which are included in this final biological opinion.

That United staff could stand in the river downstream of the diversion dam (page 2, Attachment E, United Water Conservation District 2008b) is not a clear indicator that steelhead can locate the fish-ladder entrance. We agree with United that steelhead will cue on heavy flow when migrating upstream (page 2, Attachment E, United Water Conservation 2008b), because such is consistent with the findings of other investigators and NMFS' own observations on the migratory behavior and ecology of steelhead. For this reason, we continue to expect that high flows and spills of water over the diversion crest will lead steelhead to the base of the diversion dam and away from the fish-ladder entrance. Stating that "the flooded area downstream of the dam is limited to around 500 feet width…" (page 3, Attachment E, United Water Conservation District 2008b) does not dismiss the influence of high spills on steelhead detection of the fish-ladder entrance. We agree that steelhead swimming along the downstream base of the diversion-dam face until spills subside enough that steelhead can detect the fish-ladder entrance adds to migration delays (page 3, Attachment E, United Water Conservation District 2008b).

United refers to the "performance of the fish ladder" and various data types needed to assess performance (page 3, Attachment E, United Water Conservation District 2008b). As documented in written correspondences to United on this very issue, the "performance of the fish ladder” is not the specific issue challenging migration of steelhead past the diversion dam in an upstream direction. Rather, the overall performance of the *fish passage* is the specific issue (we address this issue more fully later in the description of the effects).

NMFS’ analysis of passage delays is predicated on the “peak” of a discharge pulse because elements of United’s proposed action are likewise predicated on the peak of a storm or discharge pulse (page 2, Attachment D, United Water Conservation District 2008b). For instance, the fish ladder is only operated when a peak of any storm is large enough to allow upstream migration of steelhead. The fish-passage delay analysis NMFS performed assumes steelhead would be present at the downstream side of the Vern Freeman Diversion Dam at the time of the peak discharge. This assumption is reasonable for a few reasons. First, periods of elevated river discharge prompt steelhead migration, which means steelhead (particularly the adults) can be in a river anytime discharge is elevated (Shapavolov and Taft 1954) (page 4, Attachment D, United Water Conservation District 2008b). Second, because one or more days are often need for discharge in the Santa Clara River to reach a peak, and steelhead can migrate on average slightly more than 1 mile/hr (Evans and Johnston 1980), this species is capable of reaching the downstream side of the diversion dam (a distance of about 11 miles from the ocean) long before the peak in river discharge. The reference to arrival time of steelhead at the fish ladder on the Carmel River, which is incorrectly interpreted as steelhead arriving at the base of the dam after the peak of the discharge (page 6, Attachment D, United Water Conservation District 2008b), is in reality evidence that steelhead do not consistently locate the fish-ladder entrance until high flows subside.

Our use of photographs to derive a river discharge criterion is expected to overestimate the true river discharge that masks detection of the fish ladder by some unknown amount. We relied only on those photographs that clearly showed spills swamping the fish-ladder entrance and generating high flows that are expected to guide steelhead upstream to the base of the diversion dam and away from the fish-ladder entrance. We note that the capacity of the fish ladder and auxiliary to deliver an attraction flow is only 120 cfs; the elevated river discharges and spills of water observed at the Vern Freeman Diversion Dam commonly exceed the attraction flow by orders of magnitude.

In their comments on the draft biological opinion, United makes several claims regarding NMFS’ analysis of passage delays, and creates the perception that the analysis and findings are flawed or not reasonable. The following is a point-by-point response to their comments.

- The claim that NMFS “misrepresented” findings of Caudill *et al*. (2006) and Caudill *et al*. (2007) in this biological opinion (page 1, Attachment F, United Water Conservation District 2008b) represents a misinterpretation of the information we present in this biological opinion and the information contained in the subject investigations. These two investigations generally report on the migratory behavior of steelhead, particularly as related to spills of water, and possible consequences of migration delay for individual steelhead. NMFS’ reference to these studies is consistent with the findings presented therein, as a careful *qualified* review of the studies and this biological opinion would reveal.
- While United agrees with NMFS’ conclusion that “spills of water over diversion dams can prevent steelhead from detecting fishways, resulting in slowed and unsuccessful

migration" is supported by Caudill *et al*. (2006), United further states such a conclusion is not supported in Caudill *et al*. (2007), which we also cite. NMFS' reference to Caudill *et al*. (2007) in this specific sentence was to show the possible consequences of migration delay on individual steelhead, which is supported in Caudill *et al*. (2007). The investigation by Caudill *et al*. (2007) did consider the influence of spills of water on passage delays of steelhead.

- This biological opinion cites both Caudill *et al*. (2006) and Caudill *et al*. (2007), as well as other studies (e.g., Shapovalov and Taft 1954, Spina *et al*. 2005) regarding the behavior and ecology of migratory fish, not simply Caudill *et al*. (2007) as has been suggested (page 6, Attachment C, United Water Conservation District 2008b).

- Contrary to suggestion (page 6, Attachment C, United Water Conservation District 2008b), the reference to Caudill *et al*. 2007 (and Caudill *et al*. 2006) does not constitute a comparison between the Santa Clara River and the Columbia River or any other waterway. The relevant issue in referencing these studies is the migratory behavior and ecology of steelhead, in particular the species' behavioral response to high flows when attempting to navigate man-made structures. As reviewed elsewhere in this biological opinion, these studies provide insights into how migrating steelhead behave in response to spill-induced turbulence and elevated water velocities at man-made structures.

- Our finding that spills prevent detection of the fish-ladder entrance at the Vern Freeman Diversion Dam is not highly speculative, does employ the best available science, and does not ignore the information needed to make such a determination (page 6, Attachment C, United Water Conservation District 2008b). The approach undertaken by other investigators has been based on the magnitude of the spill over dams (Caudill *et al*. 2006, Caudill *et al*. 2007), which is similar to the approach we undertake in this biological opinion. Relying on the magnitude of spills and amount of turbulence is reasonable because high flows and turbulence at the base of dams compel migrating salmonids toward the water apex just downstream of the dam (Brown 1991, Laine *et al*. 2002, Caudill *et al*. 2006). High-magnitude spills of water over the dam crest can preclude migrating salmonids from actually locating fishway entrances and reduce the likelihood that fish would enter a fishway (e.g., Caudill *et al*. 2006).

- Spills of water over the diversion dam are capable of precluding steelhead from detecting the fish-ladder entrance (pers. comm., J. Kentosh, United Water Conservation District 2008). We selected the 500 cfs threshold based on a review of color photographs of the Vern Freeman Diversion Dam spilling at various river discharges. The photographs made clear that periods of high spills and water turbulence can mask the fish-ladder entrance. We agree, however, that there may be instances during operation of the Vern Freeman Diversion Dam when the 500 cfs threshold does not produce substantial spills (e.g., river discharges of about 500 cfs when United is operating the diversion at full capacity, 375 cfs). Hence, the specific threshold of 500 cfs may not hold true all of the time, particularly at flows of around 500 cfs. For this reason, we ran a similar analysis using a 1,000 cfs and a 3,000 cfs threshold, and the findings from the analysis corroborate the findings obtained from the 500 cfs (the findings are described later in this biological opinion).

- The reference to Caudill *et al*. (2006) (and other references) when discussing that high flows and water velocities guide upstream migration of anadromous salmonids (page 2, Attachment F, United Water Conservation District 2008b), was provided to corroborate the discussion and as a courtesy to readers who might want to pursue obtaining additional information about the response of steelhead to high flows.
- Although the delays reported in Caudill *et al*. (2006) and the delays reported in this biological opinion are different (page 2, Attachment F, United Water Conservation District 2008b), the magnitude of the delays reported in Caudill *et al*. (2006) are constrained by the duration of the experimental treatments and therefore underestimate the effects of constant high spills on migration delay. The findings of Caudill *et al*. (2006) show a negative relationship between the magnitude of flows and the number of fish ascending (locating) the fishway. Therefore, for NMFS to state in the biological opinion that "steelhead are expected to ascend the ladder and pass the diversion only after spills nearly or entirely subside" is reasonable because NMFS' statement provides for the possibility that steelhead may be able to detect the fish-ladder entrance when spills are relatively small, which is consistent with the findings of Caudill *et al*. (2006).

***Information Review and Synthesis*.—**To develop an understanding of how the proposed action (and the interrelated activity, groundwater pumping) would affect endangered steelhead and critical habitat for this species, NMFS reviewed recent (Bureau of Reclamation 2007b) and past (Bureau of Reclamation and United Water Conservation District 2004, 2005) biological assessments prepared in support of the proposed action. While aspects of the proposed action have been modified since completion of these biological assessments, portions of the documents remain valid and provide general information regarding effects of the diversion operations on this species and critical habitat. Information regarding the migratory behavior and ecology of steelhead, and the influence of environmental factors and anthropogenic activities on species migration, was obtained from articles published in peer-reviewed scientific journals and the grey literature. Information from these articles was integrated with the findings and information from the hydrologic analyses and the biological assessments. A general knowledge of physical, ecological, and biological processes, population dynamics and theory, and the life history and habitat requirements of steelhead supplemented the information review.

Based on the location of the Vern Freeman Diversion Dam and reported effects of diversion operations on the Santa Clara River (e.g., Bureau of Reclamation and United Water Conservation District 2005), effects of the proposed action are expected to be confined to two primary constituent elements of critical habitat: (1) the freshwater migration corridor, and (2) the estuary (Table 5-1)[12]. When assessing effects on critical habitat, this biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR §402.02. Instead, NMFS relied on the statutory provisions of the ESA to complete the foregoing analysis with respect to critical habitat. Therefore, in considering effects on critical habitat, NMFS assessed whether implementation of the proposed action would allow critical habitat to remain functional to serve the intended conservation role for the species.

[12] The primary constituent elements identified here are those expected to be directly affected by diversion operations only, and does not include those affected by interrelated activities (operation of Santa Felicia Dam and Pyramid Dam), which are considered in a separate consultation (NMFS 2008).

Table 5-1.—Primary constituent elements (PCE) of critical habitat affected by the proposed action.

PCE	Description[a]
Freshwater migration corridor	Freshwater migration corridors free of obstruction 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. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a nonfeeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.
Estuarine areas	Estuarine areas free of obstruction 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, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. These features are essential to conservation because without them juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean. Similarly, these features are essential to the conservation of adults because they provide a final source of abundant forage that will provide the energy stores needed to make the physiological transition to fresh water, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas.

[a] Descriptions taken from the critical-habitat designation (NMFS 2005).

When assessing effects of the proposed action at the Santa Clara River population unit and the entire endangered Southern California DPS of steelhead, NMFS included consideration of (1) the factors that cause population abundance to collapse and become extinct, (2) the fact that the loss of individuals in a population is only one of several factors that can cause population abundance to collapse to the point of extinction, (3) the variety of factors that cause population collapse and extinction, (4) the type, extent, and amount of effects (and exposure and response of steelhead and critical habitat) due to the proposed action, (5) the environmental baseline, (6) the status and distribution of steelhead (and critical habitat), spatial structure, and population dynamics in the Santa Clara River, (7) the value of the Santa Clara River population unit of steelhead and its critical habitat to the viability of the Southern California DPS, and (8) how the proposed action would affect recovery of the Southern California DPS. Evidence that anthropogenic barriers to fish migrations can reduce fish population abundance, increase the risk of extinction, and cause extinctions of populations, can be found in Nehlsen *et al*. (1991), National Research Council (1996), Morita and Yamamoto (2002), Rieman and McIntyre (1993), Dunham *et al*. (1997), Boughton *et al*. (2005), and Gustafson *et al*. (2007).

With regard to population collapse and extinction, certain population attributes can create risk for a species (Pimm *et al*. 1988, Berger 1990, Primack 2004). A small population has a higher risk of extinction than a population made up of a large number of individuals. NMFS considers the number of steelhead in the Santa Clara River watershed and the endangered Southern California DPS of steelhead to be small (NMFS 1997, Good *et al*. 2005, NMFS 2006a). The principal reasons why small populations are particularly susceptible to a rapid decrease of individuals and local extinction involve loss of genetic variability (and related genetic problems), demographic fluctuations in birth and death rates, and environmental variation (e.g., biotic interactions, food availability, fires, drought). Large population sizes minimize the effects due to loss of genetic variability and population and environmental fluctuations (Pimm *et al*. 1988, McElhany *et al*. 2000). Another attribute that can increase risk involves population variability. Populations whose number of individuals are susceptible to large temporal variations are more likely to become extinct than populations whose numbers are not inclined to large fluctuations over time.

Steelhead abundance in southern California can vary substantially over time. Lastly, species that are short lived exhibit a greater risk of extinction than long-lived species (Pimm *et al*. 1988). Steelhead are short lived, with a generation of 3 to 4 years.

The description of the proposed action presented earlier in this biological opinion was deliberately crafted to be brief, in part, to maintain conciseness. Readers not possessing a complete understanding of the proposed action may be somewhat challenged to understand how the proposed action overlaps with the life history and habitat requirements of the species that is the basis of this biological opinion. Such readers can refer to the actual project descriptions, or can simply understand that operation and much of the maintenance of the Vern Freeman Diversion Dam occurs during the migratory season for steelhead. Because the diversion dam is in the lower Santa Clara River, all steelhead attempting to leave or enter the Santa Clara River watershed must pass the diversion dam. Adult and juvenile steelhead migrate during the wet season particularly during and shortly after periods of rain-induced pulses in discharge (Shapovalov and Taft 1954, Spina *et al*. 2005). Because the proposed action overlaps with the wet-season migration of adult and juvenile steelhead, many of NMFS' analyses reported here are confined to the winter-spring seasons, i.e., January through May.

Jeopardy Assessment.**—**Our analytical approach involves an exposure-response-risk model, which in general evaluates how the proposed action overlaps with the life history and habitat requirements of the species, the reaction of the species at the individual and population level to the exposure to the proposed action, and the reaction consequences for the extinction risk to the species. Inherent in this approach involves consideration of the factors that cause species to go extinct, which was already described above and in the section *Population Viability*.

The approach to assess whether the proposed action would jeopardize the continued existence of the endangered Southern California DPS of steelhead relied on information about the status and current viability of the species at the DPS scale (presented earlier in the Status of the Listed Species and Critical Habitat section and the Environmental Baseline section), information on how the proposed action is expected to adversely affect steelhead at the individual and population level, and integration of the foregoing information in the section Integration and Synthesis of Effects. The information regarding the status and current viability of the species under the environmental baseline, and the species' status provides reference conditions at the population scale to which NMFS adds the effects of the proposed action in the Integration and Synthesis of Effects section. In the Effects on Steelhead section, NMFS identifies the effects that individual steelhead are expected to experience as a result of the proposed action, and the expected response of steelhead to the effects based on the life history and habitat requirements of this species. Finally, NMFS assesses whether the conditions that result from, or are perpetuated by, the proposed action, in combination with conditions influenced by other past and ongoing activities as described in the Environmental Baseline, and cumulative effects will affect steelhead at the individual level. Once we have determined if the proposed action when added to environmental baseline conditions will affect the fitness of individual steelhead, the final steps in NMFS' jeopardy assessment are to evaluate first whether these fitness consequences are reasonably likely to result in changes in the likelihood of viability of the Santa Clara River steelhead population unit and the entire endangered Southern California DPS of steelhead. We complete this assessment by relying on the information available on the species and the specific population in terms of its current and needed abundance, productivity, diversity, and spatial structure characteristics, as presented in the Status of the Listed Species and Critical Habitat and Environmental Baseline sections.

We emphasize here that in performing the jeopardy assessment, a conclusion of "jeopardy" does not mean "…no more steelhead swimming up the Ventura or Santa Ynez rivers…" (page 4, Attachment E, United Water Conservation District 2008b). Specifically, a conclusion of "jeopardize the continued existence of" is intended to mean that the federal agency has failed to insure that it is not likely "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 [steelhead] in the wild by reducing the reproduction, numbers, or distribution of [steelhead]" (50 CFR §402.02). In other words, the jeopardy analysis assesses whether a proposed action increases the probability or potential of extinction to a species, not whether a proposed action would cause a species to become extinct solely as a result of the action, though some actions could conceivably have such an effect. With regard to considering the contribution of resident trout to the viability of the DPS (page 4, Attachment E, United Water Conservation District 2008b, and elsewhere), in accordance with the listing decision, this biological opinion solely uses the DPS terminology and provides NMFS' conclusion as to the likelihood of jeopardy to the endangered Southern California DPS of steelhead based only on effects to the listed species.

Adverse Modification Risk Assessment.**—**The approach to determine if the proposed action is likely to result in the destruction or adverse modification of designated critical habitat involved consideration of how the proposed action would affect elements of critical habitat identified as essential to the conservation of the species. In the Status of the Listed Species and Critical Habitat section, our critical habitat adverse modification risk assessment begins with a discussion of the biological and physical features (primary constituent elements or essential features) in the entire designated critical habitat that are essential to the conservation of the endangered steelhead DPS, the current conditions of such features, and the factors responsible for the current conditions. In the Environmental Baseline section, we discuss the current condition of critical habitat in the action area, the factors responsible for that condition, the conservation role of those specific areas, and the relationship of critical habitat designated in the action area to the entire designated critical habitat at the scale of the DPS to the conservation of the endangered Southern California DPS of steelhead. In the Effects on Critical Habitat section, NMFS characterizes the effects of the proposed action on critical habitat designated in the action area and evaluates whether the designated critical habitat and primary constituent elements in the action area will continue to provide those features and functions that support the biological requirements of the species, or retain the current level of ability to establish those features and functions. With regard to critical habitat, this biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR §402.02. Instead, NMFS has relied upon the statutory provisions of the ESA to complete the foregoing analysis with respect to critical habitat. Therefore, in considering effects on critical habitat in the final steps of NMFS' assessment, NMFS assessed whether implementation of the proposed action would reduce the ability of critical habitat to remain functional or allow for primary constituent elements to be functionally established for the purpose of serving the intended conservation role for the species.

Assumptions.**—**In addition to assumptions stated elsewhere in this biological opinion, NMFS made the following assumptions regarding the proposed action and the ecology and behavior of steelhead in the Santa Clara River. The basis for these assumptions generally involves NMFS' understanding of the proposed action, the flow and channel dynamics of the Santa Clara River within the action area, and the migratory behavior, ecology, and habitat requirements of steelhead.

1. In the Santa Clara River, adult steelhead generally migrate during January 1 through May 31, and juvenile steelhead migrate during March 1 through May 31. While we believe this migration window represents the principal migration period for the species in this river, this window is not likely inclusive. The assumed migration window may be an abbreviation of the true migration window because investigators report a slightly broader migration period for steelhead in the Santa Clara River (November to June, Fukushima and Lesh 1998). The assumed migration period was defined during negotiations with United to lessen the impacts of dedicated bypass flows to United's overall project yield. If the true migration window is as in Fukushima and Lesh (1998), NMFS' findings reported here are an underestimate of the effects of the proposed action on endangered steelhead. Given our knowledge on the timing of steelhead migration, which includes observations on adult steelhead in streams and estimated time of entry, we believe the migration period defined during the negotiations is reasonable.

2. United's hydrology model, which is the basis for the analysis of effects on the freshwater migration corridor, is a reliable predictor of the effects of the proposed action on the pattern and magnitude of discharge in the Santa Clara River. We believe this assumption is reasonable given United's intimate knowledge of river discharge and its operation of the Vern Freeman Diversion Dam. We are unsure how or if application of United's "limiting criteria" to the diversion operations (i.e., operating criteria as described in United's letter of September 20, 2007, and the Bureau's January 2007 biological assessment) would materially alter the expected pattern and magnitude of river discharges downstream of the diversion dam that are projected through the model output and that are the basis for NMFS' effects analysis (described in the section "Effects on Critical Habitat").

3. The specified minimum discharge over the "critical riffle[13]" (per United's operating criteria detailed in their letter of September 20, 2007) represents a minimum river discharge at this specific location, and when measured elsewhere in the reach of river extending downstream from the Vern Freeman Diversion Dam, including downstream of the critical riffle, river discharge will not be less than the specified minimum discharge.

4. Alterations in the pattern and magnitude of discharge, including reductions in the amount and extent of surface flow, would translate into changes in the quality and quantity of the freshwater migration corridor for steelhead, with concomitant effects on individuals within the affected area. This assumption is reasonable given the flow-related

[13] "The critical riffle is a term we use that would describe the most difficult riffle for an upstream migrant. Due to our ever changing river, the critical riffle can also move. In the past it has been up towards the 118 bridge, but normally is about 1.5 to 1.9 miles upstream of the 101 bridge. Normally when that stretch of the river is a loosing reach the critical riffle will be further downstream due to less water in the river. When it is a gaining reach, it can be closer to the 118 bridge. Big riffle is located at about 1.7 miles upstream of the 101 bridge. The critical riffle will have to be located after every major storm. In general the channel morphology will change with peaks that exceed several thousand cfs." (pers. comm., M. McEachron, Hydrologist, United Water Conservation District, November 21, 2007).

dependency of many features of aquatic habitat and the inextricable connections among flow, riverine habitat, and steelhead life history, habitat requirements, and population metrics (e.g., Shapovalov and Taft 1954, Barnhart 1986, 1991, Lytle and Poff 2004, Spina *et al*. 2005, Caudill *et al*. 2006, Caudill *et al*. 2007).

5. The historical and recent discharge records for the Santa Clara River are a reasonable representation of future hydrologic conditions as would occur under the proposed action until 2011, when the Bureau's discretion over the operation of the Vern Freeman Diversion Dam lapses. These records involve a mix of below normal, normal, and above normal water years for the region, with the frequency of water-year types approximating a normal distribution.

6. Because river discharge in the Santa Clara River watershed is naturally "flashy," (rises and falls relatively quickly) and the migration behavior and ecology of steelhead evolved under such conditions, we expect adult steelhead must be able to volitionally migrate swiftly through Santa Clara River mainstem.

B. Effects on Critical Habitat

In this section, we describe the effects of the proposed action on designated critical habitat for the endangered Southern California DPS of steelhead. Knowing the effects to habitat, including critical habitat, is necessary to adequately predict effects of the proposed action on endangered steelhead, which we do in the subsequent section (*Effects on Steelhead*). The effects reported here corroborate and extend those effects on critical habitat previously reported by NMFS, and which are contained in the administrative record for this consultation.

Effects of the proposed action are expected to be confined to the freshwater migration corridor downstream of the diversion dam, through the diversion dam, upstream of the diversion dam, and the Santa Clara River estuary. We emphasize that the effects created by the proposed action are not new, but are an extension of the existing effects of operating the diversion dam on critical habitat for steelhead. Therefore, the proposed action is expected to perpetuate the existing effects of the current diversion operations on critical habitat. The description of the effects that follows includes effects due to the interrelated activity, groundwater pumping, particularly when such effects are projected to exacerbate effects due to the proposed action.

The Freshwater Migration Corridor Downstream of the Vern Freeman Diversion Dam.**—**The proposed action is expected to continue to artificially truncate the frequency and duration of the freshwater migration corridor downstream of the diversion dam (Figure 5-1, Appendix A). The bypass flows will be infrequent and of short duration, compared to the freshwater migration corridor that would otherwise exist if not for the current diversion operations. The effects of the proposed action on the frequency and duration of the freshwater migration corridor are expected to vary depending on the type of water year; below-normal water years are expected to produce the fewest, and above-normal water years the most, opportunities for the creation of a freshwater migration corridor downstream of the diversion dam.

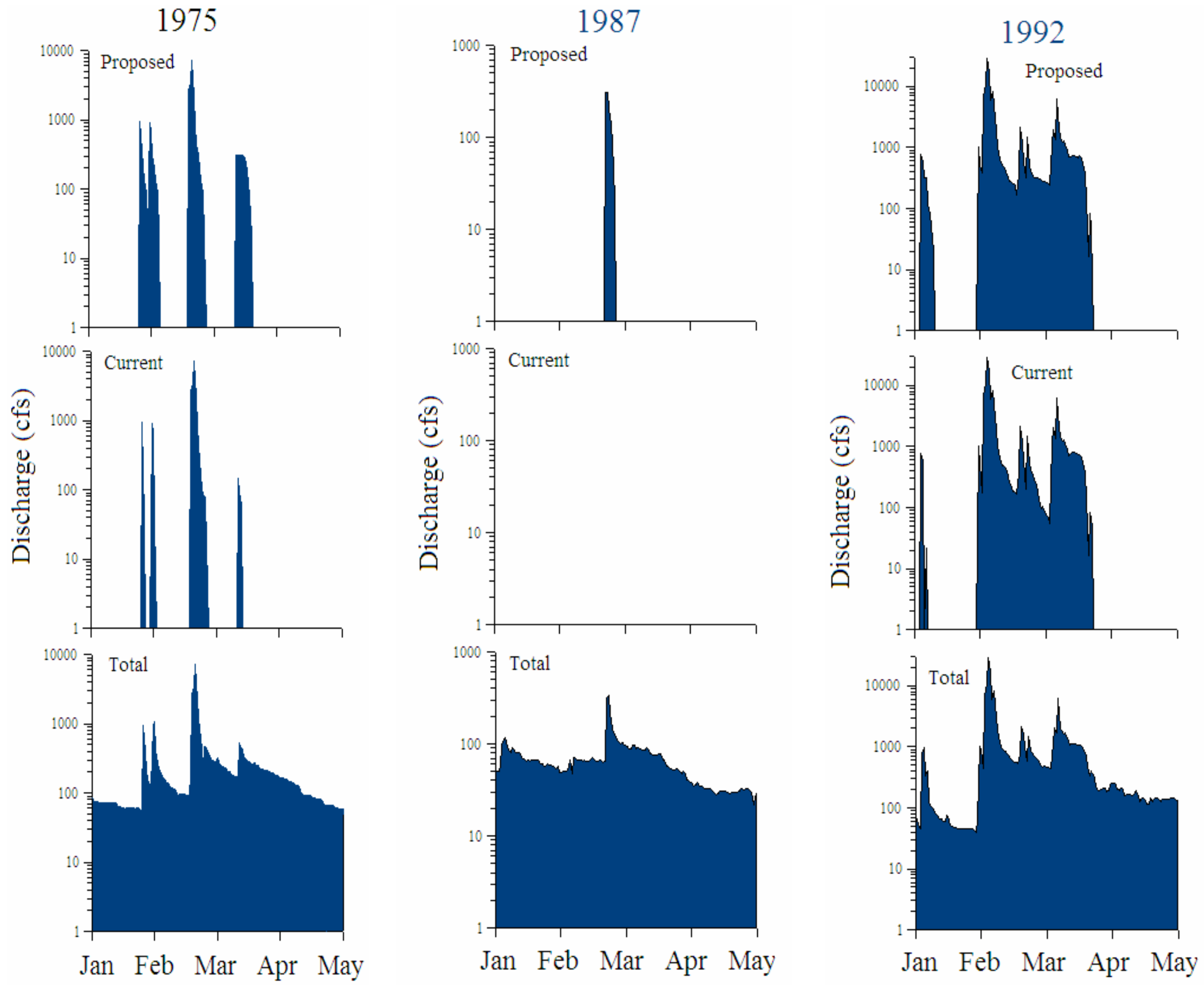

Figure 5-1.—Example of the effects of the proposed action on river discharge downstream of the diversion dam. The proposed bypass flow (shaded area), the current bypass flow (due to past and present operations) and total available river discharge as would exist if all the water in the river passed downstream and none was diverted for three different water-year types: above normal = 1992, normal = 1975, below normal = 1987. This example, and additional examples provided in Appendix A, make clear that the proposed action will perpetuate the existing effects of the current diversion operations on the freshwater migration corridor for endangered steelhead in the Santa Clara River downstream of the Vern Freeman Diversion Dam.

The large and widespread withdrawal of groundwater in the lower river valley (Bureau of Reclamation and United Water Conservation District 2005) is expected to continue to worsen the reduction in the frequency and duration of the freshwater migration corridor. Groundwater withdrawal increases the rate of surface-water percolation into the substrata, and losses of 100 cfs to groundwater are reported for the lower river. This often requires discharges in excess of 180 to 200 cfs, particularly during periods of reduced groundwater storage, to maintain a continuously flowing river and sufficient water-column depths for passage of steelhead through the river downstream of the diversion dam (Thomas R. Payne & Associates 2004a). The combination of low and infrequent river discharges downstream of the diversion dam, due to the proposed action, and the persistent groundwater withdrawal, is expected to diminish the functional value of the freshwater migration corridor downstream of the diversion dam.

The proposed action is expected to continue to artificially increase the rate that the river recedes (up to 375 cfs/24 hours) downstream of the diversion dam (Figure 5-1). Generally, river discharge in the absence of current diversion operations ceases gradually over several days. Under the proposed action, the descending limb of the hydrograph is projected to become truncated relative to the rate of decline that would be observed if not for the diversion operations. The perpetuated increased recession rate is expected to continue to translate into a rapidly dissipating freshwater migration corridor downstream of the diversion.

While it may be true that "all water diversions to some degree" artificially truncate the downstream frequency and duration of the freshwater migration corridor (page 7, Attachment C, United Water Conservation District 2008b), such does not dismiss the effects of the proposed action, including the proposed operating criteria, on steelhead critical habitat. While United's hydrologist and biologist held meetings with NMFS' steelhead biologist in late summer 2007 to discuss options for minimizing effects of the proposed action on endangered steelhead and critical habitat for this species (page 7, Attachment C, United Water Conservation District 2008b), not all of NMFS' recommendations were adopted. The findings from NMFS' analysis revealed here indicate the proposed action will continue to artificially truncate the frequency and duration of the freshwater migration corridor downstream of the Vern Freeman Diversion Dam.

Freshwater Migration Corridor through the Vern Freeman Diversion Dam.**—**The proposed action is expected to continue to create a bottleneck, and at times a complete obstruction, in the freshwater migration corridor through the diversion dam. A bottleneck would be created because the only means of a freshwater migration corridor is through the fish ladder, whereas a complete obstruction would be created when the freshwater migration corridor is rendered discontinuous due to spills of water masking detection of the fish-ladder entrance. Periods of spill can be frequent and of long duration within a single wet season. Higher flows produce spills lasting for weeks and prolonged periods when the migration corridor through the diversion dam is obstructed (Figure 5-2).

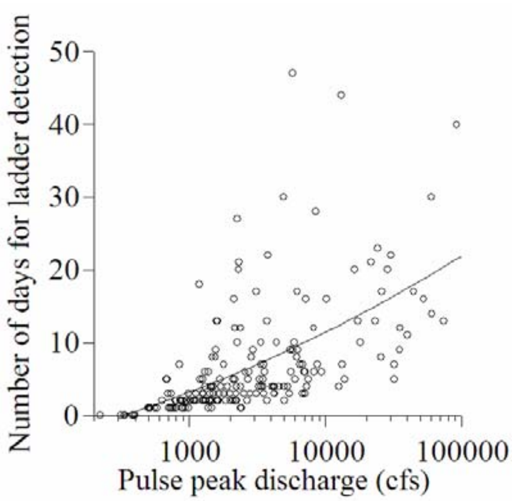

Figure 5-2.—Relationship between peak discharge in the Santa Clara River during the principal steelhead migration season (January through May) and the number of days for a continuous freshwater migration corridor to form through the diversion dam (*N* = 187). The line in the graph is a quadratic function ($y = -7.6 + 0.064 \cdot b + 0.217 \cdot b^2$) fit to the data points.

Under the proposed action, there are expected to be few instances when elevated discharge does not produce a delay in the detection of the fish-ladder entrance and most (~80%) of the discharge pulses are expected to produce a delay of about 12 days or less (Figure 5-3). The average maximum discharge pulse for the period of record is 6,847 cfs, which corresponds to an average delay of 10 days. Based on the analysis using 1,000 cfs and 3,000 cfs thresholds, the average delays are 6 and 2 days.

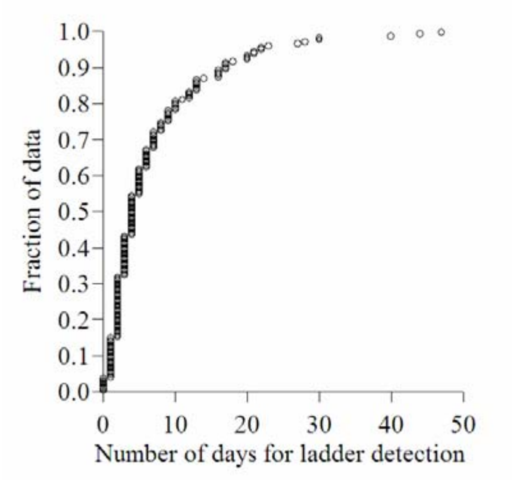

Figure 5-3.—Distribution of the number of days expected for continuous freshwater migration corridor to establish through the diversion dam, based on the 500 cfs threshold (*N* = 187).

Freshwater Migration Corridor Upstream of the Vern Freeman Diversion Dam.— The proposed action is expected to continue to cause an attenuation in the freshwater migration corridor that steelhead would experience upstream of the diversion dam. Once discharge in the river subsides enough to allow a continuous freshwater migration corridor through the diversion dam, discharge in the mainstem and tributaries upstream of the diversion will have subsided. A synchronous decline in discharge throughout the watershed is expected because discharge in the Santa Clara River watershed is correlated (Figure 5-4).

To further investigate the attenuation of the freshwater migration corridor that is expected to continue due to the proposed action, two flow variables were plotted and then inspected. The flow variables involved (1) the discharge in the Santa Clara River (at the Vern Freeman Diversion Dam) at the time the bypass flows are released (i.e., upon the peak maximum river discharge), and (2) the river discharge at first detection of the fish ladder. The first flow variable was obtained from a simple query of the hydrologic record for each discharge pulse. The second flow variable was obtained from the previous analysis (i.e., section entitled "Analysis of Discharge Records for the Santa Clara River") that predicated detection of the fish ladder on flows under 500 cfs. The findings from this analysis reveal that during periods of elevated flows, the freshwater migration corridor will experience declines of several hundred to several thousand ft^3/s upstream of the diversion dam before the obstruction in the migration corridor is eliminated (Figure 5-5)[14].

[14] Using the 1,000 cfs and 3,000 cfs thresholds would also show that river discharge must decline several hundred to thousand ft^3/s upstream of the diversion dam before the obstruction in the migration corridor is eliminated.

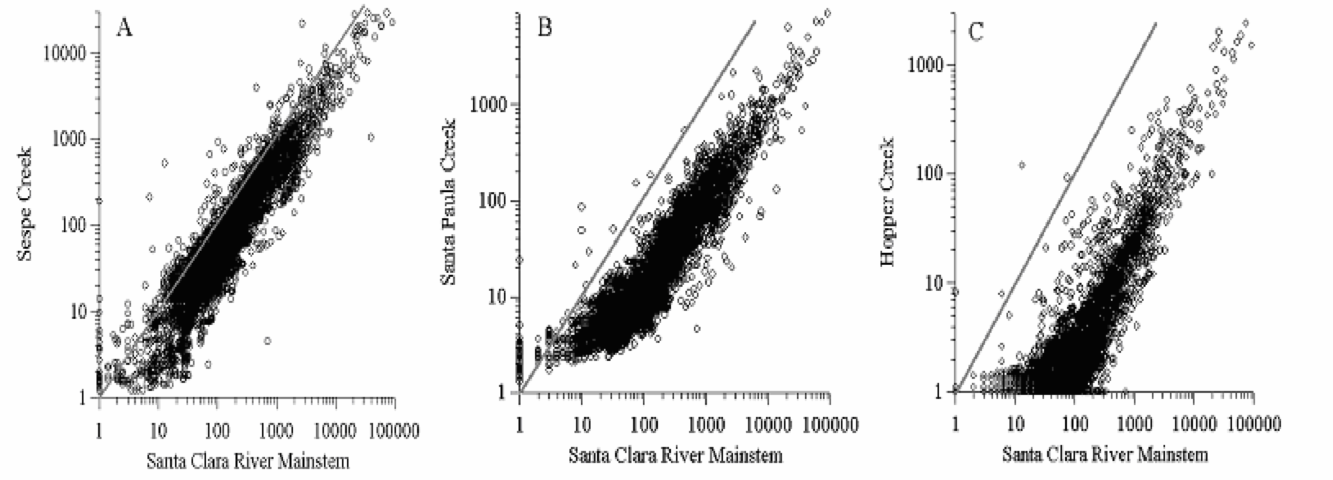

Figure 5-4. —Comparison of daily mean discharge (cfs) during January through May at the confluence of Sespe Creek (A) (1955-1985, 1990-2002, USGS gage 11113000, *N* = 6065), Santa Paula Creek (B) (1955-2002, USGS gage 11113500, *N* = 6958), and Hopper Creek (C) (1955-1983, USGS gage 11110500, *N* = 4235) with the mainstem Santa Clara River (source of flow for Santa Clara River: July 19, 2005, flow file received from M. McEachron). The diagonal line represents the point on the graph where discharge between sites is equal.

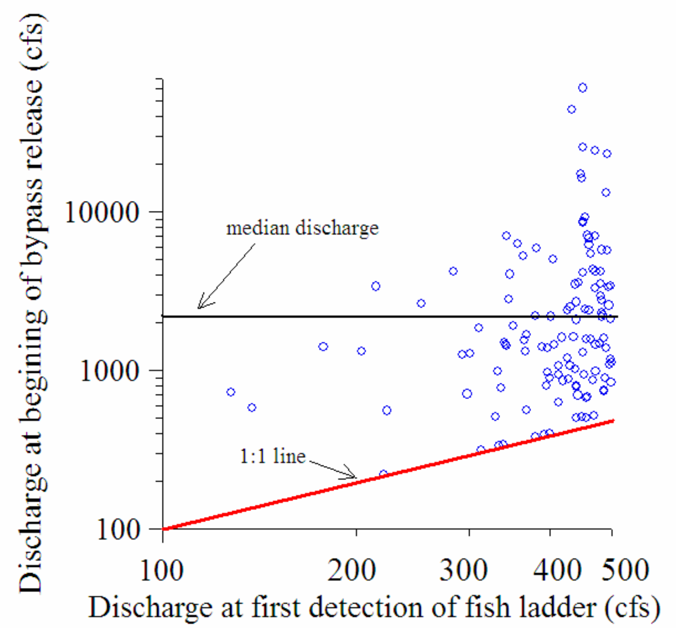

Figure 5-5.—Santa Clara River discharge at the beginning of the bypass release against discharge when the fish-ladder entrance is likely to be detected. Because the vast majority of the points in the graph lie well above the 1:1 line (where discharge for the two conditions are equal), the proposed action is expected to cause a substantial reduction in the freshwater migration corridor that upstream-migrating steelhead encounter upstream of the diversion dam. For example, in the graph above we see that a river discharge of 3000 cfs at the beginning of a bypass release (y-axis) must decline several hundred cfs, to less than 500 cfs, before reaching a magnitude when we would expect steelhead to be able to detect the fish-ladder entrance.

The reductions in river discharge necessary for the fish-ladder entrance to be detected have implications for the quality of the freshwater migration corridor. An investigation of the flow-depth relationship in the mainstem Santa Clara River revealed that river discharges of at least 800 cfs are needed to produce a sufficient distribution of water-column depths that are believed necessary for the migration of adult steelhead between the estuary and Santa Paula Creek (Harrison *et al*. 2006). Inspection of Figure 5-5 shows that by the time a continuous freshwater migration corridor forms through the diversion dam (i.e., flows less than 500 cfs), river discharge upstream of the diversion is less than 800 cfs (500 cfs or less based on the graph above). By contrast, before the formation of the continuous corridor (i.e., flows of 500 cfs or more in the graph above), there are frequent instances when river discharge exceeds 800 cfs. The proposed action is therefore expected to continue to shorten the window of the freshwater migration corridor upstream of the diversion dam, and reduce the quality of this primary constituent element through a reduction in river discharge. We note that using the 1,000 and 3,000 cfs thresholds would result in a similar finding that the proposed action would continue to abbreviate the migration window upstream of the diversion dam.

Overall, the findings from NMFS' effects analysis indicate operation of the diversion dam would continue to slow and prevent upstream migration of steelhead because the proposed operation of the fish-passage facility does not account for the flashy nature of the Santa Clara River and the migratory behavior and ecology of steelhead (see the section entitled *Effects on Steelhead*).

The disruption in the freshwater migration corridor has long been a concern and, accordingly, NMFS has continued to recommend that United physically modify the diversion dam to alleviate the obstruction and provide a continuous freshwater migration through the dam. In response to the concern, and now as part of the proposed action, United plans to convene a panel of fish-passage experts who will perform a review of the existing fish ladder (proposal of March 4, 2008). After carefully considering the proposal to review the existing fish ladder, NMFS has determined that the proposal is not likely to remedy the existing obstruction in the freshwater corridor that would extend into the future owing to the proposed action. The basis for this determination is as follows:

1. The proposal does not include a meaningful fish-passage design objective to ensure the panel's efforts are focused on the substantive matters that require improvements. United's current proposal, which relies on a concept of "adequate migration conditions," to guide the work and conduct of the panel, could conceivably be used to argue that the passage conditions expected under the proposed action are in fact "adequate." The findings from the foregoing analyses of effects on critical habitat alone (see also the section *Effects on Steelhead*) indicate the expected passage conditions are clearly not adequate. NMFS therefore defines *adequate passage* as conditions that provide or approximate unimpeded migration (without delay), which is necessary to ensure operation of the diversion dam allows critical habitat, i.e., the freshwater migration corridor, to remain functional to serve the intended conservation role for the species.

2. The proposal does not ensure the review panel would identify those physical modifications of the diversion dam that are necessary to provide or approximate unimpeded passage of adult steelhead past the diversion dam over a broad range of river discharge. Earlier in this biological opinion, NMFS determined that operation of the

diversion dam creates an obstruction in the freshwater migration corridor for endangered steelhead (see also Zapel 2007, Thomas and Wantuck 2008, Zapel 2008). However, the proposal confines the panel's review solely to the existing fish ladder[15]. As NMFS stated in meetings with United and in previous written correspondence (e.g., NMFS' letters of January 30, 2006, and August 15, 2006), the overall performance of the fish passage at the diversion dam, not the performance of the fish ladder or fish within the fish ladder, is the principal issue precluding unimpeded passage of steelhead past the diversion dam in an upstream direction. The existing fish ladder cannot account for the flashiness of the Santa Clara River and the migratory requirements and behavior of steelhead, and at times the diversion dam, including the fish ladder, represents a complete barrier to upstream migration of this species (page 8, Attachment C, United Water Conservation District 2008b)[16]. Confining the panel's review and analysis to the existing fish ladder would fail to address the key issues challenging migration of adult steelhead at the diversion dam.

3. Under section 7(a)(2) of the ESA, the Bureau is legally mandated to *ensure* that any federal action is not likely to jeopardize the continued existence of any endangered species or result in the destruction or adverse modification of critical habitat for the species by relying on the best available scientific and commercial data. In this context, United's current proposal constitutes a plan to develop new information for an uncertain period of time and with no assurance that the information will be used and acted upon by United to correct fish-passage problems at the diversion. As currently proposed, NMFS cannot be reasonably certain the panel process will lead to remedies of the existing fish-passage deficiencies, and therefore, we would be unable to rely upon the proposed panel to ensure that the diversion operations are likely to avoid jeopardizing the continued existence of endangered steelhead or adversely modifying critical habitat for this species.

4. United's current proposal specifies conditions that are expected to influence the conduct and outcome of the panel's review. For instance, the requirement in the proposal that the existing fish-passage facility must "…hinder a significant percentage of upstream steelhead migration when in operation…" prior to undertaking a remedial action is problematic for at least a few reasons. The term "significant" is undefined and could therefore be interpreted in a manner that is not favorable for passage of steelhead. This criterion is insensitive to the delays steelhead can encounter when attempting to locate the fish-ladder entrance, and therefore ignores the harmful effects of migration delay on steelhead migrants and spawning success. This criterion incorrectly assumes that blocking even a small fraction of endangered steelhead from upstream spawning areas would not contribute to jeopardizing the continued existence of the species. Hindering passage is counter to minimizing adverse effects of the proposed diversion operations on endangered steelhead and critical habitat for this species.

[15] The proposed action (and the administrative record) makes clear that United intends the panel review to be confined to the existing fish ladder. Claiming that NMFS has "misrepresented" the panel's review because the proposed action includes the phrase "fish passage facilities" (page 5, Attachment E, United Water Conservation District 2008b) is not true because the fish ladder is the "fish passage facilities."

[16] The past review of the fish ladder (page 8, Attachment C, United Water Conservation District 2008b) focused solely on the fish ladder, not the overall performance of the fish passage or attraction of steelhead to the fish-ladder entrance. Information reported here and in the administrative record indicate periods of high river discharge can swamp the fish-ladder entrance, at times rendering the entrance undetectable to steelhead.

5. United’s current proposal avoids committing to the panel’s recommendations, particularly any recommendation that exceeds “simple” modifications to the fish ladder. For instance, implementation of a panel’s recommendation is conditioned upon United’s sense of “reasonableness” and approval by United’s board of directors. Implementation of an effective remedy for the obstruction in the freshwater migration corridor is therefore uncertain.

6. The proposal does not specify a schedule. An expeditious timeframe is needed to guide the panel’s work and timely implementation of a physical modification to the diversion dam. The panel should conclude its analyses and prepare its findings and recommendations in a timely manner, and the recommendations, once concurrence from NMFS has been received, should be fully implemented and operational before the Bureau’s ongoing discretion over operation of the diversion dam lapses On December 31, 2011.

The Santa Clara River Estuary.—The available information does not allow NMFS to develop a clear understanding of how the proposed action would affect the quality and spatial extent of the estuary. However, qualitative information suggests the proposed action in combination with the ongoing groundwater pumping would reduce, and at times eliminate, the size and volume of the estuary annually, and decrease the duration that the estuary is open to the ocean (Bureau of Reclamation and United Water Conservation District 2005). The loss of volume and reduced connection to the ocean is viewed as an adverse effect because estuarine areas are a primary constituent element of critical habitat for steelhead and are essential for the conservation of the species (NMFS 2005), and stream discharge during the wet season is an important factor in some streams for creating and maintaining an outlet to the ocean (Smith 1990).

Summary of the Effects of Santa Felicia Dam and Pyramid Dam Operations.—As examined in detail in NMFS’ analysis of the effects of the Santa Felicia Hydropower Project (NMFS 2008) on endangered steelhead and habitat (including critical habitat) for this species, the effects of operations due to Santa Felicia Dam are expected to continue to eliminate the conservation value of freshwater rearing sites and the freshwater migration corridor in the Piru Creek sub-basin, and appreciably reduce the conservation value of the freshwater migration corridor in the Santa Clara River. Operation of Santa Felicia Dam is expected to create conditions that are not expected to support the formation and preservation of freshwater spawning sites in Piru Creek downstream of the dam.

With regard to habitat for steelhead, the effects due to operation of Santa Felicia Dam and Pyramid Dam are expected to continue to cause extensive habitat loss and fragmentation, and reduce the functional value of habitat characteristics and conditions for steelhead within the action area upstream of Santa Felicia Dam. Continued operation of Santa Felicia Dam and operations of Pyramid Dam are expected to continue to create obstructions in the steelhead migration corridor, and perpetuate the reduction in the amount of spawning and rearing habitats available to anadromy.

C. Effects on Steelhead

The proposed action is expected to adversely affect the endangered Southern California DPS of steelhead, as detailed in this section. Information presented earlier in this biological opinion indicates steelhead abundance is critically low in the Santa Clara River watershed, and presence of adults appears to be intermittent. These facts may not be readily apparent in the following narrative of the effects, which we suspect creates the impression that steelhead are abundant and widespread. The description of effects on steelhead was written with the intention of illustrating the expected effects when steelhead are present. Effects of the proposed action on critical habitat for steelhead and the likelihood of survival and recovery of this species are expected regardless of the low number of steelhead projected to be present at this time and should be viewed in the context of the low abundance of individuals in the current population. As a result, the proposed action would continue to create instream conditions and characteristics that suppress the abundance of steelhead and reduce the likelihood of species' recovery. The effects on steelhead reported here corroborate and extend those effects on steelhead that were previously reported by NMFS, and which are contained in the administrative record for this consultation.

Alteration of the Freshwater Migration Corridor Downstream of the Diversion Dam.— The quickened rate that the river recedes downstream of the diversion is expected to increase the chance that adult and juvenile steelhead migrants would be stranded or exposed to conditions that do not favor survival (Cushman 1985, Bradford 1997). Artificial increases in the rate of river recession stem from two diversion-related operations: (1) directing river water into the diversion intake (a process United refers to as "turning in"), and (2) discontinuing the release of the bypass flows. United acknowledges the likelihood of stranding steelhead and plan as part of the proposed action to implement five general provisions for reducing the stranding risk or decreasing the amount of time a steelhead would be stranded (Table 5-2). The provisions as currently defined (page 4, Bureau of Reclamation 2008a) possess uncertainty and are inherently limited for truly minimizing the adverse effects, as the following three examples illustrate.

The rate of change for effecting gradual reductions in the magnitude of river discharge downstream of the diversion appears to be based on United's intuition, rather than a scientifically sound approach. The recommended standard ramping rate for reducing fish stranding is 2 inches/hour (Thomas R. Payne & Associates 2004b), yet the ramping rate that is the basis for the proposed schedule (in terms of inches/hour) is not known because it is not provided. Stranding-reduction plans are usually based on an empirical understanding of the relationship among discharge, water depth and velocity, yet the proposal gives no indication the ramping schedule is based on such a relationship. Even more fundamental, the schedule does not appear to be founded on an understanding of the factors that cause fish stranding, the ramping rates that minimize the likelihood of fish stranding, or a review of the fishery literature regarding fish stranding. The proposed ramping schedule does not include a provision to evaluate the performance or effectiveness of the schedule for reducing fish stranding, or a provision to modify the ramping should the evaluation indicate the schedule is not protective of steelhead. There is no proposed mechanism to determine whether the schedule is effective for reducing fish stranding or effects due to stranding.

Table 5-2.—Description of the provisions United proposes to reduce the likelihood of stranding steelhead in the river reach downstream of the Vern Freeman Diversion Dam (Bureau of Reclamation 2007b, United Water Conservation District 2007a).

Provision	Description
1	Requires operators of the diversion to follow a two-day turning-in procedure. Upon initiating the diversion of surface water, and when the total river flow is less than the prescribed bypass release with an added 375 cfs, United will divert up to a maximum of one-half of the remaining river discharge. For instance, rather than turning in the full 375 cfs into the diversion, United would divert ~ 187 cfs the first day. The second day, United would divert an additional 93 cfs (total of 280 cfs), and then attain full diversion capacity (375 cfs) the next day. This control is already reflected in United's hydrologic model and represented in NMFS' analyses and findings (Figure 5-1, Appendix A).
2	Specifies an operational control to effect a gradual reduction in the magnitude of bypass flows downstream of the diversion dam and reach full cessation over 4 days. The proposed rate of reduction is two-thirds of the bypass flow provided the previous day with a 20 cfs minimum bypass flow provided on day 4. For instance, if the bypass flow at the initiation of the 4-day bypass-recession procedure was 80 cfs, a bypass flow of ~ 53 cfs would be provided on day 1, 35 cfs on day 2, 23 cfs on day 3, and 20 cfs on day 4. This control is already reflected in United's hydrologic model and represented in NMFS' analyses and findings (Figure 5-1, Appendix A).
3	Requires United to provide a bypass flow for a maximum of 18 days (January through March) or 30 days (April through May). We emphasize that these are *maximum* criteria and in many instances they will not be attainable due to the inherent flashy nature of the river and operation of the diversion as defined in the proposed action. As part of this provision, United will bypass a quantity of water to maintain 160 cfs at an area of the river referred to as "the critical riffle." Once the 160 cfs cannot be maintained at the subject location, United will implement the 4-day recession procedure. Flows downstream of the diversion dam will not be measured to ensure objectives (e.g., flow criteria) are met.
4	Survey the river downstream of the diversion dam, within accessible areas and private lands where permission to pass is granted, for the purpose of identifying and then rescuing stranded steelhead. Generally, stranded adults will be relocated upstream of the diversion, whereas juveniles (smolts) will be released in the estuary. United proposes to prepare a plan that will guide the rescue-survey protocols and submit this plan to NMFS for review and comment following issuance of the final biological opinion.
5	Collect steelhead as they enter the diversion and then transporting them to the ocean for release. The Santa Clara River channel downstream of the Vern Freeman Diversion Dam can be devoid of flowing water due to operation of the diversion dam. Emigration of steelhead can continue under such conditions and individuals that enter the diversion are directed into a collection box. Steelhead are removed from the box and transported downstream for release into the estuary or ocean. When the condition of the estuary is not suitable for steelhead (e.g., when the water level is extremely low), the fish have been transported back upstream and released in the river near the confluence with Santa Paula Creek (pers. comm., S. Howard, fishery biologist, United Water Conservation District).

The degree to which the "trap-and-truck" provision contributes to minimizing effects of the proposed action is questionable for at least a few reasons. First, the proposed action does not account for parr steelhead, which are common in the annual emigration, though not prepared for ocean existence (Spina *et al*. 2005). The transport provision includes no means to distinguish the juvenile steelhead that are prepared for ocean existence (e.g., smolts) from the juveniles that are not (parr). Although parr are not commonly found in the fish trap at the Vern Freeman Diversion Dam, 60 age-0 steelhead were captured in the trap in 2007 (page 9, Attachment C, United Water Conservation District 2008b) and a "parr" was found in the fish trap in spring 2006 (United Water Conservation District 2006). Under the current plan, parr could conceivably be released into the ocean or estuary; we suspect these life stages would perish if released into the ocean because they are not physiologically ready to exist in a strictly saline environment. Second, capturing steelhead at the diversion and then transporting them downstream for release in the estuary or ocean would preclude the individuals from biological benefits related to emigrating through the remaining 11 miles of river. Some of these benefits involve an area (and time) for individuals to grow (Dietrich and Cunjak 2007) and complete the physiological changes necessary for ocean existence (Hoar 1976, Quinn 2005) prior to reaching the estuary or ocean. Truncating the emigration of steelhead increases the likelihood that individuals will be smaller and not prepared to tolerate a saline environment, both of which do not favor survival. The number of juvenile and adult steelhead that may be affected by the trap-and-truck provision could approach 900 individuals in a given year (see Table 4-2). Recent information obtained from United indicates no "non-smolting" steelhead are released into the estuary (page 9, Attachment C, United Water Conservation District 2008b).

Although the actual fate of any steelhead that does become stranded is unclear, a few different possibilities exist. First, if not found by rescue crews, a stranded steelhead may perish. Second, though rescued, the steelhead could die during transport or after relocation. Third, a stranded steelhead could be rescued and relocated alive to suitable habitat, such as the river reach upstream of the diversion dam in the case of an adult steelhead, or the estuary and ocean in the case of a smolt. Even if a successful rescue is observed, such an event is not expected to fully minimize effects of the proposed action because a stranding, for example in the case of an adult, would likely result in slowed migration, which can lead to energy costs to migrating fish and failure to reach spawning areas (Hinch and Rand 1998, Geist *et al*. 2000, Caudill *et al*. 2006, Caudill *et al*. 2007).

The foregoing discussion considered the effects of the increased rate of river recession on endangered steelhead at the individual level. Besides the increased rate of river recession, the predicted effects of the proposed action include abbreviation of the frequency and duration of the freshwater migration corridor. Accordingly, the following discussion describes the effects of the proposed action on steelhead in the context of the truncated freshwater migration corridor.

The proposed action is expected to have mixed effects on migration of adult and juvenile steelhead through the reach of river downstream of the diversion dam. On one hand, because steelhead migrate during the wet season and periods of elevated river discharge (e.g., Shapovalov and Taft 1954, Spina *et al*. 2005), the proposed action is expected to promote some level of adult and juvenile steelhead migration up to the downstream side of the diversion dam. This expectation is based on the belief that the operational criteria United defined will extend portions of natural periods of elevated river discharge downstream of the diversion dam (i.e., United will provide a bypass release during the descending limb of the hydrograph generally for each "discharge pulse") and the fact that high flows easily pass over the dam. The foregoing is predicated on the assumption that United's hydrologic model, which lacks the influence of the many "limiting criteria" on the projected bypass flows, is a reliable indicator of the pattern and magnitude of river discharge downstream of the diversion dam that is to be expected under the proposed action.

On the other hand, we expect the reduction in the frequency and duration of the freshwater migration corridor will cause adverse effects to migrant steelhead. Because migratory behavior and ecology of steelhead evolved under the natural flow regime (e.g., Lytle and Poff 2004), we expect the life history and habitat characteristics of steelhead to depend on features of the unimpaired flow regime (e.g., the timing, magnitude, duration, frequency, and rate of change of streamflow). For this reason, we view the substantial *continued* (page 4, Bureau of Reclamation 2008a) departure of river discharge, due to the proposed action, from the "unimpaired" pattern and magnitude of river discharge as harmful to the species. The expected consequences of this include missed migration opportunities, as such would occur when an individual could not volitionally migrate upstream or downstream due to diversion-induced alterations of the freshwater migration corridor. Missed migration opportunities are expected to stem primarily from the reduced duration of the freshwater migration corridor. This expectation is based on the fact that high-magnitude discharges easily pass over the diversion dam and therefore would be available to migrating steelhead, whereas diversion operations (e.g., the "turning-in procedure") typically truncate the descending limb of the hydrograph. The consequences of any lost migration opportunity are projected to primarily involve those related to stranding steelhead, as discussed previously. The consequences include preventing adult steelhead from reaching intended habitats, resulting in migration failure.

***Creation of an Obstruction in the Freshwater Migration Corridor.*—**The blockage in the freshwater migration corridor is expected to slow if not prevent adult steelhead from reaching spawning habitat in tributaries to the mainstem. Effects are projected to be confined to adult steelhead because this is the only steelhead life stage believed to be migrating in an upstream direction through the reach of river downstream of the diversion dam (emigrating juveniles are either transported downstream as river flows spill over the diversion-dam crest, or are trapped and hauled to a downstream or upstream release location. The effects of the trap and haul are discussed in the previous section). These effects are described more fully in the paragraphs that follow.

The obstruction in the freshwater migration corridor is expected to either delay or preclude migration of adult steelhead to spawning areas in Sespe Creek, Hopper Creek, Santa Paula Creek, and Piru Creek (though Santa Felicia Dam precludes adult steelhead from much of the historical spawning and rearing habitat, NMFS 2008). Delaying or precluding migration is expected for two principal reasons. First, because high flows and water velocities guide upstream migration of anadromous salmonids, the spill-induced turbulence and elevated water velocities at the base of the diversion dam will most certainly lead steelhead about 100 ft upstream of the fish-ladder entrance toward the water apex just downstream of the diversion dam, based on the findings of other investigators (Brown 1991, Laine *et al*. 2002, Caudill *et al*. 2006). Second, high-magnitude spills of water over the dam crest can preclude steelhead from actually locating fishway entrances and reduce the likelihood that fish would enter a fishway (e.g., Caudill *et al*. 2006). The amount of time required for steelhead to detect the ladder entrance depends to some degree on the magnitude of river discharge at the time steelhead arrive at the diversion dam, with higher river discharge producing lengthy periods of elevated spills and therefore an extended duration until detection. Expected average delay passing the diversion dam is 10 days[17]. Prolonged periods of elevated river discharge are expected to increase the time for fish-ladder detection to several weeks, potentially preventing some adult steelhead from ever

[17] We re-ran the analysis for determining passage delays using 1,000 cfs and 3,000 cfs thresholds and found that these thresholds equate with average delays of 6 and 2 days.

locating the fish-ladder entrance. We expect such fish may return to the ocean or perish somewhere in the river.

Thalweg location and sediment deposition immediately downstream of the diversion dam is expected to occasionally slow or preclude steelhead from migrating upstream past the diversion dam. Spills of water over the dam can cause the thalweg to form on the side of the river channel that is opposite the fish-ladder entrance, and the bypass channel (i.e., the channel leading from the river to the fish-ladder entrance) can be far removed from the thalweg (Mann 1998, Zapel 2008). Both conditions are not expected to favor migration of steelhead upstream past the diversion dam. With regard to sediment deposition, sand has been observed to cover both orifices to the fish ladder (Mann 1996) and to plug the fish ladder, rendering the ladder impassable (Kentosh 1997).

Another aspect of the proposed action that is expected to slow or prevent migration of steelhead involves the magnitude of river discharge the adults encounter after passing the diversion dam. Because adult steelhead are expected to ascend the ladder and pass the diversion only after spills nearly or entirely subside (Caudill *et al*. 2006, Caudill *et al*. 2007), adults are projected to encounter low river discharges upstream of the diversion dam. This is indirectly corroborated through comparison of hydrology data for the steelhead-accessible tributaries and the mainstem Santa Clara River in vicinity of the diversion dam, which shows that hydrology in the watershed is correlated (Figure 5-5). Because high discharge generally favors migration of anadromous salmonids (i.e., generally instream habitat features are easily navigated at higher versus lower flows), and high flows are necessary to promote adequate migration depths for steelhead in the Santa Clara River mainstem (Harrison *et al*. 2006), slowed or no migration is likely after river discharges subside.

The slowed migration of steelhead is expected to preclude adult migrants from reaching intended spawning areas in the Santa Clara River watershed, leading to spawning failure in this watershed. This expectation is based on the findings of other investigators, which indicate slowed migration of anadromous species can translate into energy costs (Hinch and Rand 1998), a failure to reach spawning areas (Caudill *et al*. 2006, Caudill *et al*. 2007), and use of non-preferred spawning habitats and decreased recruitment (Fleming and Reynolds 1991, Dickerson *et al*. 2005). Adult steelhead, like other anadromous salmonids, rely on energy reserves acquired in the marine environment to sustain them during spawning and the extensive freshwater migration to and from spawning areas. In this regard, passage delays of 5 days or more can decrease energy reserves to low levels that are harmful to survival of adult migrants (Geist *et al*. 2000). With regard to the proposed action, diversion operations are expected to cause an average passage delay of 10 days, based on the 500 cfs threshold, and an average of 6 days and 2 days based on the 1,000 cfs and 3,000 cfs thresholds. Even passage delays of as little as a few hours to a few days are expected to adversely affect steelhead because such delays can increase the potential for unsuccessful migration (e.g., Caudill *et al*. 2006, Caudill *et al.* 2007).

Unsuccessful migration of steelhead to spawning areas in the Santa Clara River watershed is expected to adversely affect the entire watershed-specific population unit. If adult steelhead fail to reach upstream spawning habitats, a decline in the abundance of steelhead descendents in upstream areas is expected because upstream or tributary-specific population abundance can decrease or become extinct when adult migrants are precluded from accessing upstream habitats (e.g., Jager *et al*. 2001, Neraas and Spruell 2001, Morita and Yamamoto 2002). A reduction in steelhead abundance in the Santa Clara River watershed has already been reported (see the section "Population Viability"). Summarily dismissing the effects of unsuccessful migration of anadromous *O. mykiss* to spawning areas in the Santa Clara River watershed on the basis of resident *O. mykiss* production in the watershed (pages 4-5, Bureau of Reclamation 2008a) ignores the substantial ecological effects of disrupting the spawning migration of anadromous *O. mykiss* (reviewed elsewhere in this biological opinion, see also NMFS 2008) and related effects on anadromous *O. mykiss* population abundance, population growth rate, population diversity and population spatial structure (see section "Population Viability").

The maintenance activities planned for the diversion dam are expected to occasionally create harmful conditions for migrating steelhead. The flushing operations that are a part of the proposed action would require closing both entrances to, and including, the fish ladder. Closing the fish ladder would have the functional effect of blocking passage of any steelhead attempting to migrate upstream past the diversion dam, an effect that is expected to last from a few to several hours. The consequences for steelhead are similar to those effects related to delaying and precluding migration of steelhead, which were described earlier in this biological opinion. Dewatering the fish ladder for inspection and cleaning increases the likelihood that adult and juvenile steelhead would become stranded and their migration slowed. There has been at least one instance when an adult steelhead was found during maintenance of the diversion (United Water Conservation District 2006). We know that the flushing operations result in downstream displacement of steelhead because juvenile steelhead (including one dead smolt) have been collected downstream of the diversion dam after flushing operations (pers. comm., S. Howard, fishery biologist, United Water Conservation District, June 9, 2008). Maintaining a fyke net downstream of the diversion dam during future flushing operations is expected to minimize injury or death of steelhead displaced downstream.

Alteration of the Estuary.**—**The available information does not allow NMFS to develop a clear or complete understanding of how the proposed action would affect the quality and spatial extent of the estuary, and therefore effects to steelhead are not entirely clear. Limited qualitative information does indicate the proposed action in combination with the ongoing groundwater pumping would reduce, and at times eliminate, the amount and extent of the estuary annually (Bureau of Reclamation and United Water Conservation District 2005). If such effects occur after implementation of the proposed action, the seasonal elimination or reduction of estuary habitat is expected to harm steelhead because estuarine areas provide living space to sustain oversummering individuals (Smith 1990, Thorpe 1994, Bond 2006) and features essential to the conservation of adult and juvenile steelhead (NMFS 2005). Recent findings reaffirmed that juvenile steelhead oversummer in the estuary of their natal creek, and indicate the estuary allowed juvenile steelhead to grow fast enough to migrate to the ocean their first year (Bond 2006). Most individuals entered the ocean at a larger size than fish rearing in the freshwater portion of the stream system. Large size enhances survival in the ocean, and thus the lagoon-reared fish tend to be disproportionately represented in the adult spawning population. These findings suggest the loss or reduction in estuary habitat in the Santa Clara River watershed may lead to a reduction in the number of adults returning to the watershed.

Summary of the Effects of Santa Felicia Dam and Pyramid Dam Operations, and Groundwater Pumping.— As examined in detail in NMFS' analysis of the effects of the Santa Felicia Hydropower Project (NMFS 2008) on endangered steelhead and habitat (including critical habitat) for this species, the effects due to Santa Felicia Dam and Pyramid Dam operations and groundwater pumping are projected to continue to disrupt if not eliminate migration of steelhead into and out of Piru Creek, reduce migration opportunities and success in the Santa Clara River, and continue to preclude the anadromous component of the steelhead population from most of the Piru Creek sub-basin. A reduction in straying and gene flow into and out of the watershed is expected. The final biological opinion for the Santa Felicia Hydropower Project conclude that continued operation of the project as described in the proposed action is likely to jeopardize the continued existence of the Federally endangered Southern California steelhead DPS, and is likely to destroy or adversely modify critical habitat for this species.

D. Means to Minimize the Adverse Effects and Address Uncertainties due to the Proposed Action

In the preceding sections, we examined how the proposed action, and interrelated activity, would affect critical habitat and endangered steelhead. With regard to critical habitat, five principal effects were identified: (1) abbreviated frequency and duration of the freshwater migration corridor downstream of the diversion dam, (2) increased rate of river recession downstream of the diversion dam, (3) creation of an obstruction within the freshwater migration corridor through the diversion dam, (4) attenuated quality of the freshwater migration corridor in the Santa Clara River mainstem, and (5) reduced, and at times eliminated, estuary habitat. With regard to endangered steelhead, the effects analysis identified four principal effects: (1) harming the growth and survival of the population of juvenile steelhead through reduction or elimination of estuary habitat, with effects expected to extend to abundance of adult steelhead, (2) injuring or killing juvenile steelhead that are not prepared for existence in a saline environment, (3) delaying, or precluding, upstream migration of adult steelhead to upstream spawning habitat and downstream migration of juvenile steelhead to the estuary or ocean, thereby reducing numbers and production of steelhead in the action area and Santa Clara River watershed, and (4) reducing the abundance, diversity, and growth rate of tributary-specific populations of steelhead. Although United has not defined specific provisions to minimize adverse effects of the proposed action and interrelated activity on critical habitat or steelhead, they do propose a process to achieve the foregoing.

Under the proposed action, as currently defined, United proposes to collaborate with NMFS after issuance of the final biological opinion for the purpose of preparing and implementing a written plan that will identify specific measures to minimize (*all*) of the adverse effects related to the proposed action (not just effects attributed to the obstruction in the freshwater migration corridor and which will be addressed through the reasonable and prudent alternative, page 5, Bureau of Reclamation 2008a). Based on NMFS' analysis of the currently defined proposed action, the proposed process is conceptual and does not specify an ecologically meaningful guiding theme or intended outcome (note that no biological goal or objective is defined). Accordingly, there is no assurance the plan resulting from implementation of the proposed action would specify the sorts of measures needed to actually minimize the adverse effects, including those effects related to harming, injuring, or killing steelhead. Mechanistic solutions such as trap-and-truck protocols are not sufficient, by themselves, to minimize effects of the proposed diversion operations on this endangered species. Whether the adverse effects would in fact be minimized is uncertain. As a result, NMFS cannot analyze an undefined concept. NMFS is certainly willing to collaborate with United on the aforementioned plan (page 5, Bureau of Reclamation 2008a, page 11, Attachment C, United Water Conservation District 2008b), but our experiences attempting to collaborate with United on this proposed action have not always been fruitful. The administrative record that is the basis of this formal consultation shows that United has not adopted NMFS' recommendations and, in at least one instance, United has proposed the very operating criteria that NMFS has recommended against. Therefore, NMFS is not confident that collaboration with United would result in an outcome that would favor endangered steelhead or critical habitat for this species.

There are numerous environmental, ecological, and operational uncertainties related to the proposed action. Addressing such uncertainties is important because failure to do so can lead to tragic effects on fishery resources (Roughgarden and Smith 1996). To address and resolve such uncertainties, United proposes to prepare and implement an adaptive management plan, as recommended by NMFS, after the final biological opinion is prepared. Federal regulation defines adaptive management as:

> "…a method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned." (page 35252, Fish and Wildlife Service and National Oceanic and Atmospheric Administration 2000).

This definition is adopted here and forms the basis of NMFS' expectation for the plan that United proposes to prepare. The conceptual framework for the plan will incorporate the required elements of the adaptive management strategy that is the basis of habitat conservation plans (Fish and Wildlife Service and National Oceanic and Atmospheric Administration 2000). To this end, the adaptive management plan that United prepares and implements is expected to include a specific program that will: (1) identify the uncertainty and the questions that need to be addressed to resolve the uncertainty, (2) develop alternative strategies and determine which experimental strategies to implement, (3) integrate a monitoring program that is able to detect the necessary information for strategy evaluation, and (4) incorporate feedback loops that link implementation and monitoring to a decision-making process (which may be similar to a dispute-resolution process) that result in appropriate changes in management. Although the foregoing elements are essential to an adaptive management plan, the plan has not been prepared and there is no way of knowing whether the plan would be adequate to address and resolve the uncertainties due to the proposed action. Biological goals and objectives have not been defined, alternative strategies have not been discussed, and the types of future changes that might be employed to attain biological goals and objectives have not been agreed upon. For these reasons, the potential benefits of United's adaptive management plan cannot be reliably assessed at this time, and therefore NMFS cannot consider the possible results of such a plan in this biological opinion.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. 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. Several future, state, local, or private actions are reasonably certain to occur within the Santa Clara River watershed (Table 6-1). While some of these actions are physically located outside the action area, they are expected to create effects that extend into the action area. For this reason, such actions are considered here.

These future actions are expected to increase the potential for adverse effects to steelhead. Increasing the amount of impervious surfaces within the watershed would be expected to increase the potential for dry and wet-season runoff and input of potentially toxic elements to surface water where steelhead are present. Ongoing urbanization is expected to cause elevated rates of treated-wastewater releases to streams, possibly increasing nitrogen loads and the likelihood of adverse effects on aquatic organisms including steelhead and their prey. Housing developments constructed in or near the historical floodplain of the Santa Clara River or its tributaries are expected to cause, or perpetuate, loss of aquatic habitat.

Table 6-1.—Future, state, local, or private actions that are reasonably certain to occur.

Action	Project title and (or) source document
Allow mining of up to 100 million tons of sand and gravel within Soledad Canyon and an unincorporated area of Los Angeles County	Soledad Canyon Sand and Gravel Mining Project, Supplement to the draft EIR for the Soledad Canyon Sand and Gravel Mining Project, November 1999
Includes the development of 30 acres to construct a residential community with 437 multiple-family dwellings, a maximum of 10,000 ft^2 of commercial uses, associated recreation uses and on-site private roads	Soledad Townhomes, Initial Study, Master Case 04-344, April 2005
Includes the development of 96 single family residential lots, 218 apartment units, and 665 townhouse units, a school site, and recreational park	The Keystone, Master Case #03-358, Notice of Preparation of draft EIR, August 2004

VII. INTEGRATATION AND SYNTHESIS OF EFFECTS

This section combines the effects of the environmental baseline with effects of the proposed action and cumulative effects. The purpose of this assessment is to develop an understanding of how the combined effects may affect steelhead and critical habitat for this species, the likelihood of survival and recovery of this species, and the functionality of critical habitat to serve the intended conservation role for the species. The methodology for this assessment involved identifying potential environmental effects associated with the actions listed in the Cumulative Effects section, integrating potential effects of these actions with the environmental baseline and expected effects of the proposed action, and qualitatively evaluating these combined effects on steelhead and critical habitat. Other factors that can cause a population to collapse and become extinct, e.g., climate and environmental fluctuations, were included in the assessment as well as the status of steelhead, a brief summary of which is given below. A summary of the status of the species as it relates to distribution and diversity is presented below as well.

The larger river systems are believed to have been the historical foundation for the endangered Southern California DPS of steelhead (Boughton *et al.* 2007b). The Santa Clara River watershed is one such system because of the watershed's large size, spawning and rearing habitat quality, relatively reliable winter river discharge, and greater potential for being independently viable (Boughton *et al*. 2006). This drainage is the largest steelhead-bearing watershed within the Southern California DPS, and up to the mid-1940s, steelhead were abundant in this system (e.g., Moore 1980a). Over time, the abundance of steelhead in the Santa Clara River, like other drainages throughout the DPS, has declined dramatically (500 individuals have been estimated for the entire DPS) due to anthropogenic alterations of the watershed and waterways (NMFS 1997, Good *et al*. 2005, NMFS 2006a). Presently, the number of steelhead in the Santa Clara River watershed is small. Likewise, the number of steelhead comprising the DPS is small. Because the viability of small populations is especially tenuous, and such populations are susceptible to prompt decreases in abundance and possess a greater risk of extinction relative to large populations (Pimm *et al*. 1988, Berger 1990, Primack 2004), activities that reduce the quality and quantity of habitats, or that preclude formation of population units, are expected to compel the species toward extinction as individual population units become extinct (McElhany *et al*. 2000). Consequently, activities harming steelhead or destroying habitat, including critical habitat, within a population unit have implications for the DPS.

With regard to distribution, of the 46 drainages that currently support the Southern California DPS, only 10 population units possess a high and biologically plausible likelihood of being viable and independent. Although the geographic area of the DPS is broad, the individual population units are sparsely and unevenly distributed throughout the DPS with extensive spatial breadth often existing between nearest-neighbor populations. Extinction of some population units has been observed as well as contraction of the southern extent of the species' geographic range. With regard to diversity, steelhead anadromy has been either eliminated or reduced in many drainages (including the Santa Clara River drainage) within the Southern California DPS due to a variety of anthropogenic factors including the construction of fish-passage impediments. The loss or reduction in anadromy and migration of juvenile steelhead to the estuary or ocean has reduced gene flow. The alteration in the pattern and magnitude of discharge downstream of dams or diversions has resulted in a shift in the timing of the freshwater migration corridor or a restricted migration window, which translates into limited or no opportunities for steelhead to migrate during the wet season, the principal migration season.

Population growth rate of the Southern California DPS of steelhead has declined to dangerously low levels. Evidence indicates abundance of steelhead in the DPS has declined dramatically (Busby *et al*. 1996, Good *et al.* 2005), and many watershed-specific extinctions of this species have been reported (Nehlsen *et al*. 1991, Boughton *et al*. 2005, Gustafson *et al*. 2007). The number of adults in the subject DPS (estimated at 500 individuals, Busby *et al*. 1996, Good *et al.* 2005) is considerably less than the minimum number of adults needed to maintain the viability of independent populations within the DPS (4,150 adults per independent population, Boughton *et al*. 2007b). Recent genetic studies document a decrease in effective population size and genetic diversity (Girman and Garza 2006), both of which indicate a reduction in freshwater productivity. The natural productivity in the DPS is not sufficient to maintain abundance of the broad population above the minimum viability threshold.

Overall, the Southern California DPS of steelhead is at a high risk of becoming extinct in the foreseeable future.

A. Summary of Effects of the Environmental Baseline

Evidence indicates past and present activities have caused habitat loss and fragmentation, and severely reduced the quality and quantity of spawning sites, migration corridors, and rearing sites for the Southern California steelhead DPS within the action area (and Santa Clara River watershed). Anthropogenic activities are believed to have contributed to declines in steelhead abundance within the action area and the watershed. Because dams block upstream passage of steelhead to historical spawning and rearing habitat, abundance of this species in tributaries, including those upstream of man-made barriers (currently “non-listed steelhead”), is expected to have decreased. Effects of past and present activities are expected to extend into the future.

B. Summary of Effects of the Proposed Action

With regard to critical habitat, the effects of the proposed action and interrelated activities are expected to continue to eliminate the conservation condition (i.e., function) of freshwater rearing sites and freshwater migration corridor in the Piru Creek sub-basin, and appreciably reduce the conservation condition of the freshwater migration corridor in the Santa Clara River, including downstream of the Vern Freeman Diversion Dam. Additionally, the proposed action is expected to create conditions that are not supportive of the formation and preservation of the Santa Clara River estuary and freshwater spawning sites in Piru Creek downstream of Santa Felicia Dam.

With regard to habitat for steelhead, the effects due to the proposed action and the operation of Pyramid Dam are expected to continue to cause extensive habitat loss and fragmentation, and reduce the functional value of habitat characteristics and conditions for steelhead within the action area upstream of Santa Felicia Dam. Continued operation of Santa Felicia Dam and operations of Pyramid Dam that are interrelated with the proposed action are expected to continue to create obstructions in the steelhead migration corridor, and perpetuate the reduction in the amount of spawning and rearing habitats available to anadromy.

With regard to steelhead, the continued operation of the Vern Freeman Diversion Dam as under the proposed action (including the interrelated activities) is projected to continue to disrupt if not eliminate migration of steelhead into and out of Piru Creek, reduce migration opportunities and success in the Santa Clara River, particularly downstream of the Vern Freeman Diversion Dam, and continue to preclude steelhead from reaching historical spawning and rearing habitat in tributaries to the mainstem. The proposed action possesses aspects that are expected to continue to reduce straying and gene flow into and out of the watershed, and decrease recruitment of steelhead progeny (*i.e.*, density of age-0 steelhead) in the watershed. The effects due to the proposed action are expected to extend to the Santa Clara River steelhead population unit and reduce the likelihood that the population unit would survive.

Overall, continued operation of the Vern Freeman Diversion Dam under the proposed action contributes to increase the extinction risk to endangered steelhead by reducing and at times eliminating migration opportunities and success for endangered steelhead, and precluding migration of this species to historical spawning and rearing habitat, leading to spawning failure in the Santa Clara River watershed.

C. Combined Effects

The combined effects of the environmental baseline (i.e., the effects of past and ongoing activities), the proposed action and interrelated activities, and the actions identified in the Cumulative Effects section are expected to exacerbate rates of habitat loss and destruction and preclude formation of a viable steelhead population in the Santa Clara River watershed. The effects of environmental fluctuations including climate change and disturbances (e.g., floods, wildfire, and drought) and demographic accidents (e.g., varying or unpredictable birth and death rates, sex-ratio fluctuations) are expected to create an added risk of DPS extinction to that arising from the combined effects alone. With regard to climate change, information indicates that precipitation in southern California will exhibit measurable decreases in the future (Hayhoe *et al.* 2004). If reduced precipitation does dominate the region in the future, the findings from NMFS' analyses presented here are expected to underestimate the effects of the proposed action because the findings from the analyses performed here and elsewhere (e.g., NMFS 2008) indicate the effects of water diversion and storage activities are most pronounced during below normal and normal water years. The effects from the stochastic environmental changes, demographic accidents, and combined effects (collectively referred to as *aggregate effects*) are expected to appreciably reduce the likelihood of survival and recovery for the Santa Clara River population unit of steelhead and the Southern California DPS of endangered steelhead.

The conservation condition of critical habitat within the action area is expected to be reduced due to the aggregate effects. Continued exploitation of surface-water and ground-water resources are projected to worsen the expected effects of the proposed action on migration opportunities and success for adult and juvenile steelhead, and the quantity and quality of over-summering habitat for juvenile steelhead. Passage conditions have been greatly diminished due to unnatural obstructions in the mainstem and throughout the watershed and water storage and diversion facilities. The aggregate effects are expected to reduce the functionality of critical habitat in the Santa Clara River to serve the intended conservation role for the species. Given the importance of the Santa Clara River watershed and Piru Creek sub-basin, this reduction is expected, in turn, to reduce the overall conservation condition of critical habitat for the species.

The aggregate effects are expected to continue to translate into a reduction in the abundance of this species in the watershed. This is due to the type, amount and extent of the effects on steelhead, the fact that population abundance is already at critically low levels, and the functional importance of the steelhead-bearing tributaries to the Santa Clara River steelhead population unit (e.g., Blecker *et al*. 1997). Given the value of the Santa Clara River population unit of steelhead to the viability of the DPS and its relationship to recovery, the aggregate effects are expected to continue to reduce the viability of the entire endangered Southern California DPS of steelhead by reducing both the prospects of species survival and chances of its recovery. The basis for this determination is described more fully as follows.

There are few steelhead and even fewer steelhead-bearing watersheds in the Southern California DPS. The DPS is currently at a high risk of extinction, and extinctions of specific population units have already been noted (Boughton *et al*. 2005, Gustafson *et al*. 2007). The number of steelhead in the Santa Clara watershed is low (e.g., Good *et al*. 2005) and is expected to remain low due to the proposed action. The Santa Clara River steelhead population unit is one of only a few population units in the Southern California DPS that have a high potential of being independent and able to withstand environmental stochasticity once restored to viability. The Santa Clara River steelhead population is expected to support formation of steelhead numbers in several adjacent population units, which would not otherwise exist if not for the core population. The formation and maintenance of population units effectively increases numbers of individuals in the broad population, and given the risk of extinction that small populations face (e.g., Pimm *et al*. 1988, Primack 2004), a larger number of individuals decrease the risk of weakened viability of the broad population. Consequently, this population is expected to contribute to the viability of the endangered Southern California DPS and recovery of the species (Boughton *et al*. 2006). However, because the proposed action is expected to reduce the viability of the Santa Clara River steelhead population unit, and its ability to withstand environmental stochasticity, the abundance of steelhead in adjacent population units (i.e., those that depend on abundance of steelhead in, or immigrants from, the Santa Clara River) is expected to be reduced as well. Given the functional value of the Santa Clara River watershed to the viability of the Southern California DPS, the continued reduction of steelhead abundance in the watershed is expected to reduce the viability of the DPS and prospects for its recovery.

VIII. CONCLUSION

After reviewing the best available scientific and commercial information, the status of the Southern California steelhead DPS and its critical habitat, the environmental baseline, expected effects of the proposed action, cumulative effects, and the combined effects of the environmental baseline, the proposed action, and cumulative effects, NMFS concludes the proposed action is likely to jeopardize the continued existence of the Federally endangered Southern California steelhead DPS, and is likely to destroy or adversely modify critical habitat for this species.

IX. REASONABLE AND PRUDENT ALTERNATIVE

Regulations (50 CFR §402.02) implementing section 7 of the ESA define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technically feasible; and (4) would, as NMFS believes, avoid the likelihood of jeopardizing the continued existence of a listed species or destroy or adversely modify critical habitat. NMFS believes the following reasonable and prudent alternative is necessary and appropriate to avoid the likelihood of jeopardizing the continued existence of the endangered Southern California DPS of steelhead or destroying or adversely modifying critical habitat for this species:

Implement an operation plan for the Vern Freeman Diversion Dam that requires restoring and maintaining a continuous, unobstructed, and properly functioning freshwater migration corridor in the Santa Clara River during winter and spring *for the purpose of providing or approximating unimpeded migration of steelhead past the diversion dam over a broad range of hydrologic events* (hereafter referred to as *fish-passage objective*). To this end, this reasonable and prudent alternative involves two elements, and both elements must be implemented to avoid jeopardizing the continued existence of the endangered Southern California DPS of steelhead, and destroying or adversely modifying critical habitat for this species. Because this biological opinion has determined the proposed action is likely to jeopardize the continued existence of the Federally endangered Southern California DPS of steelhead, and is likely to destroy or adversely modify critical habitat for this species, the Bureau is required to notify NMFS of its final decision on the implementation of the reasonable and prudent alternative. The elements of the reasonable and prudent alternative are as follows:

1. United shall rely on Terry Roelofs, Ph.D., with input from NMFS' Southwest Regional Office, to convene a panel of qualified fish-passage engineers, hydrologists, and fish biologists, and serve as the facilitator of this panel. The selected members of the panel shall include at least one NMFS fish-passage specialist[18] and all members shall possess meaningful practical experience designing fish-passage facilities for steelhead. The panel facilitator shall oversee the conduct of the panel. The panel and facilitator shall function independently and perform science-based analyses as necessary to identify the specific physical modification(s) of the Vern Freeman Diversion Dam (including the fish ladder) that are necessary to attain the fish-passage objective as defined in this reasonable and prudent alternative. United shall fund the work of the panel facilitator and panel, including reimbursement for cost incurred from labor and expenses[19]. United must receive written agreement from NMFS' Southwest Regional Office[20] for the panel members before the panel undertakes the substantive technical steps outlined in reasonable and prudent alternative 1(a) through, and including, 1(d) as follows.

[18] Discussions with the Bureau of Reclamation on July 8, 2008, indicated that having a NMFS specialist on the panel would likely expedite the overall process of developing and designing a preferred alternative by, for example, reducing the amount of time that may be necessary for NMFS to review and agree on a particular aspects of the panel's work products, as is required in this reasonable and prudent alternative.

[19] United is to reimburse only the travel expenses of the NMFS panel member, not the labor of said member.

[20] Whenever NMFS agreement or review is required by this reasonable and prudent alternative, NMFS would conduct a timely review and provide an equally timely response.

(a) Conceptual alternatives study.—The panel shall conduct a formal conceptual alternative study for two purposes: (1) identification of interim physical modifications and (2) identification of long-term physical modifications. **Interim physical modifications** must be implemented by the Bureau and United at the Vern Freeman Diversion Dam, and such modifications must be fully implemented and operational ready prior to the start of the pending winter (December 21, 2008). Interim physical modifications shall advance the overall effort as defined in this reasonable and prudent alternative to provide or approximate unimpeded migration of steelhead past the diversion dam over a broad range of hydrologic events. In this regard, implementation of any interim physical modification must minimize (by a minimum of 50%) the existing passage delays for steelhead migrating past the Vern Freeman Diversion Dam over a broad range of hydrologic events. Interim physical modifications may include material changes to the diversion dam, fish ladder and entrance, and the river channel upstream or downstream of the Vern Freeman Diversion Dam. Interim physical modifications must operate at least until the long-term physical modifications are fully operational, or longer if such continued operation is a recommendation of the fish-passage review panel or is necessary to achieve the fish-passage objective as defined in this reasonable and prudent alternative. In addition to minimizing existing passage delays for steelhead migrating past the Vern Freeman Diversion Dam over a broad range of hydrologic events, the interim physical modifications must further and complement the long-term physical modifications[21] that are needed to fully attain the fish-passage objective defined in this reasonable and prudent alternative. **Long-term physical modifications** are those material changes that would be implemented after the interim physical modifications have been implemented, and which are necessary to fully attain the fish-passage objective as defined in this reasonable and prudent alternative. The process the panel shall undertake to identify interim and long-term modifications is as follows.

In the conceptual alternatives study, the panel shall consider and list the types of modifications (both interim and long-term types) that may be appropriate for attaining the fish-passage objective as defined in this reasonable and prudent alternative. NMFS engineering and biological staff (the specific points of contact in NMFS will be identified at a later date) must be consulted to consider arguments and rationale supporting all contending conceptual designs, and to allow for review of information or conceptual drawings that support each alternative. NMFS' Southwest Regional Office must provide written agreement for the conceptual alternatives before the panel undertakes reasonable and prudent alternative element 1(b).

(b) Feasibility study.—Once the conceptual alternatives study is complete, the panel will undertake a feasibility study. In this study, the panel will build greater detail and develop each design concept of merit (including a preliminary cost estimate as part of the consideration of feasibility) for the purpose of enabling selection of a preferred

[21] In response to comments received on the draft biological opinion (e.g., page 5, Bureau of Reclamation 2008a), we emphasize here that knowing the "preliminary stage" of the long-term modification is not requisite to designing and implementing the interim modification because (1) the fish-passage objective is what guides the design of each type of modification, and (2) we expect as part of the panel's conduct of the review, development of the interim and long-term physical modifications would proceed largely in parallel, not incrementally.

alternative that is commensurate with the fish-passage objective defined in this reasonable and prudent alternative. NMFS engineers and biologists must agree with the set of fish-passage options considered at the feasibility level of study. NMFS engineering and biologists must review the findings of the feasibility study and the Southwest Regional Office of NMFS must provide written agreement for the preferred alternative before work on a preliminary design document begins.

(c) Preliminary design development.—Once NMFS' Southwest Regional Office has provided written agreement for the preferred alternative, a preliminary design for a fish-passage facility (or interim modifications) must be developed in an interactive process with NMFS' Southwest Region engineering and biological staff. The preliminary design must be developed based on a synthesis of the required site and biological information (to be defined in collaboration with NMFS). The low, high, and flood-flow design (i.e., the streamflow range for safe and quick passage of steelhead) shall be defined during the preliminary-design phase[22] (see Table 9-1). NMFS' engineering and biological staff will review the fish-facility design(s) (or interim modifications) in the context of how the required site and the biological information were integrated into the design. Submittal of all site and biological information is required in writing for NMFS review. The panel shall initiate coordination with NMFS' staff early in the development of the preliminary design to facilitate an iterative, interactive, and cooperative process.

(d) Detailed design phase.—Using elements of the preliminary design, the panel shall proceed to a detailed design phase and prepare the final design and specifications package suitable for a bid-solicitation process. If the panel requests, United shall hire an engineering firm who is acceptable to the panel, and this firm shall prepare specific draft and final designs including engineered design drawings, based on panel directions and specifications. Once the detailed design process commences, NMFS engineering and biological staff must have the opportunity to review and provide comments at the 50% and 90% completion stages. These comments usually entail refinements in the detailed design that will lead to operations, maintenance, and fish-safety benefits. Electronic drawings accompanied by 11 x 17 inch hardcopies are the preferred review medium and shall be submitted to NMFS (501 West Ocean Blvd., Suite 4200, Long Beach, California 90802). Written agreement from NMFS' Southwest Regional Office must be obtained for the final design package before proceeding with implementation of the final design.

(e) Implementation.—The Bureau and United shall implement the final design developed by the panel and with written agreement from NMFS' Southwest Regional Office as required by reasonable and prudent alternative 1(d). With regard to interim physical

[22] The design low flow is the mean daily average streamflow that is exceeded 95% of the time during periods when migrating fish are normally present at the site. The design high flow is the mean daily average streamflow that is exceeded 5% of the time during periods when migrating fish are normally present at the site. With regard to the flood flow, the general fishway design should have sufficient river freeboard to minimize overtopping by 50 year flood flows. In response to comments received on the draft biological opinion (e.g., page 3, Attachment E, United Water Conservation District 2008b), we emphasize here that these flow-design criteria may be modified to suite site-specific conditions or constraints. Therefore, concluding that a full-width rock ramp is the only means of achieving compliance with these flow-design criteria (page 3, Attachment E, United Water Conservation District 2008b) is premature and misleading.

modifications, the final design shall be fully implemented and operational ready no later than December 21, 2008. With regard to long-term physical modifications, the final design shall be fully implemented and operational before the Bureau's ongoing discretion over operation of the diversion dam lapses in 2011.

(f) Monitoring and maintenance.—Upon implementation of the interim and long-term physical modifications, and using methods and according to schedules acceptable to NMFS, United shall monitor and maintain the interim and long-term physical modifications to ensure the modifications function over time in a manner that would allow attainment of the fish-passage objective as defined in this reasonable and prudent alternative.

2. United shall not allow operation of the Vern Freeman Diversion Dam to preclude a properly functioning migration corridor for adult and juvenile steelhead in the Santa Clara River from the Vern Freeman Diversion Dam downstream to the Pacific Ocean.

(a) When initiating the turning-in procedure (i.e., directing river water into the diversion intake), the daily rate at which the Vern Freeman Diversion reaches its operating capacity of 375 cfs (ramping rate) shall not exceed the rates in the following table for each category of total river discharge in the Santa Clara River as measured immediately upstream of the Vern Freeman Diversion Dam[23]. The rates in the table below apply only to turning-in procedures undertaken during the principal steelhead migration season (January through May) when total river discharge is ≤ 750 cfs:

Total river discharge	Ramping rate[24]
≤ 635 cfs	Upon initiating the turning-in procedure, and only after providing the necessary bypass flow required to maintain a minimum of 160 cfs over the critical riffle[25], United shall divert no more than 20% of the remaining river discharge, provided that diverting 20% of the remaining river discharge does not reduce river discharge downstream of the diversion dam more than (1) the river discharge that is expected to result from the operating criteria that are the basis of the action as proposed by United and the Bureau, and (2) the river discharge resulting from reasonable and prudent alternative element 2(b).
> 635 cfs and ≤ 750 cfs	Upon initiating the turning-in procedure, and only after providing the necessary bypass flow required to maintain a minimum of 160 cfs over the critical riffle, United shall divert no more than 30% of the remaining river discharge, provided that diverting 30% of the remaining river discharge does not reduce river discharge downstream of the diversion dam more than (1) the river discharge that is expected to result from the operating criteria that are the basis of the action as proposed by United and the Bureau, and (2) the river discharge resulting from reasonable and prudent alternative element 2(b).

[23] The phrase "total river discharge in the Santa Clara River immediately upstream of the Vern Freeman Diversion Dam" (and similar phrases) refers to the total amount of water that would pass downstream of the Vern Freeman Diversion Dam if none was diverted.

[24] Rates were developed from an analysis of discharge decay rates in Sespe Creek and the Santa Clara River (page 3, Bureau of Reclamation 2008b).

[25] "The critical riffle is a term we use that would describe the most difficult riffle for an upstream migrant. Due to our ever changing river, the critical riffle can also move. In the past it has been up towards the 118 bridge, but normally is about 1.5 to 1.9 miles upstream of the 101 bridge. Normally when that stretch of the river is a loosing reach the critical riffle will be further downstream due to less water in the river. When it is a gaining reach, it can be closer to the 118 bridge. Big riffle is located at about 1.7 miles upstream of the 101 bridge. The critical riffle will have to be located after every major storm. In general the channel morphology will change with peaks that exceed several thousand cfs." (pers. comm., M. McEachron, hydrologist, United Water Conservation District, November 21, 2007).

(b) Trapping and then trucking juvenile steelhead shall be undertaken solely as a rescue operation, not the principal means of moving juvenile steelhead to the Santa Clara River estuary or ocean especially when total river discharge is sufficient to maintain connectivity with the Santa Clara River estuary[26]. Therefore, when total river discharge immediately upstream of the Vern Freeman Diversion Dam is sufficient to maintain connectivity with the Santa Clara River estuary during the emigration season for juvenile steelhead (March 1 through May 31), United shall extend the proposed 18-day and 30-day bypass flows to ensure volitional emigration of juvenile steelhead to the estuary. The magnitude of the substantive aspects of the 18-day and 30-day bypass flows as defined under the proposed action are intended, in part, to maintain connectivity with the estuary and ocean; we expect that the same and at times lower bypass flows (particularly as total river discharge declines) will be necessary to meet the purpose and intent of reasonable and prudent alternative element 2(b). When total river discharge immediately upstream of the Vern Freeman Diversion Dam recedes to a magnitude no longer capable of maintaining connectivity with the Santa Clara River estuary, even with all water in the river passing downstream and none being diverted, the extension in the bypass flows that is required in this reasonable and prudent alternative may cease in accordance with the ramping down criterion set forth in the proposed action, provided that before ceasing the bypass flows, United documents that total river discharge immediately upstream of the Vern Freeman Diversion Dam is not sufficient to maintain connectivity with the estuary and then in writing notifies NMFS (501 West Ocean Blvd., Suite 4200, Long Beach, California 90802) of the documented conditions indicating that ceasing the bypass flows is warranted.

A. Consistency of the Reasonable and Prudent Alternative with Regulations Implementing Section 7 of the ESA

Regulations (50 CFR §402.02) implementing section 7 of the ESA define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technically feasible; and (4) would, as NMFS believes, avoid the likelihood of jeopardizing the continued existence of a listed species or destroy or adversely modify critical habitat.

With regard to item #1 above, the elements of the reasonable and prudent alternative can be implemented in a manner consistent with the intended purpose of the action. The reasonable and prudent alternative will not preclude United from diverting water for groundwater recharge and agricultural users. With regard to the ramping rates (reasonable and prudent alternative element 2a), the ramping rates apply to the operation of the Vern Freeman Diversion Dam only when United undertakes the "turning-in procedure" at total river discharges ≤ 750 cfs. If United

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[26] A flow-related threshold effect has been noted in the Santa Clara River downstream of the Vern Freeman Diversion Dam. Under certain environmental conditions, in particular periods of low groundwater storage and low river discharge, surface water can percolate entirely into the channel bed downstream of the diversion dam, rendering the river discontinuous.

initiates the turning-in procedure when total river discharge is > 750 cfs, the ramping rates defined in this reasonable and prudent alternative do not apply. We expect United would primarily, if not exclusively, undertake the turning-in procedure when river discharge exceeds 750 cfs based on our knowledge of past diversion operations and because under the proposed action United will attempt to divert water as soon as possible after a storm (i.e., periods of elevated flows induced by rainfall). Storms produce peak river discharges that are on average 6,800 cfs, well above the 750 cfs threshold specified in this reasonable and prudent alternative. With regard to the bypass flow (reasonable and prudent alternative element 2b), NMFS is aware that under certain conditions United diverts most if not all of the Santa Clara River at the Vern Freeman Diversion Dam when juvenile steelhead are still emigrating through the mainstem to the estuary and ocean. During times when sufficient river discharge is available to transport emigrating juveniles from the river reach immediately upstream of the Vern Freeman Diversion Dam to the estuary, trapping and trucking emigrating juveniles is not scientifically sound. The bypass-flow requirement is therefore necessary to ensure juveniles complete their emigration on their own. The bypass-flow requirement represents a nominal extension of the operating criteria under the proposed action and is conditioned upon total river discharge and "connectivity" to allow United flexibility in how the diversion is operated and to avoid precluding United from diverting river water. Diverting surface water at higher river discharges, as is specified under the proposed action, is expected to maintain or approximate the yield of the proposed action, while at the same time minimizing adverse effects of diversion operations on endangered steelhead and the freshwater migration corridor.

The elements can be implemented consistent with the scope of the action agency's legal authority and jurisdiction under the authority of the Small Reclamation Project Act of 1956, and the contract entered into between the Bureau and United, which comprises the legal basis for this section 7 consultation. The contract gives the Bureau discretion to examine and approve operation of the Vern Freeman Diversion Dam, and to assist United in determining the adequacy of operation and maintenance. This biological opinion makes clear that operation of the Vern Freeman Diversion Dam, as would occur under the proposed action, is inadequate to support the life history and habitat requirements of endangered steelhead in the Santa Clara River, and therefore identifies a reasonable and prudent alternative to the proposed action. We expect the Bureau will use the information contained in this biological opinion, including the reasonable and prudent alternative, to guide operation of the Vern Freeman Diversion Dam to ensure the operations are adequate with regard to the needs of endangered steelhead.

The elements of the reasonable and prudent alternative are expected to be economically and technically feasible because dams and diversions are commonly made passable for fish (e.g., Smith *et al*. 2000) and NMFS possesses considerable experience collaborating with project proponents for the purpose of improving migration conditions for steelhead at obstructions to fish passage. A detailed evaluation of the feasibility of the reasonable and prudent alternative is provided in the following section.

The elements of the reasonable and prudent alternative avoid the likelihood of jeopardizing the continued existence of a listed species or destroy or adversely modify critical habitat. In particular, the elements address those aspects of the proposed action that reduce the amount and quality of habitat for steelhead, and continue to cause a decrease in abundance of this species. Chief among these aspects are the adverse effects of habitat loss and degradation in the Santa

Clara River due to the Vern Freeman Diversion Dam and its continued operation, and the lack of a properly functioning freshwater migration corridor for adult and juvenile steelhead in Santa Clara River. In this regard, the reasonable and prudent alternative is essential to address the adverse effects of the obstructed and improperly functioning freshwater migration corridor due to continued operation of Vern Freeman Diversion Dam. The reasonable and prudent alternative restores unobstructed steelhead access through the lower Santa Clara River to spawning habitats in tributaries to the mainstem, and re-establishes those bypass flows necessary to ensure a properly functioning migration corridor. The ramping rates promote higher flows of longer duration for attraction and migration of steelhead, particularly during periods when the proposed action would otherwise truncate the descending limb of the hydrograph. The interim physical modification and flow-related measures are intended to minimize existing operational effects (e.g., passage delays for steelhead) such that species can survive the interim period until the long-term physical modifications of the diversion dam that are necessary to provide or approximate unimpeded migration of this species are fully implemented and operational. Overall, the reasonable and prudent alternative is expected to promote an increase in the amount and extent of suitable habitat for adult and juvenile steelhead, improve the functional value of habitat for steelhead, and lead to increased numbers of steelhead in the Santa Clara River watershed. Accordingly, NMFS believes the reasonable and prudent alternative would avoid the likelihood of jeopardizing the continued existence of a listed species or destroying or adversely modifying critical habitat for this species.

Contrary to suggestions (e.g., page 1, United Water Conservation District 2008b, page 3, Attachment E, United Water Conservation District 2008b), this reasonable and prudent alternative is not a deliberate scheme to "force" (sensu page 3, Attachment E, United Water Conservation District 2008b) United to design and construct a rock ramp at the Vern Freeman Diversion Dam. Rather, this reasonable and prudent alternative was crafted to define what is expected to be an impartial scientific approach for remedying the exiting obstruction in the freshwater migration corridor for endangered steelhead that would continue to exist under the proposed action. In this regard, NMFS' expectation is that the review panel would undertake an impartial scientific process for identify a preferred alternative that would support attainment of the fish-passage objective. Because this reasonable and prudent alternative does not define the type or scope of the preferred alternative, we expect the preferred alternative that results from the panel's work could involve any type or manner of structure or modification necessary to attain the fish-passage objective. Therefore, to state that this reasonable and prudent alternative deliberately strives to require United to design and construct a rock ramp represents a misinterpretation of the reasonable and prudent alternative and is misleading.

The administrative record does support the statement that United has made some effort to address the adverse effects due to continued operation of the Vern Freeman Diversion Dam (page 2, United Water Conservation District 2008b). The administrative record further indicates that, despite NMFS' recommendations, United has failed to fully address in any meaningful manner the substantive issues related to the effects of the proposed action on the freshwater migration corridor for endangered steelhead. Among other issues, there is no ecologically meaningful provision in the proposed action that would be expected to actually remedy the obstruction in the freshwater migration corridor. This biological opinion concluded the proposed action is likely to jeopardize the continued existence of the endangered Southern California steelhead DPS, and is likely to destroy or adversely modify critical habitat for this species.

B. Evaluation of the Feasibility of Implementing the Reasonable and Prudent Alternative

Comments NMFS received on the draft biological opinion questioned the feasibility of implementing the long-term physical modification (preferred alternative[27]), particularly in terms of financing the preferred alternative and completion before the Bureau's discretion ceases at the end of 2011 (Bureau of Reclamation 2008a, United Water Conservation District 2008b). The comments include estimates of the environmental requirements and timing for implementing the preferred alternative. NMFS is keenly aware of the environmental requirements and time commitments necessary for reviewing and permitting projects. This practical awareness was acquired through (1) conducting environmental reviews and permitting projects, (2) designing fish-passage and restoration projects, (3) coordinating the reviews of projects with local governments, and state and federal regulatory agencies, (4) working with and applying the tenants of the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), (5) assessing project compliance with CEQA and NEPA regulations, and (6) complying with NEPA and the ESA. Based on this extensive experience, NMFS concludes that the estimates contained in comments are unrealistic, artificially inflated projections of the true environmental requirements and timing for implementing the preferred alternative, and are unreliable.

To develop a reliable understanding of whether the reasonable and prudent alternative could be implemented, NMFS performed a feasibility evaluation. This evaluation relied on NMFS' own regulatory experience, including knowledge and practical experience working with CEQA, NEPA, and the ESA. This experience and knowledge was supplemented with information obtained from phone interviews of representatives from other regulatory agencies whom we expect to be involved in the implementation of the preferred alternative and an engineering firm. The phone interviews generally focused on the types of permits or approvals that would be necessary for implementing certain types of a preferred alternative, the level of environmental review required under CEQA and NEPA, the time required to issue the required regulatory permit or approval, and the amount of time for constructing a certain type of preferred alternative. When considering compliance with CEQA, we used a standard CEQA checklist and criteria to guide our understanding of how a certain type of preferred alternative could affect the human environment. In addition to expectations and assumptions stated elsewhere in this evaluation, the following expectations and provisions were included in our evaluation:

1. The preferred alternative would be constructed during summer and early fall, when no or little flowing water is likely in the action area.
2. The application for permits that United submits to the Corps and the California Department of Fish and Game would be deemed complete.
3. Regulatory permits, reviews, or approvals for implementation of the preferred alternative would be required only from the Corps (404 permit), the California Department of Fish and Game (streambed alteration agreement), the Regional Water Quality Control Board (401 certification), the U. S. Fish and Wildlife Service (section 7 consultation), and NMFS (section 7 consultation).

[27] We use the phrases *reasonable and prudent alternative* and *preferred alternative* interchangeably in this evaluation.

4. Bidding and contracting, processing of applications for the 404 permit (and 401 water quality certification) and streambed alteration agreement, and compliance with CEQA and NEPA would proceed in parallel.
5. United must comply with the CEQA.
6. In most cases, the estimates of the amount of time required to complete a particular step (e.g., acquire a permit from the Corps) are initially presented in a range (e.g., "two to three months"). When a range was identified, we used the maximum value in our calculations to estimate a schedule for implementing the preferred alternative.
7. United would act in good faith and proceed diligently when undertaking the steps necessary to accomplish implementation of the reasonable and prudent alternative.
8. We expect that implementation of the preferred alternative would proceed according to the following general steps: (a) identification and design of the preferred alternative, (b) selection of a contractor to construct the preferred alternative (bidding and contract), and acquisition of environmental permits and regulatory approvals, and (c) implementation.
9. When a time estimate appeared to depend on a specific type or complexity of preferred alternative, we selected for evaluation what we expect would be the most involved preferred alternative of all those considered to date – the partial-width rock ramp. This approach is expected to deliberately accentuate the amount of time required to implement the reasonable and prudent alternative.

NMFS' feasibility evaluation involves two principal components: an evaluation of feasibility related to schedule, and evaluation of feasibility related to cost. Each of these are as follows.

Evaluation of Feasibility Related to Schedule.—We estimated the time required to complete the expected steps necessary to implement the preferred alternative. The total estimated time was then compared to the date upon which the Bureau's discretion over the proposed action terminates (December 31, 2011) to determine whether the preferred alternative could be implemented before the Bureau's discretion ends. What follows is our discussion of the amount of time required for each of the expected steps, beginning with the process of assembling the panel and developing and designing the preferred alternative. This evaluation of feasibility related to schedule concludes with a determination of whether the preferred alternative could be implemented before the Bureau's discretion over the proposed action terminates.

With regard to developing the preferred alternative, United has already advanced the process of assembling a panel to review the performance of the fish passage. A list of potential panel candidates has been assembled, and invitations soliciting candidate participation have been sent. Once the panel is assembled and begins working on the short-term and long-term physical modifications, we expect the actual process of developing the preferred alternative would proceed relatively swiftly, on the order of 6 to 8 months. Several ideas already exist for the types of physical modifications necessary to attain the fish-passage objective (e.g., alternatives identified in the "Zapel report" as well as NMFS' past recommendation regarding a partial-width rock ramp) and these ideas are expected to further the overall process of developing the preferred alternative. Assuming the panel convenes and begins collaborating on this task on September

15, 2008, development of the preferred alternative (including design) is expected on or about May 15, 2009.

Our experience working with project proponents at the scale of city, county, and state indicate a reasonable duration for bidding and contracting is 30 to 60 days. This estimate includes the time needed to prepare the bidding documents and contract. Based on identification of the preferred alternative no later than May 15, 2009, the bidding and contracting can be completed by July 15, 2009.

With regard to United's obligation under CEQA and the related environmental review of the preferred alternative, a reasonable expectation is that the preferred alternative (even if the preferred alternative rises to the level of a partial-width rock ramp) would trigger at most a mitigated negative declaration to fulfill the CEQA requirement. We believe a mitigated negative declaration is appropriate because while the preferred alternative would likely be found to have significant construction-related effects on elements of the human environment (e.g., Noise, Air Quality, Geology and Soils, and Transportation/Traffic), we expect the effects can be reduced to a level of insignificance through incorporation of standard avoidance measures, based on the type and temporary nature of effects to elements of the human environment. For instance, air quality impacts (e.g., dust) can be avoided by watering the work area and covering truck trailers. Potential impacts to aquatic species and their habitats can be avoided by confining construction to the dry season. Because the area to be affected by the preferred alternative would be confined to a sandy wash and not encroach into vegetative upland areas, we do not expect terrestrial species would be adversely affected. Overall, we expect that 3 months would be required for United to prepare a final mitigated negative declaration. The development of the negative declaration can begin once the preferred alternative is fully defined (expected on or about May 15, 2009) and could be completed by August 15, 2009.

Our discussion with the Corps indicate the preferred alternative may qualify for either for an exemption or Nationwide Permit 27, *Aquatic Habitat Restoration, Establishment, and Enhancement Activities*, depending on the type of preferred alternative. A Nationwide Permit can be issued to United within 2 to 3 months of receiving a complete application (pers. comm., A. Szijj, Army Corps of Engineers, June 25, 2008). NMFS was informed that the Corps does not need to perform NEPA analysis when issuing a Nationwide Permit because NEPA compliance is already embedded in the Nationwide Permit Program. The application for a Corps exemption or Nationwide Permit can begin once the preferred alternative is fully defined. Given an expected date of May 15, 2009, for the preferred alternative, verification of an exemption or permit would be expected no later than August 15, 2009.

The Corps is expected to consult with the U. S. Fish and Wildlife Service and NMFS under section 7 of the ESA prior to issuing a Nationwide Permit. Because construction of the preferred alternative is expected to be confined to the dry season and dry river channel, we do not expect aquatic species or their habitat to be present in the area to be affected by construction of the preferred alternative. Additionally, we do not expect that construction activities would encroach into upland areas, thereby avoiding effects to terrestrial species. Therefore, informal consultation with the Fish and Wildlife Service and NMFS appears appropriate at this time, and such consultation can be usually concluded within 30 days. The time required for conducting the informal consultation is already embedded in the time required for the Corps to process the application for an exemption or Nationwide Permit (pers. comm., A. Szijj, Army corps of Engineers, June 25, 2008). Therefore, the consultation is not expected to require more time than is already needed for United to acquire the necessary regulatory permit or exemption from the Corps.

Our discussion with the California Department of Fish and Game indicate United would be required to obtain a streambed alteration agreement prior to implementing the preferred alternative. The streambed alteration agreement can be issued to United within 3 months of receiving a complete application (pers. comm., M. Larson, California Department of Fish and Game, June 25, 2008). The application for a streambed alteration agreement can be submitted once the preferred alternative is fully defined. Given an expected date of May 15, 2009, for the preferred alternative, the final streambed alteration agreement could be presented to United after CEQA compliance is demonstrated, August 15, 2009.

With regard to constructing the preferred alternative, we assumed that, at most, a partial-width rock ramp would be constructed. We made this assumption, not because we expect a partial-width rock ramp would be identified as the preferred alternative, but because such an alternative would likely require the most time for construction as compared to other potential alternatives such as the incremental alternatives identified in the "Zapel report." We believe that such an assumption would provide an "upper limit" on the estimated time commitment for implementing the preferred alternative. For constructing a partial-width rock ramp, we have been informed by a representative of Boyle Engineering that the construction time may require one or possibly two seasons (pers. comm., D. Hahn, Boyle Engineering Corporation, June 26, 2008), which we interpret as one or two *construction* seasons. In our experience collaborating with project proponents, projects undertaken in or near rivers are typically confined to the dry season, which in southern California typically begin in June and last until late November. So we define a construction season as one dry season in this evaluation. The availability of rock appears to be a factor in determining whether one or two seasons would be required to complete construction; if the rock is available and can be transported to the site prior to construction, then we are lead to believe that one season would be required. We believe it reasonable to expect that with proper planning and foresight arrangements could be made to ensure the rock is transported to the site before construction. However, for purposes of this evaluation, we assumed two dry seasons would be required to construct a partial-width rock ramp.

Given that (1) the environmental review and permits are expected to be completed no later than summer 2009, (2) two dry seasons (June through November) are expected to be necessary to construct the preferred alternative (2010 and 2011), and (3) the Bureau's discretion over the proposed action does not end until December 31, 2011, there appears to be sufficient time for the preferred alternative to be implemented before December 31, 2011. Overall, we conclude the preferred alternative could be implemented before the Bureau's discretion ceases at the end of 2011.

Evaluation of Feasibility Related to Cost.—At this time, we do not know what the preferred alternative will be, though we felt it informative to estimate the feasibility of financing a potential alternative that would likely be the most costly in terms of dollars. In this regard, we expect that a partial-width rock ramp would represent the "upper limit" in terms of material and labor of any preferred alternative the panel would be reasonably expected to recommend. Hence our evaluation of cost is based on a preferred alternative involving a partial-width rock ramp. In this evaluation, it is worth noting that United's net assets for the fiscal year ending June 30, 2007, totaled $56,777,869 (United Water Conservation District 2007c).

United provided NMFS with a cost estimate to construct a partial-width rock ramp; the total cost estimate is slightly less than twenty-eight million dollars (Hahn 2008)[28]. With regard to financing the preferred alternative (page 2, United Water Conservation District 2008b), United is already undertaking steps to notify ratepayers and increase revenue (e.g., United Water Conservation District 2008d), and a variety of revenue tools are expected to be of use in funding the preferred alternative. These tools may include Proposition 218 related to the General Fund Groundwater Extraction Charge and the Freeman Diversion Groundwater Extraction Charge (United Water Conservation District 2008e), as well as user fees or charges. Acquisition of funds through various grant restoration and cost-sharing programs or loans may be possible. Overall, we expect United is able to fund the reasonable and prudent alternative.

[28] Despite the cost estimate developed by Hahn (2008), United subsequently developed its own cost estimate of "around $60,000,000" (page 6, Attachment A, United Water Conservation District 2008b) to build a full-width rock ramp, citing that a partial-width rock ramp was not feasible. United based this determination on flow-design criteria presented in Table 9-1 of this biological opinion. We emphasize that these flow-design criteria are guidelines and may be modified as necessary to meet site-specific characteristics, conditions, or operating requirements. Therefore, we view United's assertion that a partial-width rock ramp to be infeasible as unfounded. Additionally, the panel that is assembled as part of the reasonable and prudent alternative may recommend a preferred alternative that does not involve a rock ramp of any sort.

Table 9-1.— Flow-related information for the Santa Clara River.

A: Sums of exceedance values for Santa Clara River U/S of Piru Creek plus Piru Creek, Sespe Creek and Santa Paula Creek (this includes all north slope watersheds upstream of Freeman).

	January	February	March	April	May
1%	5994.7	16196.9	8530.6	3486.8	2685.5
5%	1155.85	4128.4	3183.8	1469	872.8
10%	551.5	1649.9	1663.2	836	405.3
20%	248	544.4	695.6	400	186.8
50%	93	148	167	127	76

B: Diversion rate exceedance values at Vern Freeman diversion dam.

	January	February	March	April	May
1%	343.1	364.2	354	397.9	400.4
5%	260.4	261.6	315.2	343.5	318.6
10%	221	215	288	314	276.1
20%	147.4	186.4	222.8	245	205
50%	88	106	94	94	92

C: Values Table B subtracted from those in Table A (river flow to the dam, less diversion rate)

	January	February	March	April	May
1%	5651.6	15832.7	8176.6	3088.9	2285.1
5%	895.45	3866.8	2868.6	1125.5	554.2
10%	330.5	1434.9	1375.2	522	129.2
20%	100.6	358	472.8	155	-18.2
50%	5	42	73	33	-16

D: Exeedance values at gage 10-11 miles D/S of Vern Freeman (at Hwy 101)

Compare with values in Table C

	January	February	March	April	May
1%	6270	19960	6980	2464	1220
5%	937.4	3830	2073	1200	218.6
10%	279.6	1190	1222	520	31.2
20%	42	300	434.4	105	5.3
50%	0.1	0.8	2.9	0.2	0

X. INCIDENTAL TAKE STATEMENT

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS 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. Incidental take is defined as take of listed animal species that results from, but is not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, must be undertaken by the Bureau for the exemption in section 7(o)(2) to apply, and assume the reasonable and prudent alternative will be implemented. The Bureau has a continuing duty to regulate the activity covered by this incidental take statement. If the Bureau (1) fails to assume and implement the terms and conditions or (2) fails to adhere to the terms and conditions of this incidental take statement through enforceable terms that are added to the contract, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Bureau must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement (50 CFR §402.14(i)(3)).

A. Amount and Extent of Take

Operating the Vern Freeman Diversion Dam, even with the reasonable and prudent alternative, is expected to cause incidental take of the endangered Southern California DPS of steelhead in the Santa Clara River. Incidental take of steelhead is expected solely from operation of the Vern Freeman Diversion Dam. Take owing to implementation of the reasonable and prudent alternative is not expected because the physical facility changes required as part of the reasonable and prudent alternative can be performed during the dry season when steelhead are not expected in the vicinity of the Vern Freeman Diversion Dam[29]. NMFS anticipates the following type and amount of incidental take owing to operation of the Vern Freeman Diversion Dam as expected under the proposed action. We emphasize the following take cannot be minimized through implementation of the reasonable and prudent alternative alone:

1. Decrease the magnitude (up to a 375 cfs reduction), frequency (up to a 100% reduction), and duration (up to a 100% reduction) of the freshwater migration corridor for adult and juvenile steelhead downstream of the Vern Freeman Diversion Dam during winter and spring, with the expectation of injuring and killing these steelhead life stages;
2. Increase the recession rate (up to 375 cfs/24 hours) of the freshwater migration corridor for adult and juvenile steelhead downstream of the Vern Freeman Diversion Dam during winter and spring, with the possibility of injuring and killing these steelhead life stages; and,

[29] Although the preferred alternative has not been identified (page 1, Bureau of Reclamation 2008b), NMFS believes it is reasonable to conclude that any work undertaken at the diversion dam and river channel would be conducted during the dry season because such is common when project proponents undertake construction activities in or near waterways, based on NMFS' experience.

3. Collect and relocate 2 adult and 900 juvenile steelhead annually as part of fish-rescue activities (including collection and relocation of steelhead that may be prompted by implementation of the reasonable and prudent alternative), diversion maintenance and operations, and monitoring activities, with the expectation of injuring or killing up to 2 adult and 90 juvenile steelhead annually.

B. Effect of Take

In the accompanying Biological Opinion, NMFS concludes the anticipated level of take associated with the proposed action is not likely to jeopardize the continued existence of the endangered Southern California DPS of steelhead when all of the elements of the reasonable and prudent alternative are implemented[30].

C. Reasonable and Prudent Measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize and monitor incidental take of steelhead.

1. Ensure that the operation of the Vern Freeman Diversion Dam does not preclude a properly functioning freshwater migration corridor for adult and juvenile steelhead in the Santa Clara River from the Vern Freeman Diversion Dam downstream to the Pacific Ocean.
2. Implement a steelhead rescue and relocation protocol that is protective of adult and juvenile steelhead including parr.
3. Implement an adaptive management plan for the purpose of effectively addressing and resolving uncertainties related to implementation of the proposed action.
4. Report to NMFS the activities associated with minimizing and monitoring the effects of the proposed action, and with monitoring steelhead migrants.

D. Terms and Conditions

To be exempt from the take prohibitions of the ESA, the Bureau and United must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary and are as follows:

1. The following terms and conditions implement reasonable and prudent measure 1.

    (a) For the purpose of ensuring that flow criteria are met, United shall apply a non-contact method (e.g., continuous wave microwave radar, monostatic UHF Doppler radar, pulsed Doppler microwave radar, ground-penetrating radar, or acoustic Doppler technologies), or other method that is agreeable to NMFS, to continuously monitor instantaneous river discharge in the Santa Clara River both where the Highway 118 bridge and the Highway 101 bridge cross the river[31]. The application

[30] We understand that the Bureau is concerned with the grammatical construction of this sentence (page 2, Bureau of Reclamation 2008b), but this sentence is consistent with NMFS policy (U. S. Fish and Wildlife Service and National Marine Fisheries Service 1998).

[31] NMFS' acknowledges the challenges related to the shifting sand bottom (page 4, United Water Conservation District 2008e) and for this reason has identified the use of non-contact methods to overcome such challenges related to measuring flows.

of the selected method shall include integration of a remote telemetry station to log the data and then transmit the data by a satellite transmitter to a NMFS-designated site accessible by Anthony Spina or other NMFS-designated staff in NMFS' Southwest Region Office. NMFS' engineers and biologists must provide written agreement for the selected method, including the method to store and transmit data and degree of flow-measurement error, before the method is implemented.

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

   (a) The spawning status of adult steelhead (i.e., "pre-spawn" or "post-spawn") that are intentionally or unintentionally captured, collected, or trapped within the Vern Freeman Diversion Dam (including within any fish-collection device) or found, including individuals that are stranded, in the Santa Clara River downstream of the Vern Freeman Diversion Dam shall be assessed immediately upon sighting. Adult steelhead shall be digitally photographed, measured to the nearest mm (FL) and scales shall be removed and preserved using standard methods. The date and time of each capture shall be recorded, and referenced to the digital photograph, length, and scale sample. Pre-spawn male and female adult steelhead shall be released immediately upstream of the Vern Freeman Diversion Dam. Post-spawn male and female adult steelhead shall be released into the Santa Clara River immediately downstream of the Vern Freeman Diversion Dam. If the characteristic or condition of the freshwater migration corridor throughout the Santa Clara River downstream of the Vern Freeman Diversion Dam is not conducive to allowing volitional migration of adult steelhead from the Vern Freeman Diversion to the ocean, post-spawn adult male and female steelhead shall be placed in an aerated container of river water and immediately transported by vehicle downstream and then released into the ocean near the mouth of the Santa Clara River.

   (b) Juvenile steelhead that are intentionally or unintentionally captured, collected, or trapped within the Vern Freeman Diversion Dam (including within any fish-collection device), or found, including individuals that are stranded, in the Santa Clara River downstream of the Vern Freeman Diversion Dam, 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). Scales shall be removed from each specimen using standard methods, and the date and time of the capture shall be recorded and referenced to the digital photograph, measured length, and scale sample. Juvenile steelhead showing characteristics that are intermediate to parr and smolt (e.g., no evidence of parr marks and external silvering or blackened fin margins) will be classified as presmolt. Parr shall be released into a suitable instream area of the Santa Clara River or adjoining tributaries upstream of the Vern Freeman Diversion Dam. Presmolt and smolt steelhead shall be released into the Santa Clara River immediately downstream of the Vern Freeman Diversion Dam. If the characteristic or condition of the freshwater migration corridor throughout the Santa Clara River downstream of the Vern Freeman Diversion Dam is not conducive to allowing volitional migration of steelhead from the Vern Freeman Diversion to the estuary or ocean, steelhead shall be placed in an aerated container of river water and immediately transported by vehicle downstream and then released into the ocean near the mouth of the Santa Clara River. Using methods and equipment that are agreeable to NMFS, United shall insert telemetry devices in juvenile steelhead exceeding 100mm FL prior to release, and then monitor the in-river and in-estuary post-release movement and habitat use of the steelhead over time using a combination of fishery telemetry and direct-observation methods (the specific sampling schedule for tracking fish movement over time and space will be developed in collaboration with and written agreement from NMFS). United shall provide the findings from such monitoring to NMFS according to the schedules and formats defined by NMFS.

(c) United shall contact NMFS (Anthony Spina, 562-980-4045, or other staff as directed by NMFS) immediately if one or more steelhead are found dead or injured. The purposes of the contact shall be to review the activities resulting in take, to determine if additional protective measures are required, and to discuss handling procedures for injured or dead steelhead.

3. The following term and condition implements reasonable and prudent measure 3.

(a) With regard to United's proposal to address uncertainties, United shall prepare a draft adaptive-management plan for the purposes of addressing and resolving uncertainties related to implementation of the proposed action, and submit this plan to NMFS' Southwest Regional Office (501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802) for review and potential agreement no later than 120 days after the date of NMFS' final biological opinion that is the basis of this formal consultation. United shall develop this adaptive management plan for operation of the Vern Freeman Diversion Dam and related appurtenances for the principal purpose of addressing uncertainties related to operation of the diversion. The general categories of uncertainties are expected to involve: (1) the appropriateness of the proposed bypass flows for migration of adult and juvenile steelhead through the mainstem Santa Clara River downstream of the Vern Freeman Diversion Dam, (2) the response of steelhead to the physical modification of the Vern Freeman Diversion Dam, (3) the implications of the entire suite of operating criteria on the pattern and magnitude of the freshwater migration corridor in the Santa Clara River downstream of the Vern Freeman Diversion Dam, (4) the effectiveness of measures to avoid or minimize adverse effects on endangered steelhead and critical habitat for this species, and (5) effects of the proposed action and interrelated activity on the Santa Clara River estuary (e.g., aerial extent and depth of the estuary, and estuary breaching). To address these uncertainties, United's adaptive-management plan shall: (A) incorporate all of the NMFS-identified general categories of uncertainties, (B) within each general category of uncertainty, identify specific uncertainties and the questions that need to be addressed to resolve each uncertainty, (C) identify biological goals and objectives for each uncertainty, (D) define and require the implementation of a monitoring program that is able to detect the necessary information to answer questions related to resolving uncertainty, and (E) define and implement a protocol that will respond to new information or changing conditions, detect and reconcile deficiencies or problems in a timely manner, and incorporate feedback loops that link implementation and monitoring to a decision-making process that results in appropriate changes in operations to benefit steelhead and their habitat. Specific details of various aspects of this plan, including schedules, shall be developed by United in cooperation with and agreement from NMFS prior to implementation of this plan. United shall be responsible for funding and implementing this plan. No later than 30 days following the date of NMFS' letter commenting on this plan, United shall submit to NMFS (at the foregoing address) for review and potential agreement a final plan that addresses NMFS' comments. United must receive final NMFS agreement for the final plan prior to implementing the final plan. Upon receipt of final NMFS agreement, United shall commence implementation of the final plan as agreed upon by NMFS in accordance with the schedules provided therein.

4. The following terms and conditions implement reasonable and prudent measure 4.

    (a) United shall document evidence demonstrating compliance with term and condition 1(a), and submit this information to Anthony Spina, NMFS' Southwest Regional Office (501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802) for review no later than June 15 of each year for the life of the proposed action.

    (b) The data that will be collected as required by term and condition 2(a) and 2(b) shall be recorded on standardized data sheets, along with information about river flow and water temperature, and then entered and saved into an electronic spreadsheet (Microsoft Office Excel) according to the NMFS-required format. The electronic spreadsheet will be transmitted to a NMFS designated electronic address of NMFS staff (Anthony Spina) in the Southwest Region Office no later than June 15 of each year for the life of the proposed action. Scale samples shall be mounted, packaged, and then mailed to Anthony Spina NMFS' Southwest Regional Office (501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802) no later than June 15 of each year for the life of the proposed action. Specific details of various aspects of the data collection, including schedules and the specific information to be collected, shall be developed by United in cooperation with and agreement from NMFS prior to collecting data as required by term and condition 2(a) and 2(b).

    (c) United shall document and in writing notify NMFS of any dispute or problem encountered with achieving compliance with any of the Reasonable and Prudent Measures and Terms and Conditions in this biological opinion. Such notification shall be made to NMFS (Anthony Spina) within a reasonable period of time, but in no case later than 48 hours after United's discovery of any such problem or dispute.

XI. REINITIATION OF FORMAL CONSULTATION

As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion, (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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Appendix A

Graphs comparing the proposed bypass flows (labeled as "proposed action" in the graphs) with the total available river discharge that would pass downstream of the diversion if none was diverted ("river flows") and flows resulting from current operations ("current flows") at the Vern Freeman Diversion Dam

The following results are for:
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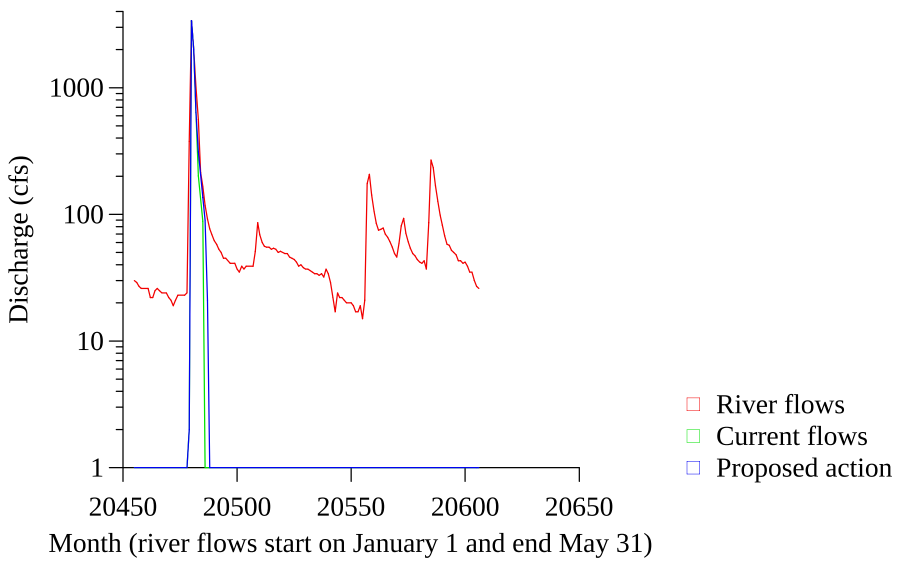

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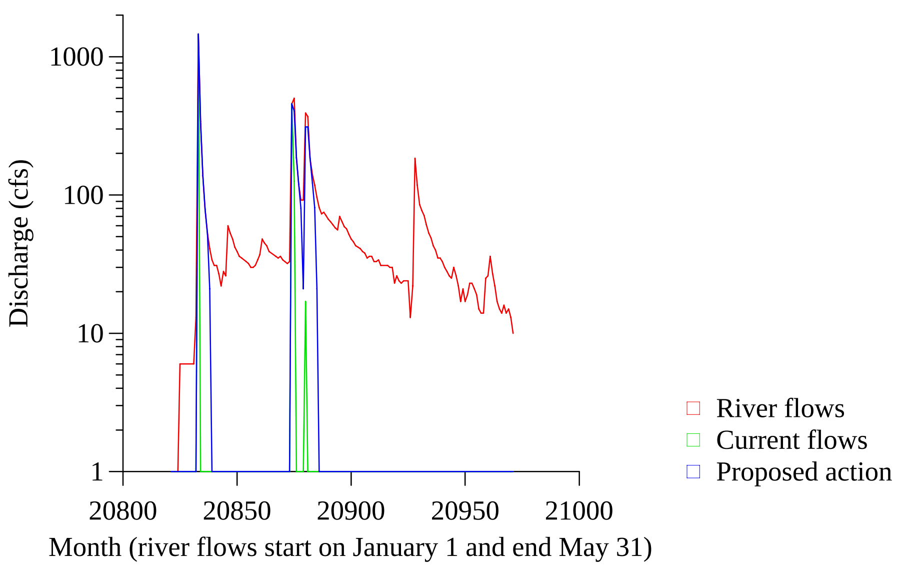

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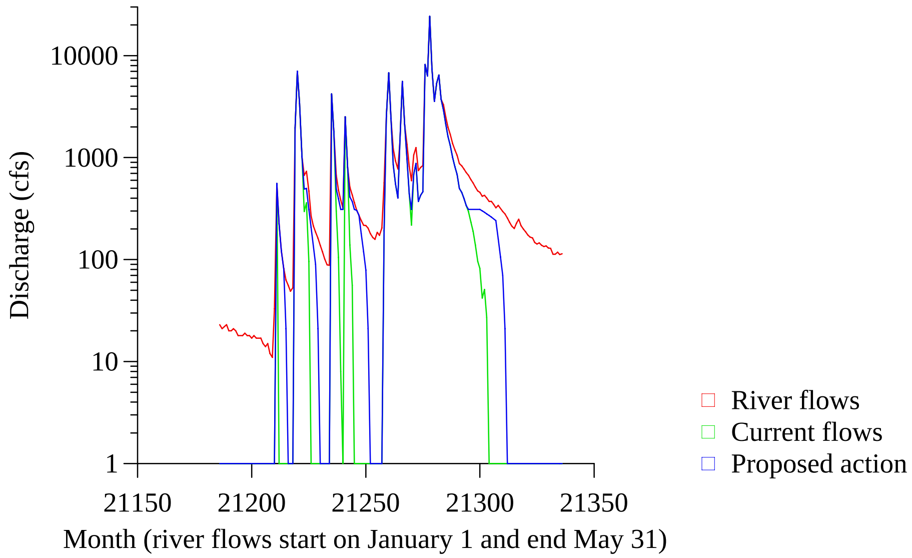

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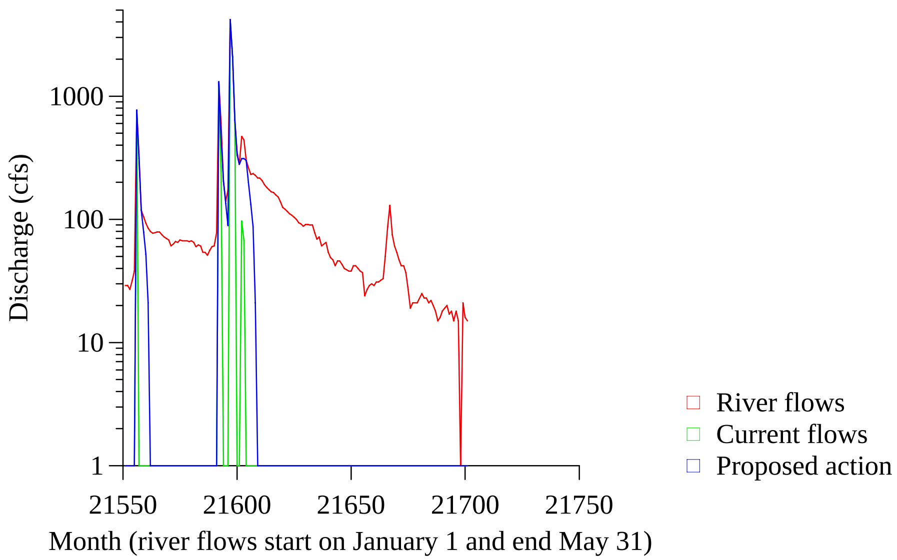

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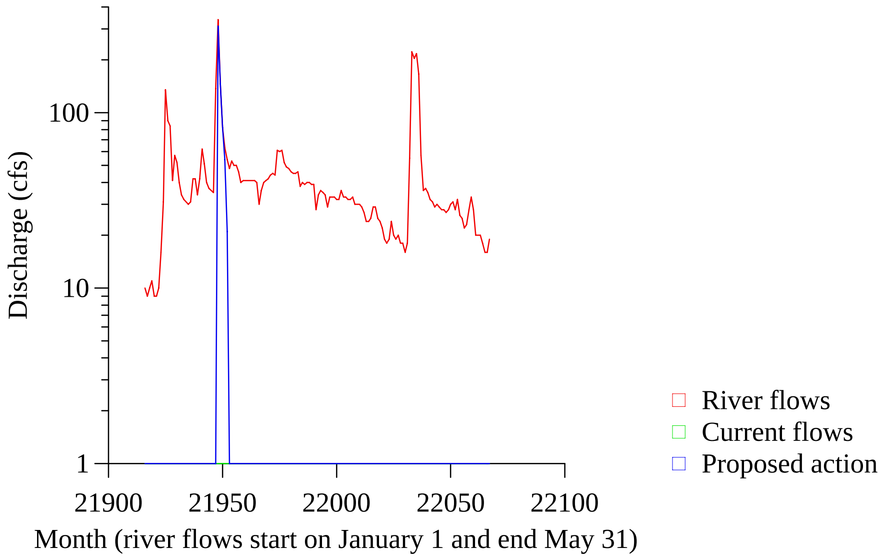

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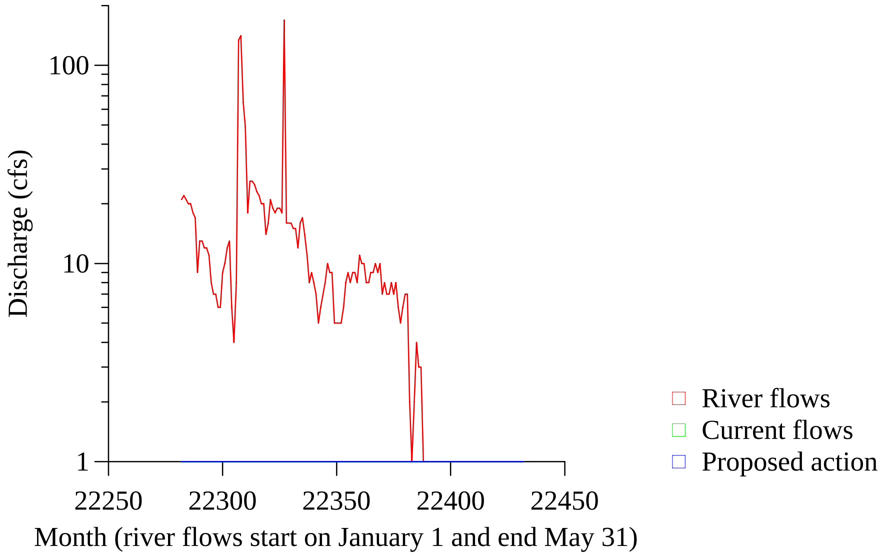

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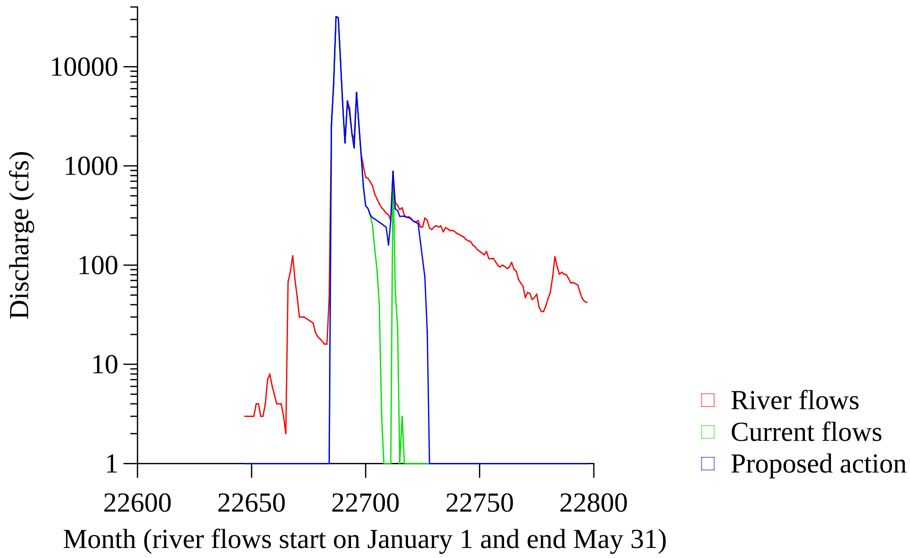

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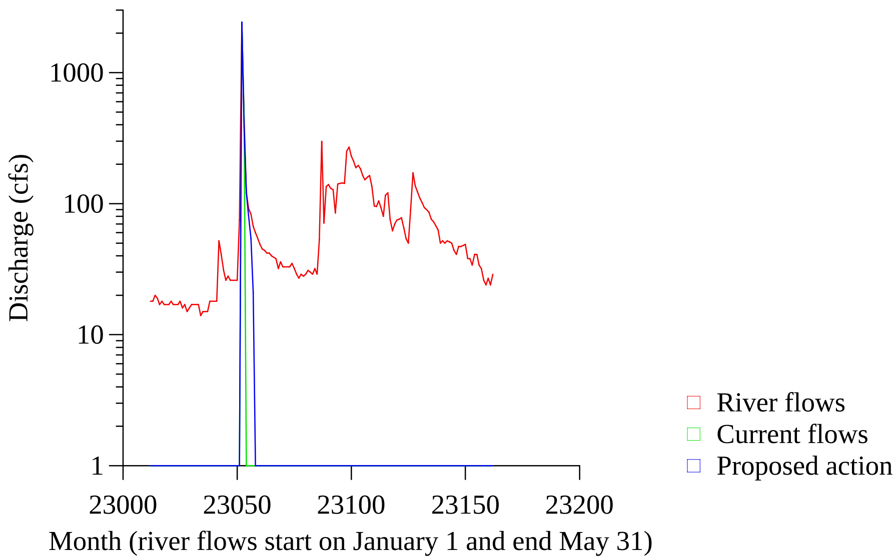

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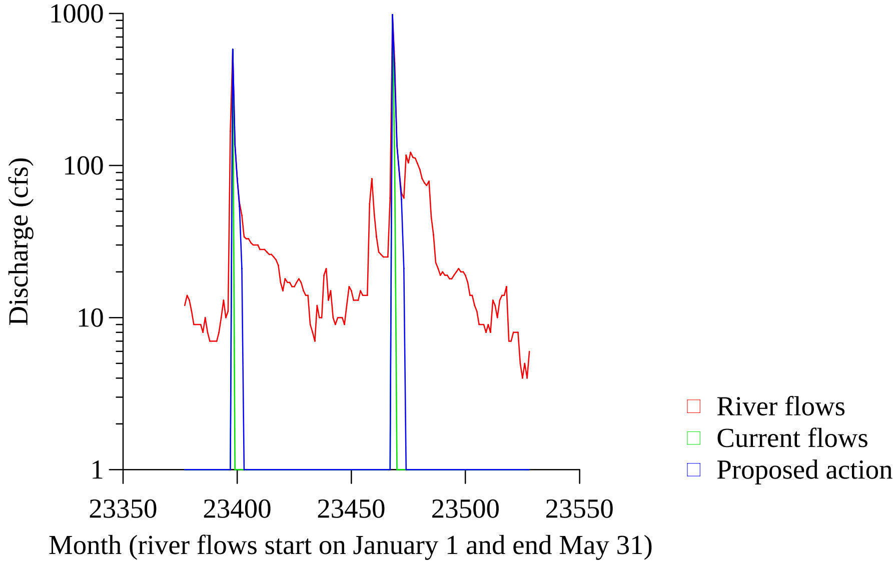

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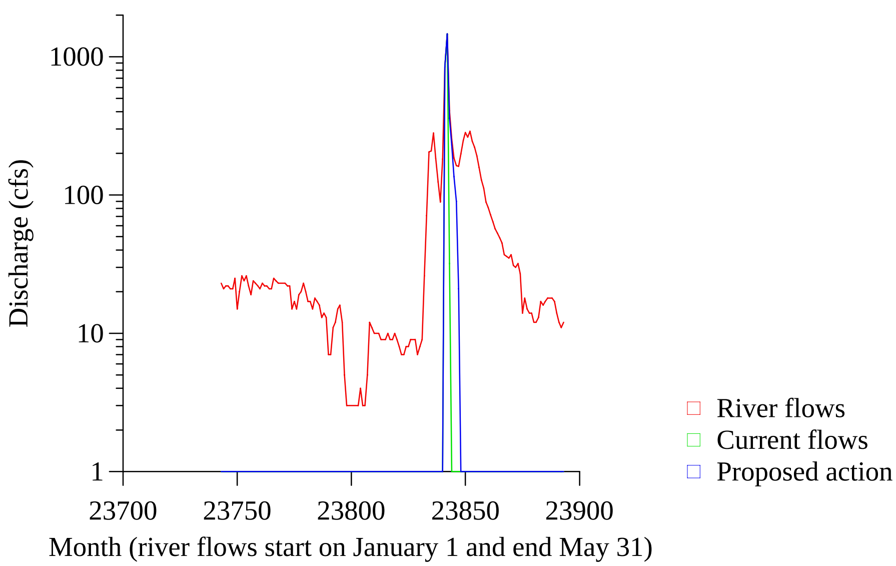

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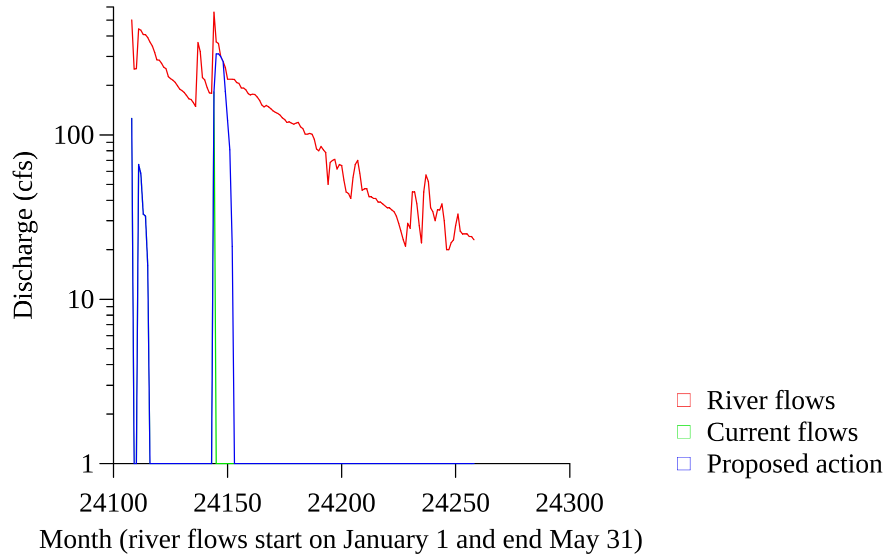

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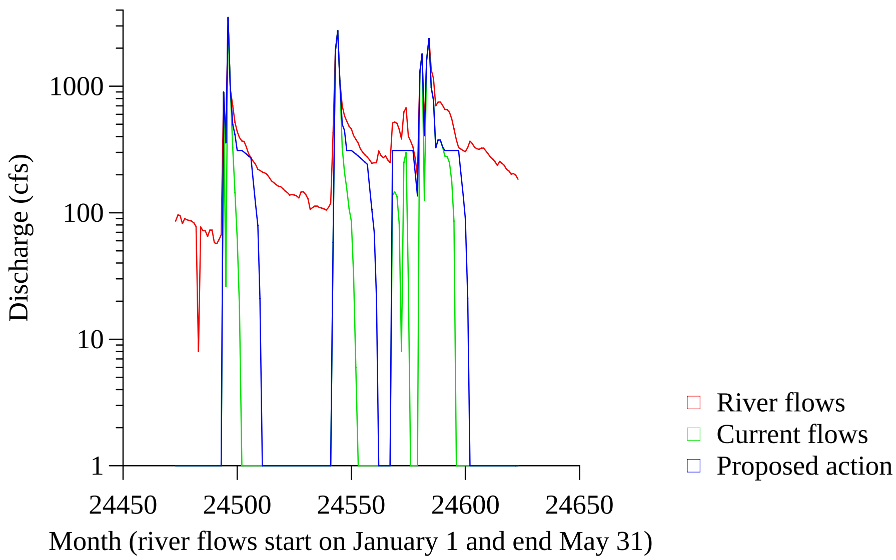

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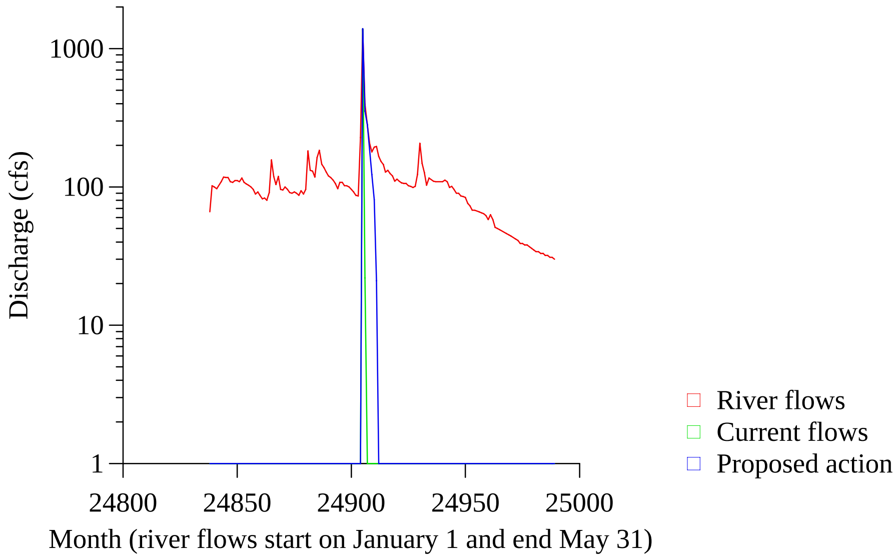

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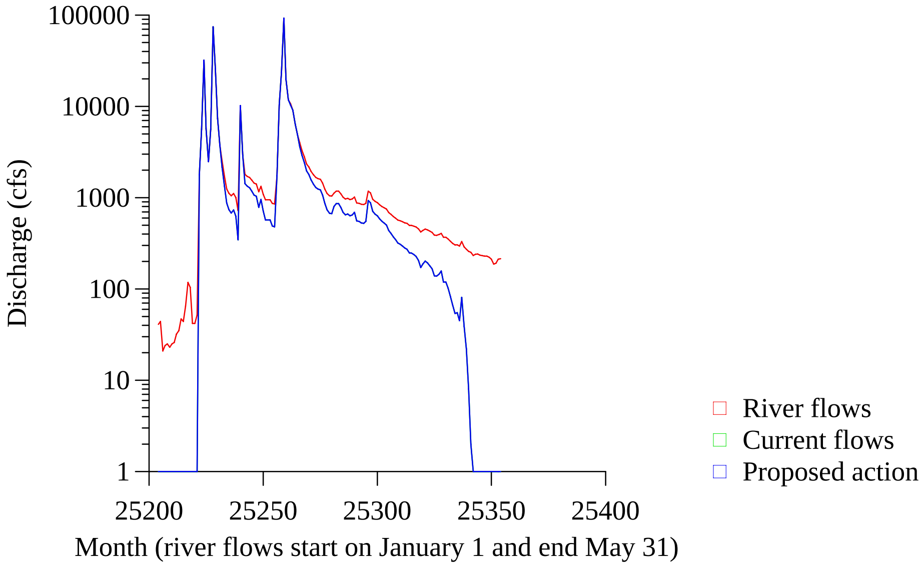

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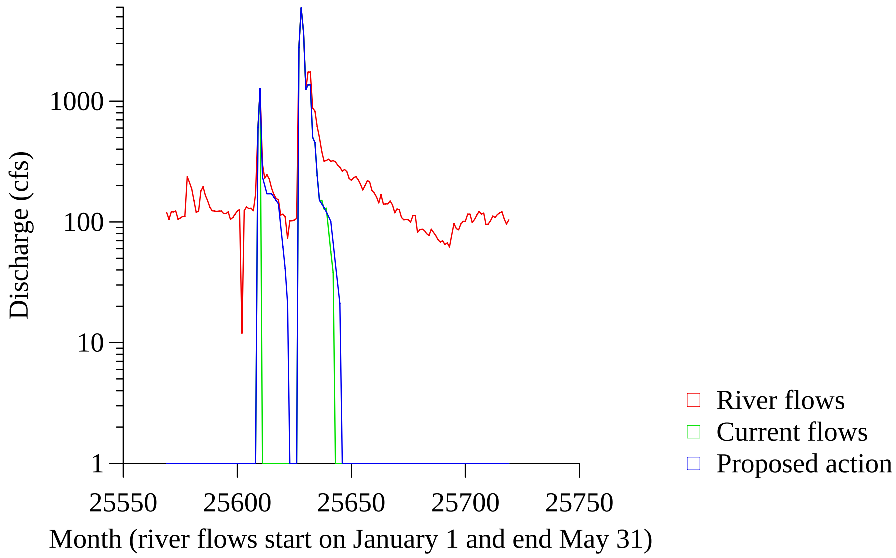

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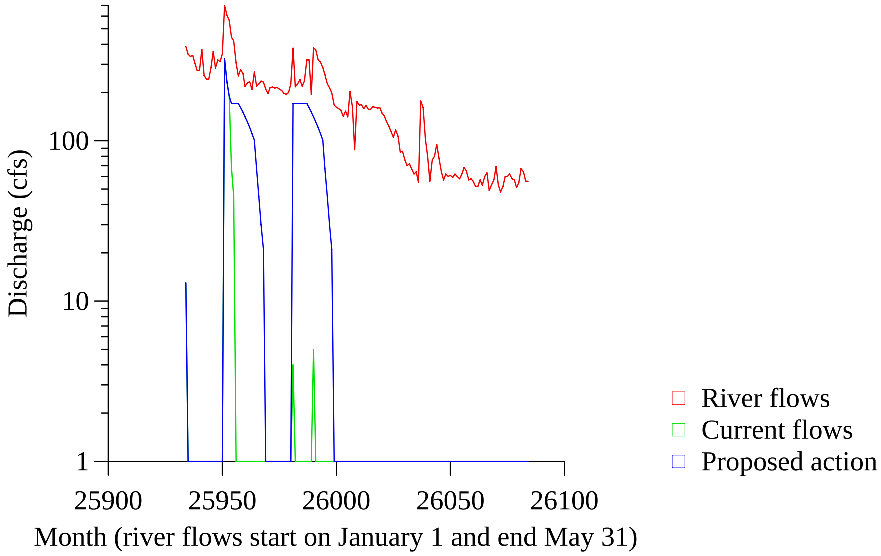

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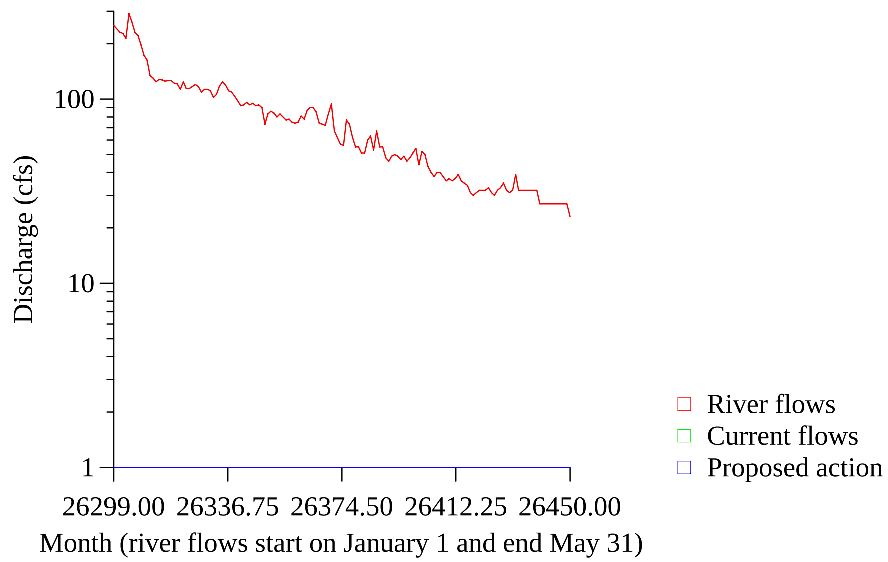

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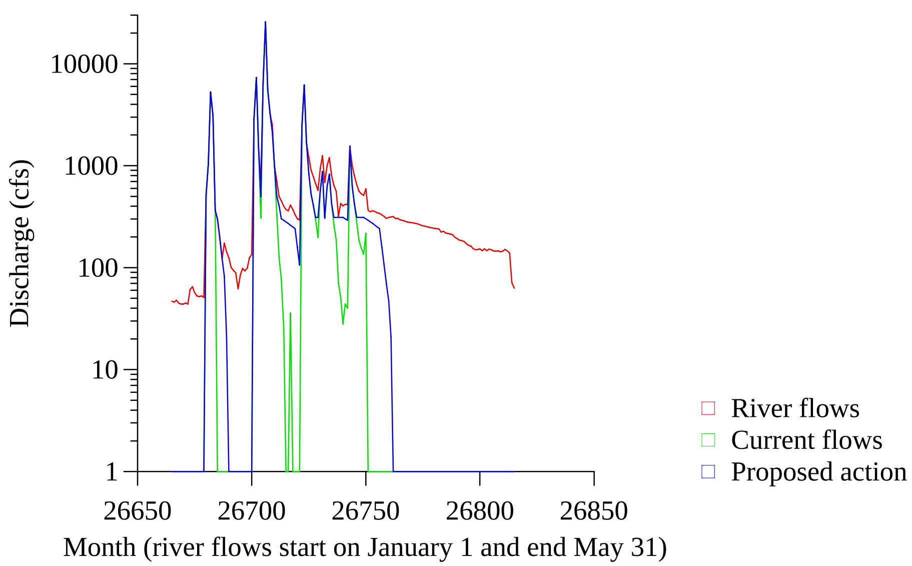

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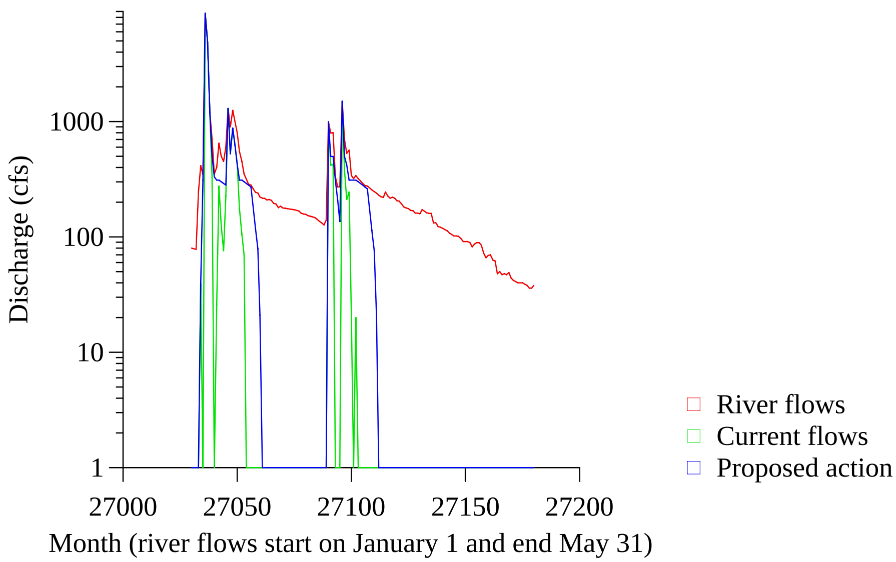

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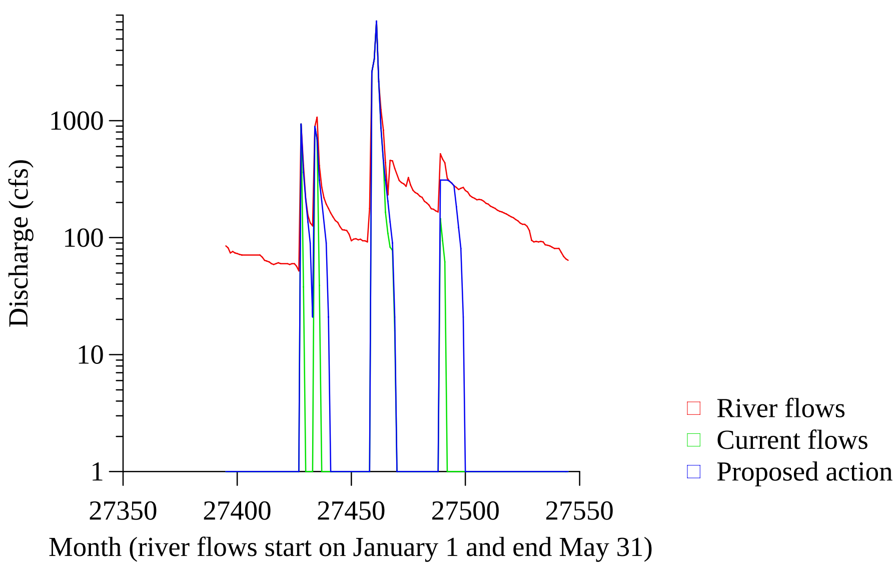

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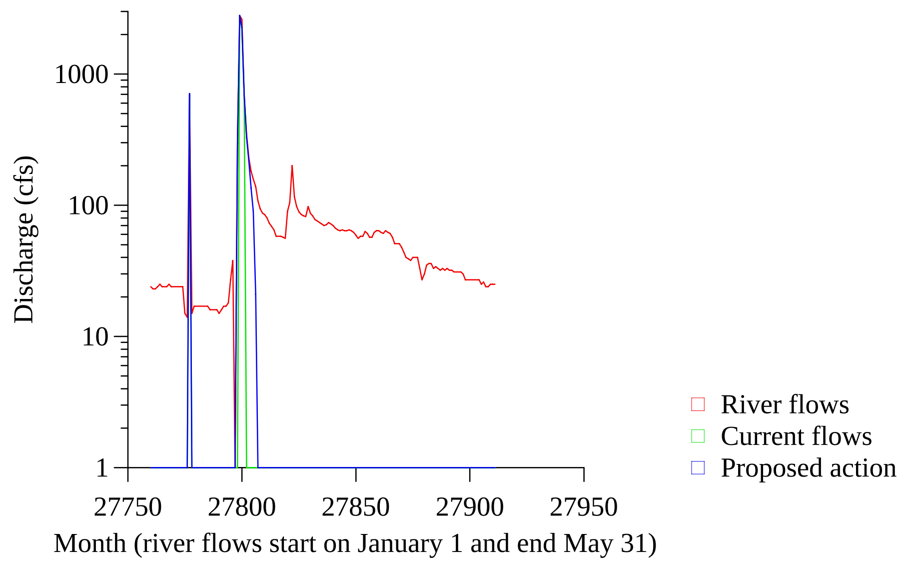

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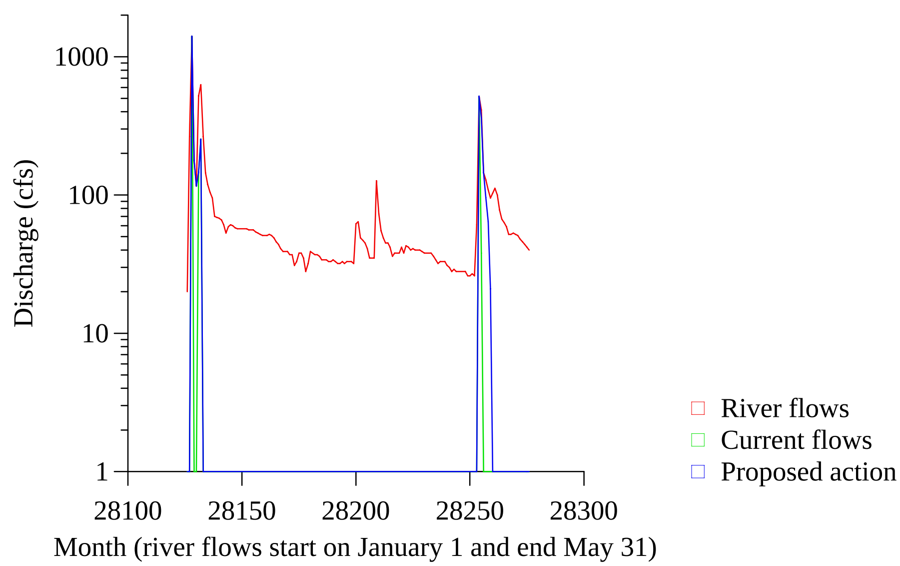
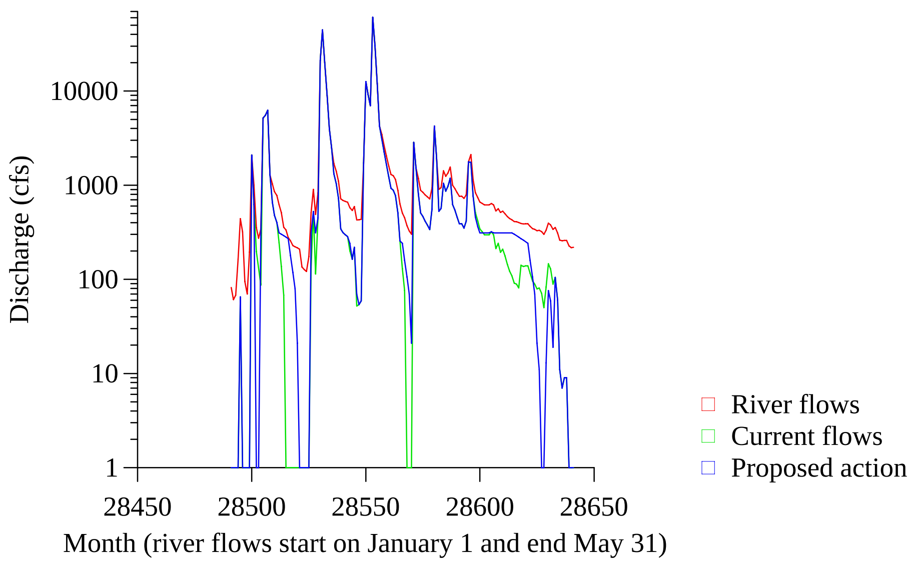
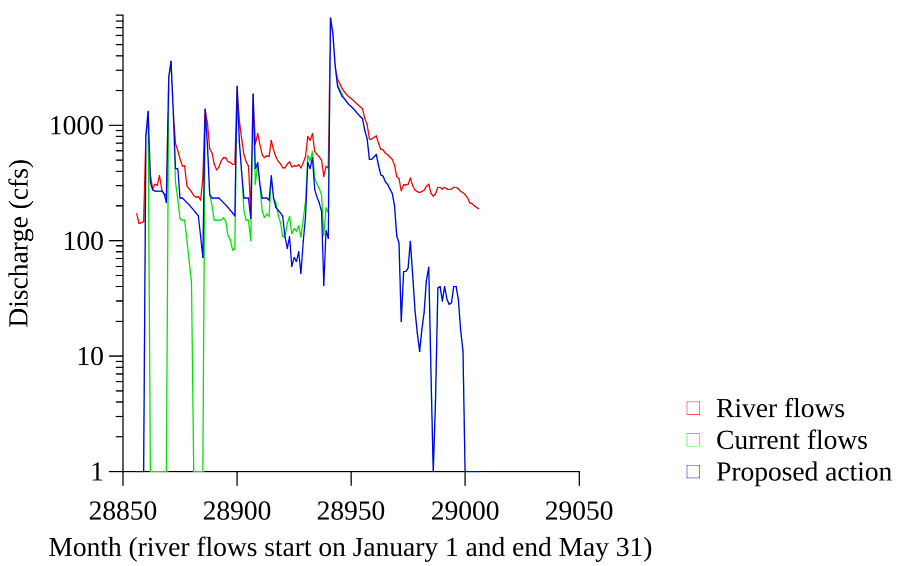


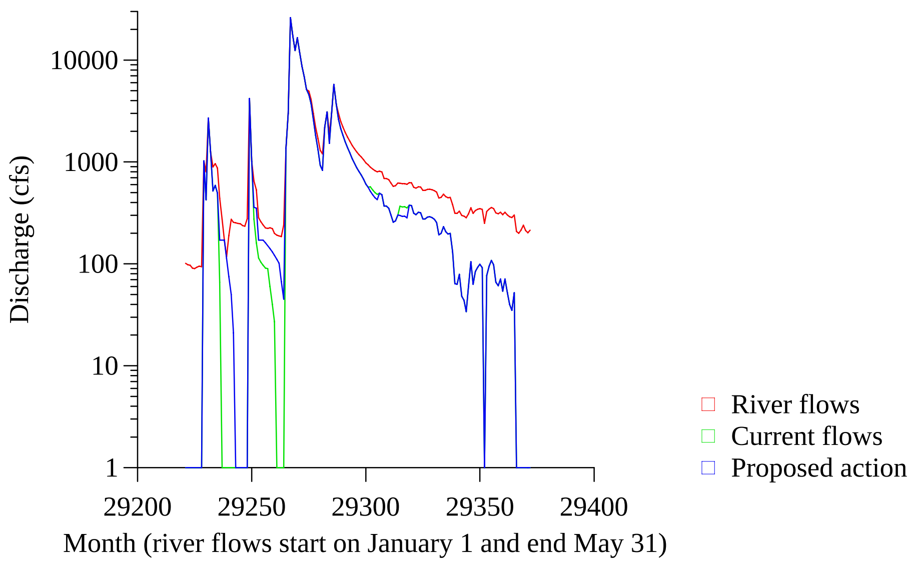
The following results are for:
WAT_YR = 78.000



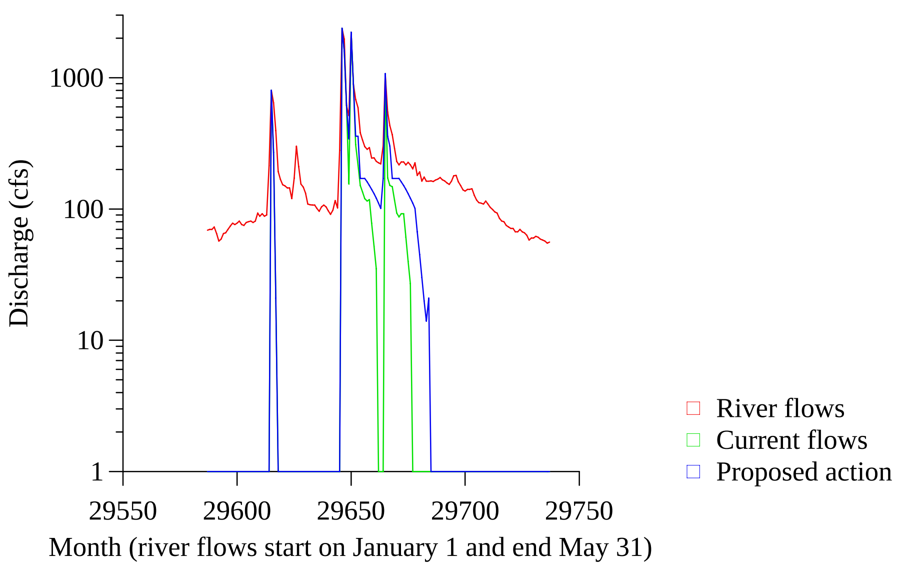
The following results are for:
WAT_YR = 79.000



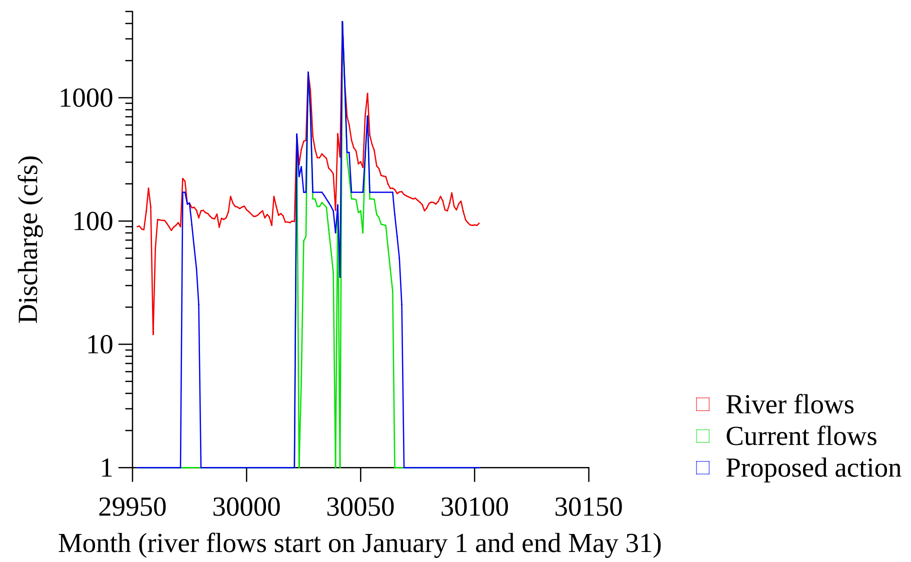
The following results are for:
WAT_YR = 80.000



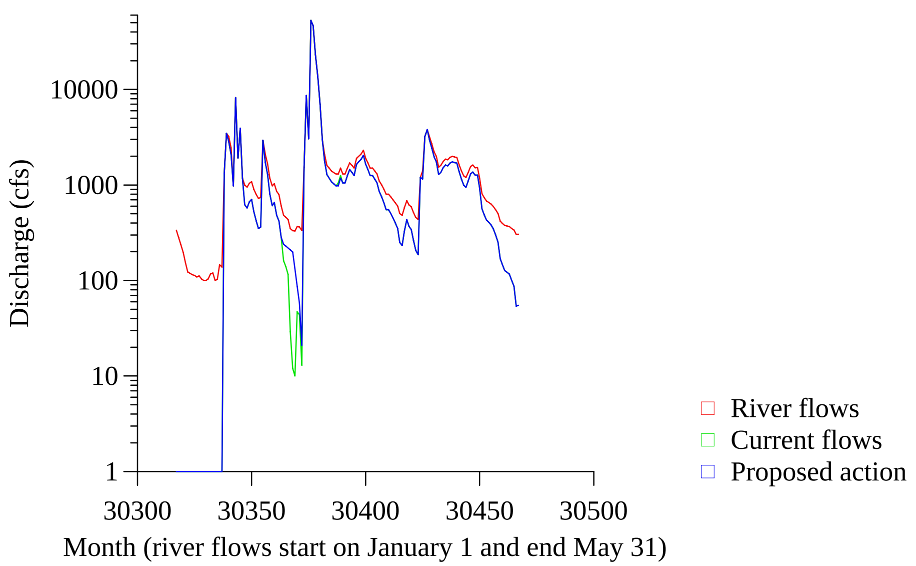
The following results are for:
WAT_YR = 81.000



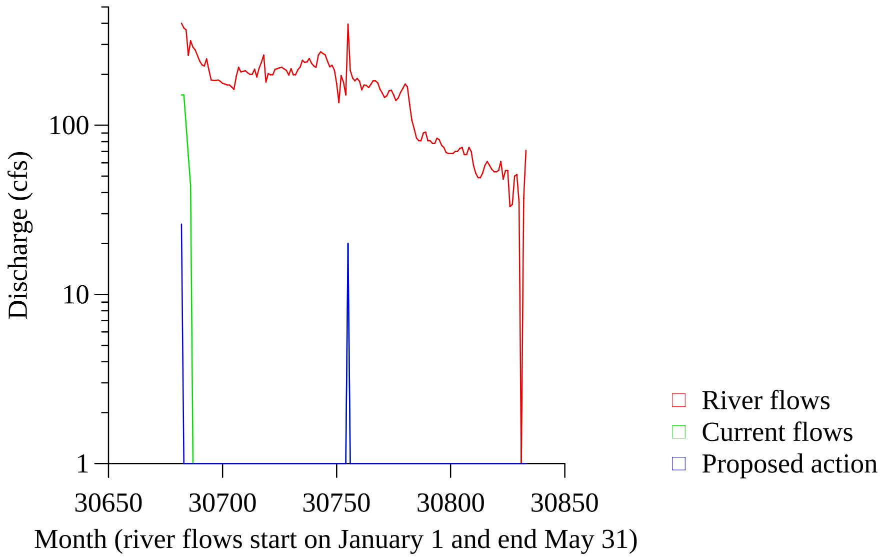
The following results are for:
WAT_YR = 82.000



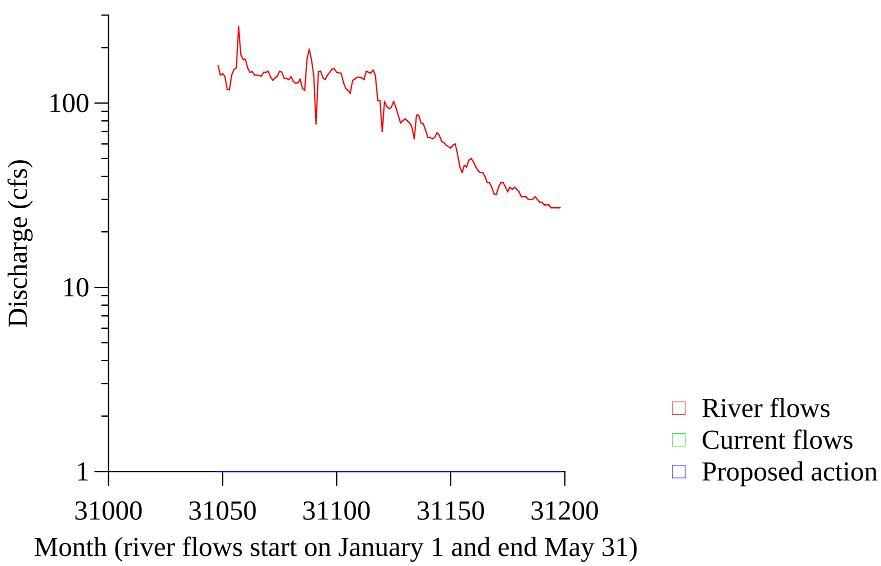
The following results are for:
WAT_YR = 83.000



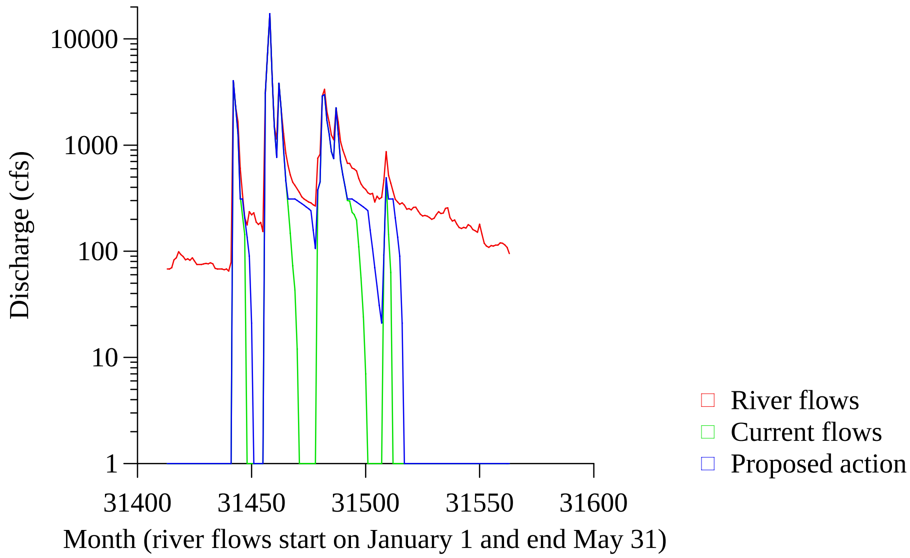
The following results are for:
WAT_YR = 84.000



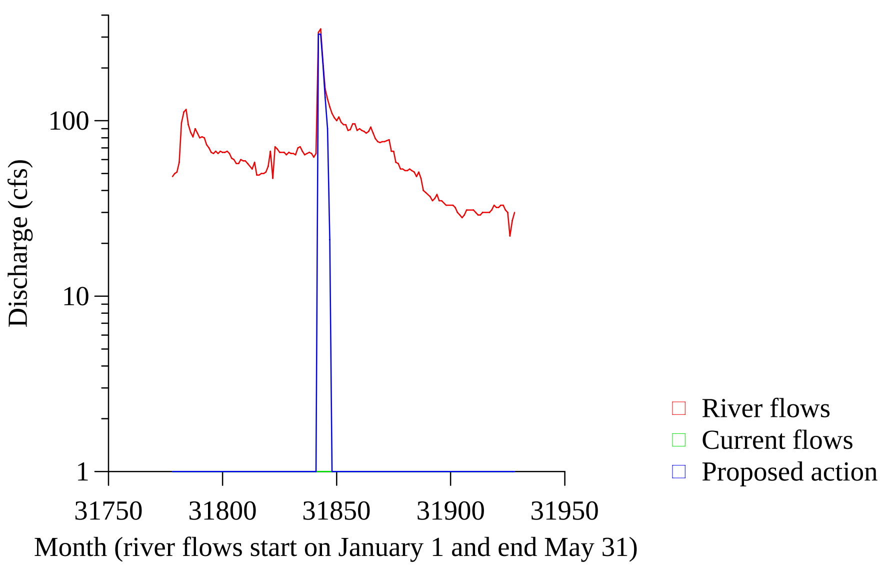
The following results are for:
WAT_YR = 85.000



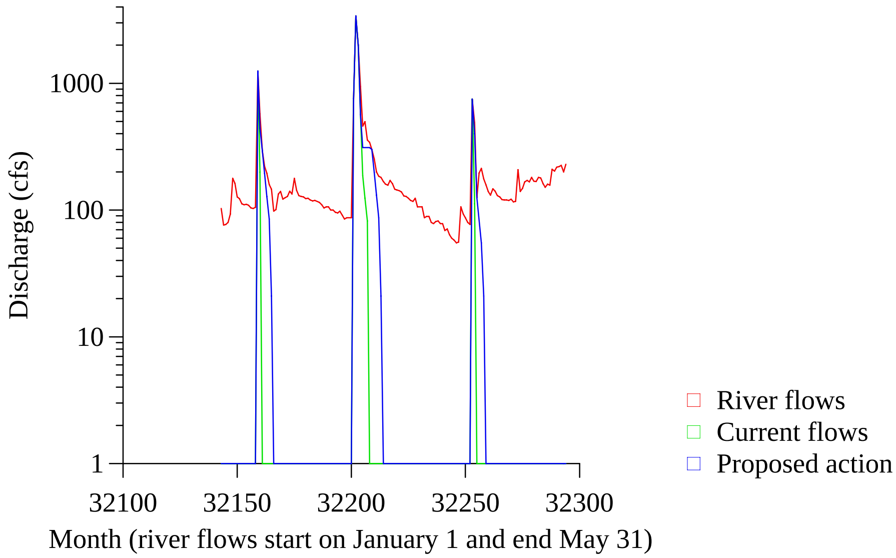
The following results are for:
WAT_YR = 86.000



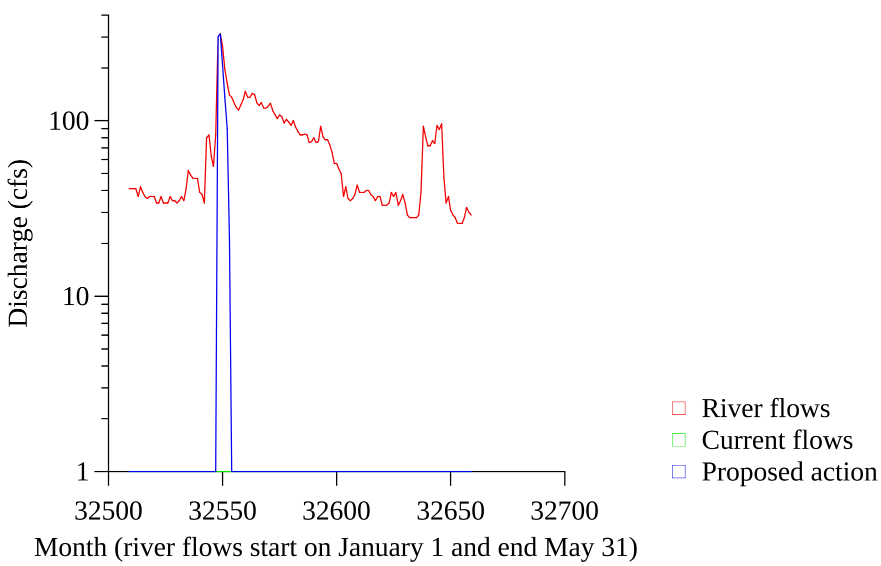
The following results are for:
WAT_YR = 87.000



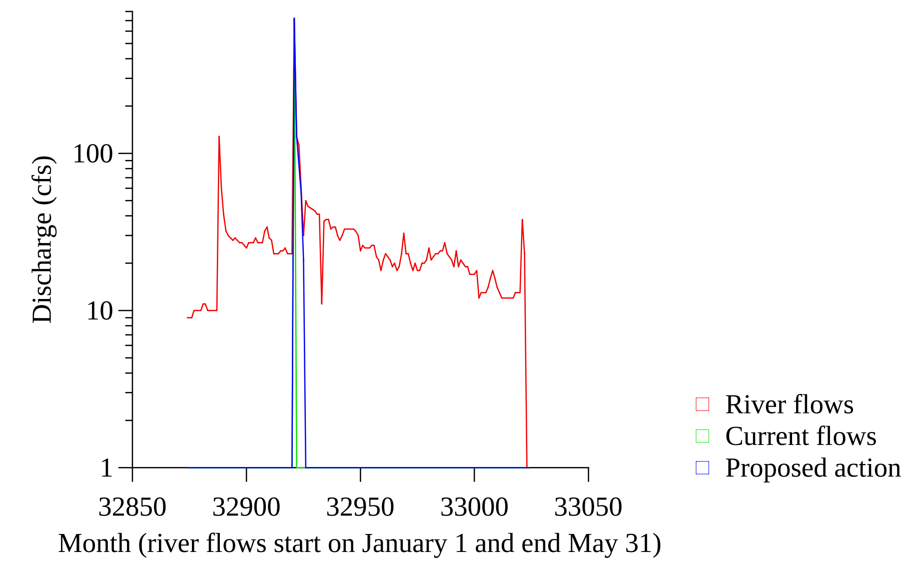
The following results are for:
WAT_YR = 88.000



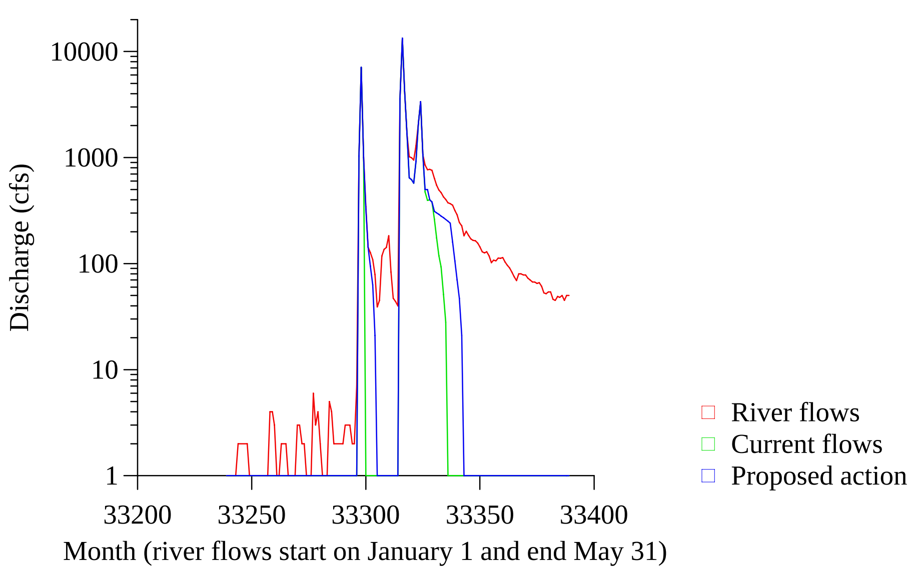
The following results are for:
WAT_YR = 89.000



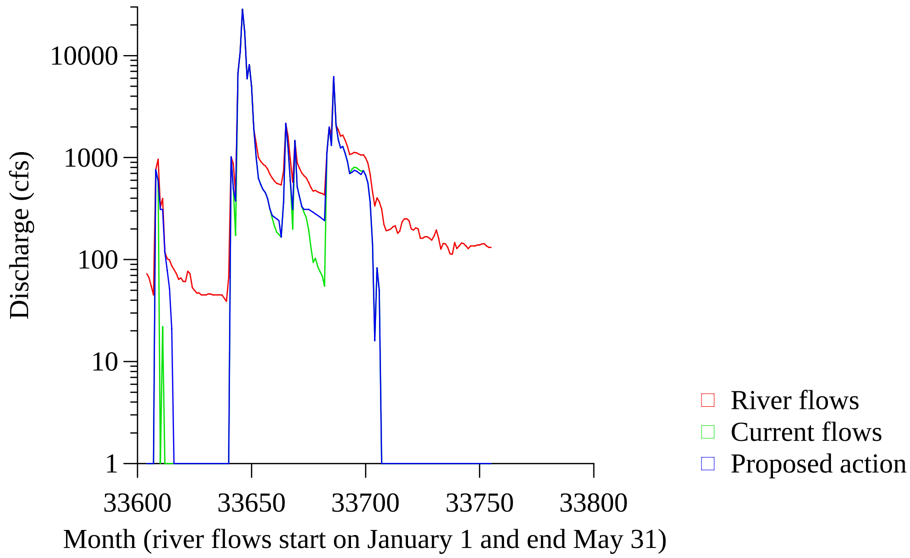
The following results are for:
WAT_YR = 90.000



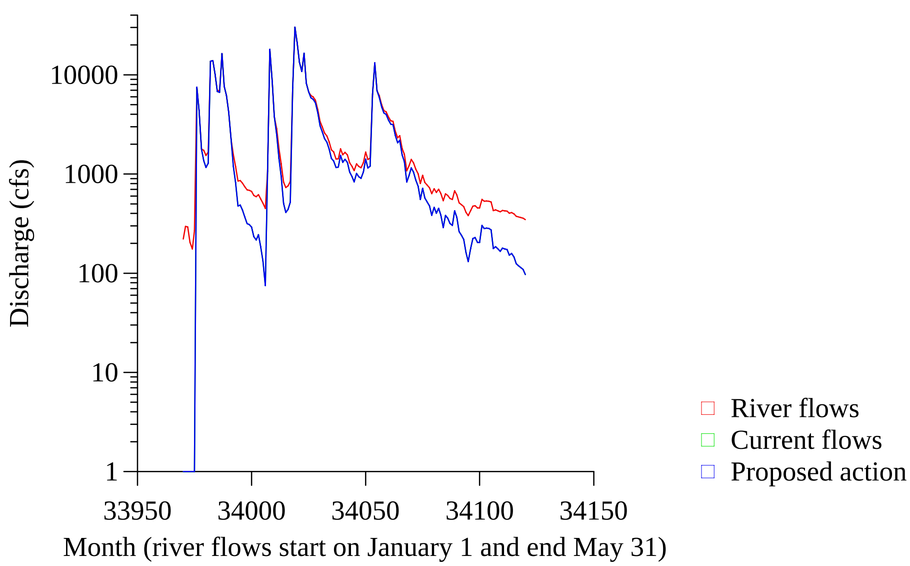
The following results are for:
WAT_YR = 91.000



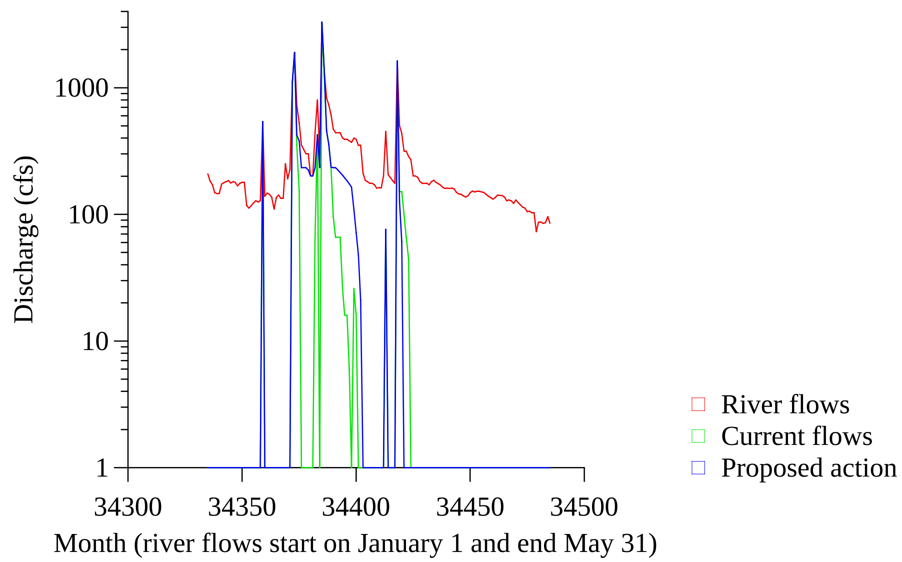
The following results are for:
WAT_YR = 92.000



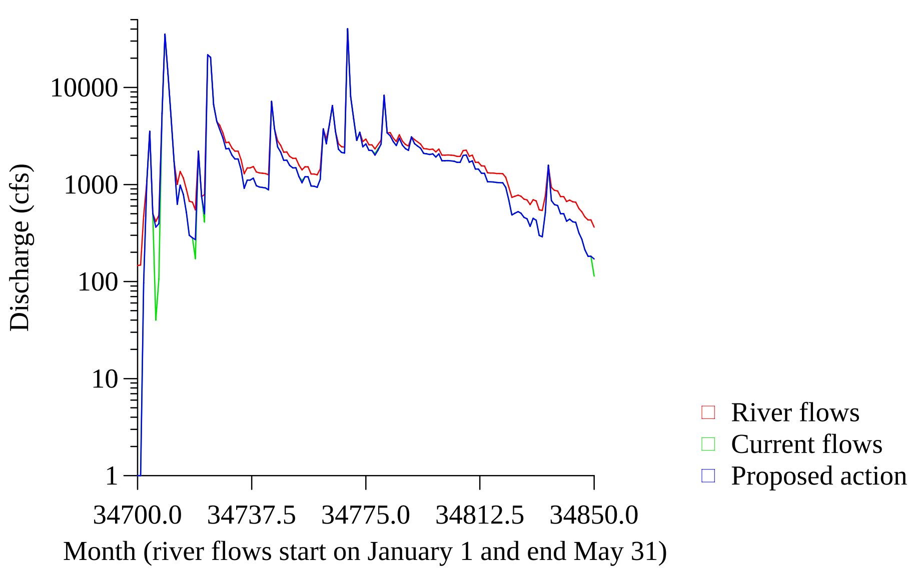
The following results are for:
WAT_YR = 93.000



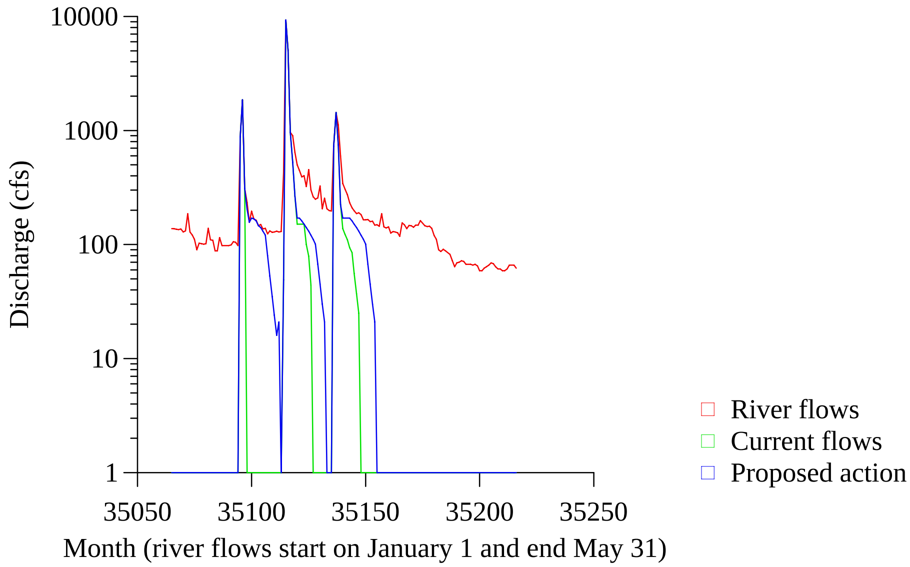
The following results are for:
WAT_YR = 94.000



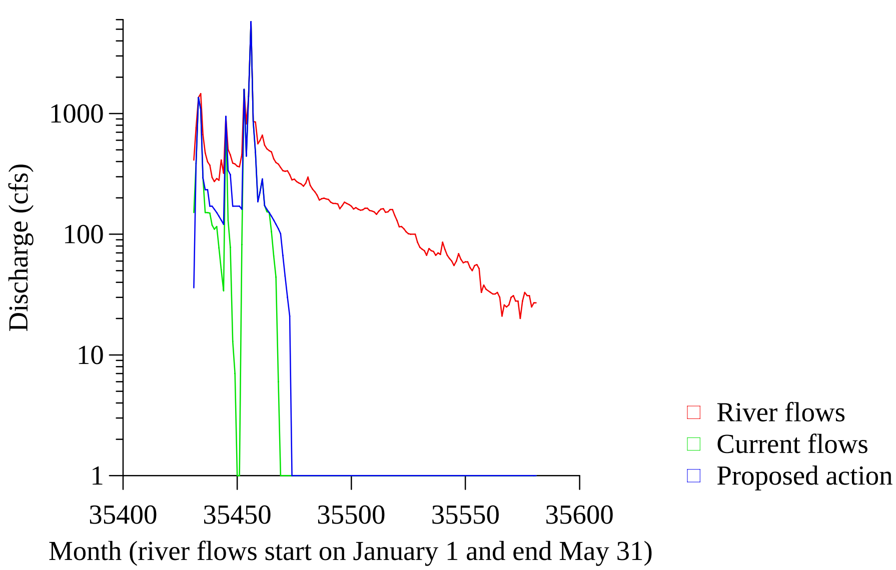
The following results are for:
WAT_YR = 95.000



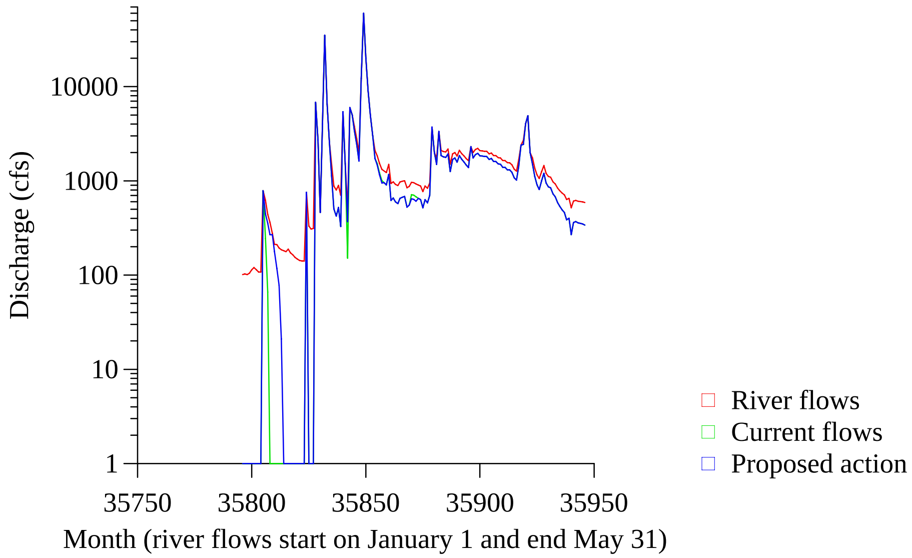
The following results are for:
WAT_YR = 96.000



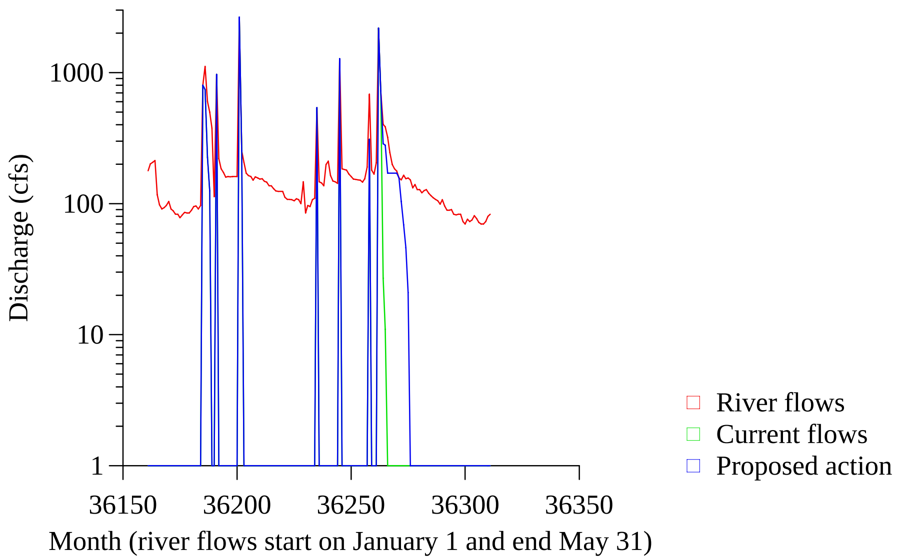
The following results are for:
WAT_YR = 97.000



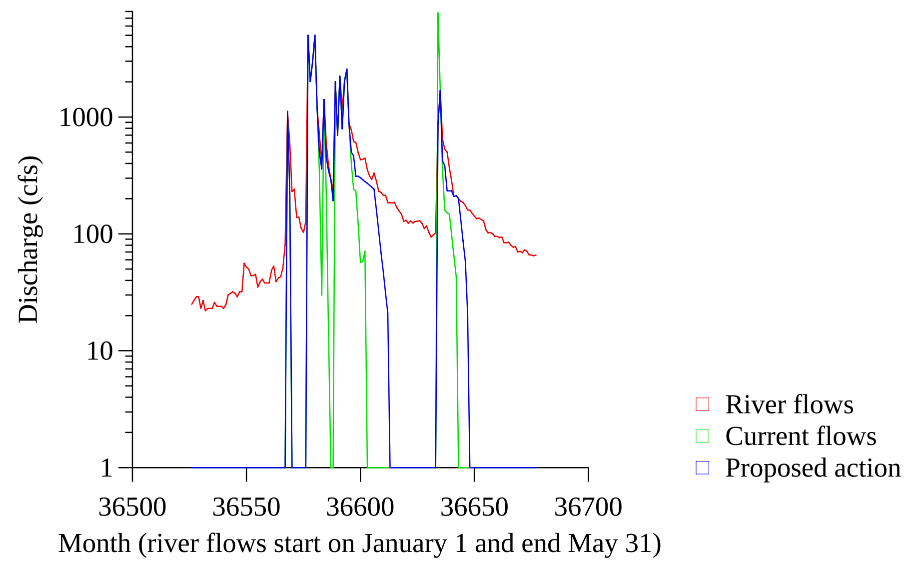
The following results are for:
WAT_YR = 98.000



The following results are for:
WAT_YR = 99.000



The following results are for:
WAT_YR = 2000.000



The following results are for:
WAT_YR = 2001.000