Appendix C

Minimum Instream Flow Requirements (Agreed Flows)

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SANTA CRUZ WATER RIGHTS PROJECT MINIMUM INSTREAM FLOW REQUIREMENTS (AGREED FLOWS)

PREPARED FOR:

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1 INTRODUCTION

1.1 Report Purpose

The purpose of this report is to provide necessary supporting information about the instream flow requirements (Agreed Flows) that the City of Santa Cruz (City) has negotiated with the California Department of Fish and Wildlife (CDFW) and the National Marine Fisheries Service (NMFS) as part of the development of a pending Anadromous Salmonid Habitat Conservation Plan (ASHCP) (City of Santa Cruz 2021). The pending ASHCP will provide for California Endangered Species Act (CESA) and Federal Endangered Species Act (ESA) compliance for City operation and maintenance activities that may affect special-status anadromous salmonids, specifically the Central California Coast coho salmon (coho) (*Oncorhynchus kisutch*), a federally and state listed endangered species, and the Central California Coast steelhead (steelhead) (*Oncorhynchus mykiss*), a federally listed threatened species.

1.2 Relationship to Santa Cruz Water Rights Project

The Santa Cruz Water Rights Project (Proposed Project) would include modifying City water rights to incorporate the Agreed Flows into both pre-1914 rights on the North Coast streams and post-1914 permits and licenses on the San Lorenzo River and Newell Creek to improve instream habitat and flow conditions for coho and steelhead. While it is expected that Agreed Flows will be further codified through the ASHCP process and a Streambed Alteration Agreement with CDFW, the Proposed Project would commit the City to these flows regardless of the outcomes of these processes.

1.3 Report Contents

The report provides background on the pending ASHCP relevant to the Agreed Flows, discusses the process of developing the Agreed Flows, provides the Agreed Flows tables and measures, and compares the Agreed Flows to the interim bypass flows requirements agreed to by CDFW and the City as part of an April 2018 agreement between these two entities (see Attachment 1). This document was developed based on the administrative draft ASHCP prepared by the City of Santa Cruz.

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2 HABITAT CONSERVATION PLAN BACKGROUND

The City has applied for an incidental take permit (ITP) from NMFS pursuant to section 10(a)(1)(B) of the ESA, as amended (16 U.S.C. 1531 *et seq.*) to incidentally take the federally threatened Central California Coast steelhead *(Oncorhynchus mykiss)* and federally endangered Central California Coast coho *(Oncorhynchus kisutch)*. The ESA prohibits the unauthorized "take"[1] of a wildlife species that is listed as endangered or, if the necessary regulations have been adopted, for threatened species. The ASHCP and ITP would provide incidental take permit coverage for a wide range of City activities called "Covered Activities". These Covered Activities include operation, maintenance and repair of the City's water supply and water system facilities; operation and maintenance of the City's municipal facilities; and management of City lands. The City is requesting that the ESA section 10(a)(1)(B) permit be issued for a period of 30 years.

The ASHCP, developed in close coordination with NMFS and the CDFW over a thirteen-year period, provides the basis for the issuance of an incidental take permit under the ESA. This HCP further provides the basis for issuance of an incidental take permit under Section 2081(b) of the CESA.

2.1 Plan Area

The area covered by this HCP (Plan Area) is located on the central coast of California in Santa Cruz County, approximately 70 miles south of San Francisco. The Plan Area is contained on the Davenport, Santa Cruz and Felton U.S. Geological Survey 7.5-minute quadrangles. The total watershed and water service/urban areas within the Plan Area are approximately 176 square miles and include three geographically distinct areas: the North Coast Unit, the San Lorenzo River Unit, and the City Urban Center Unit, as well as the water service areas outside the City limits.

2.2 Covered Species

Steelhead (*Oncorhynchus mykiss*)

Steelhead inhabiting the drainages within the Plan Area are part of the Central California Coast Distinct Population Segment (DPS) listed as threatened under the federal ESA (NMFS 2006). The California Coast DPS consists entirely of winter-run steelhead and extends from the Russian River south to and including Aptos Creek in the southern end of Santa Cruz County. The Plan Area includes streams that are located in the critical habitat designation for CCC Steelhead (NMFS 2005a).

[1] "Take" includes various activities that may result in injury or death of a species, including habitat modification.

Steelhead life history is diverse and adaptive, providing the flexibility to survive in varied environmental conditions naturally occurring through their range and within their natal watershed. In general, steelhead grow and mature in the ocean and spawn in freshwater. In central California, adult steelhead enter coastal streams during the wet season in association with increased runoff. The majority of steelhead enter freshwater from December through March or April, and spawn relatively soon after entering freshwater. Spawning frequently occurs in the tail-end of pools, glides, or runs where the female buries her eggs in pockets (or redds) excavated in a gravel-cobble substrate (Shapovalov and Taft 1954). The length of time it takes eggs to hatch is dependent on water temperature with hatching in about 30 days at 51°F and longer at cooler temperatures. Embryos remain in gravel until they are fully developed and ready to begin feeding, then young steelhead (or fry) typically disperse to the stream margins in close vicinity of the redd. As the fish grow, they move to areas with more suitable feeding and hiding conditions (e.g., heads of pools, pocket water, etc.).

Juvenile steelhead can spend 1 to 3 years in freshwater before beginning physiological processes that prepare them for life in seawater (known as smoltification). Steelhead begin the process of smoltification most commonly at a size of 150-200 mm (6 to 8 inches) and migrate downstream to the ocean as early as the fall, but most commonly in the spring (March - May). Steelhead may spend 1 to 2 years in the ocean before reaching maturity and returning to the natal stream to spawn (Shapovalov and Taft 1954).

Steelhead are unusual among the Pacific salmonids because they do not necessarily die after spawning. After spawning, some of these fish, called kelts, remain in fresh water for a short period of time, then return to the ocean (Barnhart 1986). Steelhead are also unusual in that they have several life history strategies. Young steelhead produced from common parents have the capability of following distinctly different forms. Some may remain in freshwater even when the ocean is readily available. These fish can reach sexual maturity and spawn without ever entering the ocean and are also known as rainbow trout. Furthermore, the progeny of these “resident” spawning fish can produce young that assume an anadromous life history and leave the freshwater environs as juveniles to grow and mature in the ocean before returning to spawn. This life history variability provides greater potential for population persistence, especially in areas with episodic periods of prolonged drought that can prevent fish from entering or leaving the stream for several generations (Titus et al. *In prep*.).

Steelhead populations in the North Coast streams are relatively small due to the short lengths of anadromous habitat. Suitable rearing habitat exists in the coastal streams; however, the extent of this habitat is limited by the presence of natural barriers to upstream passage. Sedimentation is also high in these streams, which affects the amount of spawning habitat (embedding gravels), the amount of rearing habitat (infilling pools), and production of salmonid food.

Additionally, available analyses suggest that steelhead have declined in the Central California Coast DPS and in the San Lorenzo River from historic levels. The primary factors limiting salmonid production in the San Lorenzo River watershed are related to excessive accumulation of fine sediments in rearing and spawning habitat, reductions in streamflow during critical life history phases, impediments to adult passage, and inhospitable water temperature conditions (Alley et al. 2004, Ricker and Butler 1979).

Coho (*Oncorhynchus kisutch*)

In the Plan Area, coho are part of the Central California Coast ESU, which is listed as endangered under the FESA. The Central California Coast ESU extends from Punta Gorda in Humboldt County south to, and including, Aptos Creek (NMFS 2005b). Critical habitat has been designated for the Central California Coast ESU and includes the accessible portions of the streams in the Plan Area.

Central California represents the southern margin of the species' natural distribution, and coastal streams of Santa Cruz County constitute the southernmost extent of coho distribution. In Santa Cruz County, historically coho are believed to have used Gazos, Waddell, Scott, San Vicente, Soquel, and Aptos creeks and the San Lorenzo River (CDFW 2003). During surveys from 2000-2002, coho were found in Gazos, Waddell and Scott creeks.

Coho spawning migrations from the ocean to freshwater streams and rivers usually begin after the first heavy rains in late fall or winter. The timing of their migration varies somewhat throughout their range, but coho typically return to fresh water during November through February in Central California, with a peak in December and January. Females construct redds, typically near the head of a riffle in gravel and small cobble substrate. The female may dig several pits to complete spawning, probably laying a few hundred eggs in each pit.

Newly hatched fry (embryos) remain in the gravel for approximately 3 weeks before emerging and schooling in still, shallow water along stream margins. As they grow during the spring, juvenile coho disperse to pools where they set up individual territories. After spending the ensuing summer, fall and winter in the stream, the immature yearling coho begin to migrate downstream toward the ocean in spring. During this time, juveniles undergo smoltification. Growth in freshwater varies with a number of factors, but typically smolts leaving California streams as "yearlings" (12-15 months old) measure 8 to 15 centimeters (cm). Some juveniles may achieve even larger sizes before emigration by staying 2 years in the stream (Moyle 2002). Migration to the ocean typically peaks from late April to mid-May if conditions are favorable (Moyle 2002). After entering the ocean, immature coho initially remain inshore, close to the parent stream. Gradually, they spread out, over the continental shelf, where they grow much more rapidly than in the stream.

California coho have a 3-year life cycle with little variation. About half is spent in freshwater and half spent in salt water. After 2 summers of growing and sexually maturing in the ocean, coho return to their natal streams as 3-year-olds to spawn and die.

Freshwater habitat requirements for coho include adequate cover, food supply, and optimal water temperatures of 54°-57°. Coho primary habitat includes pools with extensive cover. The factors most limiting to juvenile coho are high summer water temperatures, poor summer and winter habitat quality, and predation (Moyle 2002).

Central California represents the southern margin of the species' natural distribution, and coastal streams of Santa Cruz County constitute the current southernmost extent of coho distribution (NMFS 2016c). Historically, coho were found in as many as 50 coastal drainages in San Mateo and Santa Cruz counties but spawning runs were limited to 11 stream systems by the 1960's (Anderson 1995). More recently, the two independent populations in the Santa Cruz Mountain diversity strata (Pescadero Creek and San Lorenzo River) were considered likely extirpated in the last NMFS 5-year status review (NMFS 2016). Factors limiting coho in Santa Cruz County include high summer temperatures; extreme hydrologic variability typical of the Central California Coast that results in frequent droughts, low flows for early upstream passage during November and December, which is critical for coho, and excessively high flood flows that are destructive to redds during late winter and early spring; and the narrow and early coho spawning season and inflexible coho life history that subject the coho to catastrophic losses on a frequent basis and provide little ability to rebound during brief periods of more suitable conditions. In addition, the high sedimentation levels and lack of pool development in many of the streams are at least as limiting for coho as for steelhead.

2.3 Conservation Strategy

The conservation strategy was developed from the City's review of available data and literature on the species and extensive field data collection, including the status and features of populations and habitat conditions within each stream. The City coordinated closely with NMFS and CDFW to address research methodologies and results, and develop the conservation strategy. The primary focus of the City's conservation strategy is to avoid or minimize existing and potential effects of Covered Activities to maximum extent practicable. The avoidance and minimization measures define specific tools and techniques and measurable steps to meet HCP objectives and achieve desired future conditions. The avoidance and minimization measures may involve the removal of an activity from a particular location or the scheduling of an activity to occur during a period in which the species is unlikely to be affected. Avoidance and minimization measures may also apply constraints or limitations on an activity that allow it to proceed while avoiding or minimizing effects to species.

A major element of the conservation strategy involved identification of instream flows (Agreed Flows) at City diversions to minimize the effect of diversions on habitat conditions for steelhead and coho. The conservation strategy specifies Agreed Flows for each of the City's sources that would be maintained through flow bypasses at the City diversions. Agreed Flows and the strategy for implementing them are described in detail in Section 3.

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3 AGREED FLOWS

3.1 Agreed Flows Development Process

Early work in developing the HCP focused on understanding the relationship between flow and habitat quality downstream of each diversion. The goal was to develop instream flow targets through an iterative process that considered both the habitat values of instream flows as well as the ability of the City to meet its water supply obligations. Instream flow alternatives were modeled using the City's water supply operations model (Confluence® Model) to understand the effect of various flow alternatives on the City's water supplies (see Appendix D-2 for additional information about this model). The City also developed a fisheries habitat-based model to analyze the effect that the various flow alternatives would have on covered species habitat (see Appendix D-3 for additional information about this model). This process was the combined effort of a technical working group convened by the City beginning in 2005 and composed of resource agency personnel representing NMFS and CDFW, City staff, and consultants.

The City submitted a proposal for instream bypass flows and other conservation measures in June 2012 to the technical working group (City of Santa Cruz 2012). CDFW responded to this proposal with comments and proposed modifications to the flow proposal (CDFW 2012). The City worked to resolve comments provided by CDFW and completed modeling studies of several iterations of the CDFW proposal that ultimately became the proposal known as DFG-5. In 2014, the City Council convened a Water Supply Advisory Committee (WSAC) to engage a multi-disciplinary, stakeholder-driven process that would advise the Council on future water supply development.

Based on the information developed through field studies and iterative model runs, the WSAC convened by the City recommended that the City adopt the flow alternative that was the most protective of the covered species (CDFW DFG-5) and develop new water supply strategies that would make it practicable for the City to provide the flows for Covered Species while meeting its water supply obligations. DFG-5 provided the basis from which the final bypass flows were negotiated by the City, NOAA, and CDFW, and adopted with minor modifications.

3.2 Agreed Flows Measures and Tables

The Agreed Flows comprise a schedule of instream flows (bypass flows) that would avoid and minimize effects on steelhead and coho due to operation of the Laguna Creek, Liddell Spring, Majors Creek, Tait and Felton Diversions, as well as the Loch Lomond Reservoir. The Agreed Flows are those flows needed to maintain habitat for steelhead and coho during all freshwater life stages (migration, spawning, incubation, and rearing) over a range of Hydrologic Condition Types (see Table 1). The Hydrologic Condition Types are based on the record of cumulative daily average flow by water year (October 1–September 30) at the Big Trees gage on the San Lorenzo River. To

develop the Hydrologic Condition Types, cumulative flow was calculated for each month in the record (water years 1937–2015), sorted from lowest to highest, and split into five equal parts representing a range of hydrologic conditions from driest to wettest conditions. Operationally, the Hydrologic Condition Type would be determined each month based on conditions for the preceding month, and the bypass flows would be established based on the month and hydrologic condition as described in Table 1.

Table 1. Agreed Flows Hydrologic Condition Types

Month	Flow Ranges Used to Determine Monthly Hydrologic Condition Type[1] (cfs) Using San Lorenzo River End-of-Month Cumulative Daily Flow[2]				
	Hydrologic Condition 5 (driest)	*Hydrologic Condition 4 (dry)*	*Hydrologic Condition 3 (normal)*	*Hydrologic Condition 2 (wet)*	*Hydrologic Condition 1 (wettest)*
Oct	≤459	460 – 539	540 – 709	710 – 875	>875
Nov	≤1,186	1,187 – 1,497	1,498 – 1,827	1,828 – 2,485	>2,485
Dec	≤2,397	2,398 – 3,134	3,135 – 5,642	5,643 – 10,196	>10,196
Jan	≤4,322	4,323 – 8,456	8,457 – 16,694	16,695 – 28,019	>28,019
Feb	≤8,442	8,443 – 16,368	16,369 – 29,140	29,141 – 42,995	>42,995
Mar	≤13,004	13,005 – 22,948	22,949 – 35,371	35,372 – 57,968	>57,968
Apr	≤14,203	14,204 – 24,491	24,492 – 39,487	39,488 – 67,884	>67,884
May	≤15,448	15,449 – 25,279	25,280 – 41,659	41,660 – 71,412	>71,412
Jun	≤16,005	16,006 – 26,116	26,117 – 43,123	43,124 – 73,420	>73,420
Jul	≤16,364	16,365 – 26,819	26,820 – 44,073	44,074 – 74,718	>74,718
Aug	≤16,653	16,654 – 27,355	27,356 – 44,799	44,800 – 75,591	>75,591
Sep	≤16,978	16,979 – 27,843	27,844 – 45,398	45,399 – 76,368	>76,368

Notes: cfs = cubic feet per second.

1 The Hydrologic Condition Types are based on the record of cumulative daily average flow by water year (water years 1937–2015) at the Big Trees gage on the San Lorenzo River.

2 To implement the Agreed Flows, the Hydrologic Condition type is determined on the first day of each month based upon the previous month's San Lorenzo River end-of-month cumulative flow for the Water Year. Water Year is defined as the 12-month period from October 1 through September 30.

a. The end-of-month cumulative daily flow is calculated by adding the San Lorenzo River daily flows, as measured at the Big Trees Gage, from the first day of the Water Year to the last day of the month.

b. The flow ranges for the month are then reviewed to determine within which Hydrologic Condition type this end-of-month cumulative daily flow falls.

c. This Hydrologic Condition type is used until the first day of the next month to determine bypass flow conditions under the Agreed Flows across all City of Santa Cruz source waters.

As indicated in Section 1.2, the Proposed Project would include modifying City water rights to incorporate the Agreed Flows the City negotiated with CDFW and NMFS during development of the pending ASHCP to better protect federally listed coho and steelhead in all watersheds from which the City diverts water. The Agreed Flows would be incorporated into both pre-1914 rights

on the North Coast streams and post-1914 permits and licenses on the San Lorenzo River and Newell Creek to improve instream habitat and flow conditions for these fish species. Specific flow measures and tables that encompass the Agreed Flows are also provided. A measure that all diversions share in common is to limit operational flow reductions such that change in stage is no greater than 0.16 feet per hour when fry may be present (January 15 through May 31) and no greater than 0.3 feet per hour at other times.

Laguna/Reggiardo Creek Diversion

The technical working group assigned Laguna Creek a high priority for restoration of flows relative to the other North Coast streams covered in the HCP due to underlying habitat conditions that have a higher potential to support recovery of salmonids. It is the largest watershed and has the longest reach of anadromous habitat of all the North Coast streams where the City diverts water. It also has a nearly intact lagoon system that can be very productive for steelhead. Laguna Creek also has the potential to support coho as evidenced by recent observations of juveniles there.

A schedule of instream flow targets to minimize effects of the Laguna/Reggiardo Diversion is presented in Table 2 and described as specific measures as follows. The numbers for the measures are from the ASHCP, so those numbers are not consecutive, and not all numbered ASHCP measures appear in this appendix, as not all measures are applicable to the Proposed Project and associated Agreed Flows.

The instream flow targets in Table 2 apply to the City-maintained stream gage in the anadromous reach of Laguna Creek, a short distance upstream of State Highway 1. The point of diversion is approximately 4 miles upstream of the anadromous gage and there is accretion of flows from other sources including Y Creek. Although the point of compliance is at the anadromous gage, other gages will also be used to ascertain effects of these other diversions on flows and habitat availability in the anadromous reach.

Measure WS-8: Provide 2 cfs minimum bypass flow for rearing juvenile steelhead in the anadromous reach of Laguna Creek at all times. This is approximately the 44% exceedance flow for August in the historical hydrologic record and equates to about 70% of the maximum habitat index for steelhead rearing in August in the reach and approximately 99% of the maximum habitat index for coho rearing.

Measure WS-9: Provide minimum bypass flows for adult migration in the anadromous reach with a lower flow threshold of 10.6 cfs and an upper threshold of 15.5 cfs in December through March of all hydrologic conditions and April when hydrologic condition is 0-60% whenever flow would be at this level without City diversions.

Measure WS-10: Provide minimum bypass flows for spawning in the anadromous reach of 9.4 cfs during December through May for 14 days following any adult migration period (providing 80% of peak habitat index for steelhead spawning and 97% of the peak for coho).

Measure WS-11: Provide bypass flows for egg incubation in January through May in all hydrologic conditions. The incubation flow in Laguna Creek is 4.0 cfs. Incubation flows are provided for 60 days after the last spawning day or until May 30, whichever is earliest.

Measure WS-12: Provide bypass flows for smolt migration in the anadromous reach during January through May in 0-80% hydrologic conditions (hydrologic conditions 1-4), and for at least 3 consecutive days per week in 80%-100% conditions (hydrologic condition 5). The smolt migration minimum is 3.8 cfs. For background on the various hydrologic conditions, see Appendix 8: *Anadromous Salmonid HCP Models*.

Table 2. Agreed Flows for Laguna Creek Diversion, as Measured at the Laguna Creek Anadromous Gage[1]

Month	Rearing (Base Flow) (cfs)					Adult Migration (cfs)	Spawning[2] (cfs)	Egg Incubation[3] (cfs)	Smolt Out-migration[4] (cfs)
	Hydrologic Condition 5 (driest)	*Hydrologic Condition 4 (dry)*	*Hydrologic Condition 3 (normal)*	*Hydrologic Condition 2 (wet)*	*Hydrologic Condition 1 (very wet)*				
Jan	2.0	2.0	2.0	2.0	2.0	11.3/15.5	9.4	4.0	3.8
Feb	2.0	2.0	2.0	2.0	2.0	11.3/15.5	9.4	4.0	3.8
Mar	2.0	2.0	2.0	2.0	2.0	11.3/15.5	9.4	4.0	3.8
Apr	2.0	2.0	2.0	2.0	2.0	11.3/15.5[5]	9.4	4.0	3.8
May	2.0	2.0	2.0	2.0	2.0	—	9.4	4.0	3.8
Jun	2.0	2.0	2.0	2.0	2.0	—	—	—	—
Jul	2.0	2.0	2.0	2.0	2.0	—	—	—	—
Aug	2.0	2.0	2.0	2.0	2.0	—	—	—	—
Sep	2.0	2.0	2.0	2.0	2.0	—	—	—	—
Oct	2.0	2.0	2.0	2.0	2.0	—	—	—	—
Nov	2.0	2.0	2.0	2.0	2.0	—	—	—	—
Dec	2.0	2.0	2.0	2.0	2.0	11.3/15.5	9.4	—	—

Notes: cfs = cubic feet per second.

1 The required flow is determined by the life stage requiring the highest flow in any given month.

2 Provided for 14-day period after any potential migration event.

3 Provided for 60 days following occurrence of last spawning flow or May 31, whichever occurs first.

4 Provided in Hydrologic Conditions 1–4 and for 3 consecutive days per week in Hydrologic Condition 5 in March, April, and May.

5 April adult migration flows provided in Hydrologic Conditions 1–3.

Liddell Spring Diversion

Restoration of flow in Liddell Creek was given lower priority than Laguna Creek and the San Lorenzo River due to limited productive capacity for steelhead, lower suitability of habitat for coho, relatively short anadromous length, and relatively small size of the diversion relative to Laguna Creek and the San Lorenzo River. Productive capacity is limited due to excessive amounts of fine sediment and lack of a functional lagoon.

The instream flow targets in Table 3 apply to the City-maintained stream gage in the anadromous reach of Liddell Creek, a short distance upstream of Highway 1. The point of diversion is offstream from a point approximately 2 miles upstream of the anadromous gage and there is accretion of flows from other sources including the Middle Branch and West Branch of Liddell Creek. There are also other diverters in the watershed including the former CEMEX quarry, numerous wells in the recharge area for the creek, two alluvial wells near the confluence of the West and East Branches owned by the Coast Dairies and Land Co., and an agricultural diversion just upstream of Highway 1. The magnitude and timing of other diversions is not known with any certainty and cannot be predicted. The point of compliance is at the Anadromous Liddell gage; other gages will also be used to ascertain effects of these other diversions on flows and habitat availability in the anadromous reach.

The applicable conservation measures from the ASHCP are below. Their numbers are not consecutive, and not all numbered ASHCP measures appear in this appendix, as not all measures are applicable to the Proposed Project and associated Agreed Flows.

Measure WS-1: Provide 0.25 cfs minimum bypass flow for rearing juvenile steelhead in Liddell Creek in the two driest hydrologic conditions (80%-100% exceedance and 60%-80% exceedance).

Measure WS-2: Provide up to 5.2 cfs minimum bypass flow for rearing juvenile steelhead in the anadromous reach of Liddell Creek in normal, wet, and very wet hydrologic conditions (0%-60% exceedance). This provides approximately 76% of the maximum habitat index for steelhead rearing in the reach.

Measure WS-3: Provide minimum bypass flows for adult migration in the anadromous reach in December through April of 0%-60% hydrologic conditions with a lower flow threshold of 4.9 cfs and an upper threshold of 11.3 cfs whenever flow would be at this level without City diversions.

Measure WS-4: Provide minimum bypass flows for spawning in the anadromous reach in December through May of 0%-60% hydrologic conditions of 7.4 cfs for 14 days following any adult migration period (provides estimated 80% of peak habitat index for steelhead spawning and 97% of the peak for coho).

Measure WS-5: Provide bypass flows for egg incubation in January through May of 0%-60% hydrologic conditions. The incubation flow in Liddell Creek is 2.0 cfs. Incubation flows are provided for 60 days after the last spawning day or until May 30, whichever is earliest.

Measure WS-6: Provide bypass flows for smolt migration in the anadromous reach during January through May in 0-60% hydrologic conditions (hydrologic conditions 1-3), and for at least 3 consecutive days per week in March, April, and May in 60%-100% conditions (hydrologic conditions 4 and 5). The smolt migration minimum is 2 cfs.

Table 3. Agreed Flows for Liddell Spring Diversion, as Measured at the Liddell Creek Anadromous Gage[1]

Month	Rearing (Base Flow) (cfs)					Adult Migration[2] (cfs)	Spawning[3] (cfs)	Egg Incubation[4] (cfs)	Smolt Out-migration[5] (cfs)
	Hydrologic Condition 5 (driest)	*Hydrologic Condition 4 (dry)*	*Hydrologic Condition 3 (normal)*	*Hydrologic Condition 2 (wet)*	*Hydrologic Condition 1 (very wet)*				
Jan	0.25	0.25	2.9	3.6	4.7	4.9/11.3	7.4	2.0	2.0
Feb	0.25	0.25	4.6	3.9	5.1	4.9/11.3	7.4	2.0	2.0
Mar	0.25	0.25	3.5	4.8	5.2	4.9/11.3	7.4	2.0	2.0
Apr	0.25	0.25	3.0	4.3	4.6	4.9/11.3	7.4	2.0	2.0
May	0.25	0.25	2.6	3.3	4.0	—	7.4	2.0	2.0
Jun	0.25	0.25	2.0	2.4	2.9	—	—	—	—
Jul	0.25	0.25	1.6	1.9	2.2	—	—	—	—
Aug	0.25	0.25	1.4	1.7	1.8	—	—	—	—
Sep	0.25	0.25	1.3	1.5	1.6	—	—	—	—
Oct	0.25	0.25	1.5	1.5	1.6	—	—	—	—
Nov	0.25	0.25	1.8	1.9	1.9	—	—	—	—
Dec	0.25	0.25	2.1	2.6	3.0	14.9/11.3	7.4	—	—

Notes: cfs = cubic feet per second.

1 The required flow is determined by the life stage requiring the highest flow in any given month.

2 Provided in Hydrologic Conditions 1–3 only.

3 Provide for 14-day period after any potential migration event in Hydrologic Conditions 1–3.

4 Provided in Hydrologic Conditions 1–3 for 60-day period following occurrence of last spawning flow or May 31, whichever occurs first

5 Provided in Hydrologic Conditions 1–3, and for 3 consecutive days per week in March, April, and May in Hydrologic Conditions 4–5.

Majors Creek Diversion

Restoration of flow in Majors Creek was given lower priority than Laguna Creek and the San Lorenzo River due to the short anadromous reach length of about 0.7 miles and absence of a developed lagoon. It also has a relatively small diversion capacity of 2.1 cfs, relative to Laguna Creek at 6.3 cfs and the San Lorenzo River at Tait St at 12.2 cfs. A schedule of instream flow

targets to minimize effects of the Majors Creek diversion is presented in Table 4 and described as specific measures as follows.

The instream flow targets in Table 4 apply to the City-maintained stream gage in the anadromous reach of Majors Creek, immediately upstream of State Highway 1. The point of diversion is approximately 2 miles upstream of the anadromous gage and there is accretion of flows in the intervening reach. There are at least four known non-City operated diversions on Majors Creek (ENTRIX, Inc. 2004c) including three diversions operated by Edwards, two of which are located in the anadromous reach just upstream of the Highway 1 crossing. There are also several diversions upstream of the City diversion (Chris Berry, personal communication to Kindra Loomis, 2004, cited in ENTRIX, Inc. 2004c). Production numbers and season of diversion for the non-City diversions are unavailable and their impacts on Majors Creek hydrology are unclear. The point of compliance is at the anadromous gage; other gages will also be used to ascertain effects of other diversions on flows and habitat availability in the anadromous reach.

The applicable conservation measures from the ASHCP are below. Their numbers are not consecutive, and not all numbered ASHCP measures appear in this appendix, as not all measures are applicable to the Proposed Project and associated Agreed Flows.

Measure WS-14: Provide 0.25 cfs minimum bypass flow for rearing juvenile steelhead in Majors Creek in the two driest hydrologic conditions (80%-100% and 60%-80%).

Measure WS-15: Provide up to 4.7 cfs minimum bypass flow for rearing juvenile steelhead in the anadromous reach of Majors Creek in normal, wet, and very wet hydrologic conditions (0%-60%). This is more than the maximum August flow and approximately the 10% exceedance flow for June in the historical hydrologic record and equates to about 86% of the maximum habitat index for steelhead in June.

Measure WS-16: Provide minimum bypass flows for adult migration in the anadromous reach in December through April of 0%-60% hydrologic conditions with a lower flow threshold of 9 cfs and an upper threshold of 16 cfs whenever flow would be at this level without City diversions.

Measure WS-17: Provide minimum bypass flows for spawning in the anadromous reach in December through May of 0%-60% hydrologic conditions of 12.1 cfs for 14 days following any adult migration period (provides estimated 80% of peak habitat index for steelhead spawning and 97% of the peak for coho).

Measure WS-18: Provide bypass flows for egg incubation in January through May of 0%-60% hydrologic conditions. The incubation flow in Majors Creek is 2.9 cfs. Incubation flows are provided for 60 days after the last spawning day or until May 30, whichever is earliest.

Measure WS-19: Provide bypass flows for smolt migration in the anadromous reach during January through May in 0-60% hydrologic conditions (hydrologic conditions 1-3), and for at least 3 consecutive days per week in March, April, and May in 60%-100% conditions (hydrologic conditions 4 and 5). The smolt migration minimum is 3.4 cfs.

Table 4. Agreed Flows for Majors Creek Diversion, as Measured at the Majors Creek Anadromous Gage[1]

Month	Rearing (Base Flow) (cfs)					Adult Migration[2] (cfs)	Spawning[3] (cfs)	Egg Incubation[4] (cfs)	Smolt Out-migration (cfs)
	Hydrologic Condition 5 (driest)	*Hydrologic Condition 4 (dry)*	*Hydrologic Condition 3 (normal)*	*Hydrologic Condition 2 (wet)*	*Hydrologic Condition 1 (very wet)*				
Jan	0.25	0.25	2.2	2.7	4.1	9.0/16.0	12.1	2.9	3.4
Feb	0.25	0.25	4.1	3.0	4.4	9.0/16.0	12.1	2.9	3.4
Mar	0.25	0.25	2.4	4.3	4.7	9.0/16.0	12.1	2.9	3.4[5]
Apr	0.25	0.25	1.7	3.1	3.2	9.0/16.0	12.1	2.9	3.4[5]
May	0.25	0.25	1.4	1.8	2.4	—	12.1	2.9	3.4[5]
Jun	0.25	0.25	1.0	1.2	1.6	—	—	—	—
Jul	0.25	0.25	0.8	1.0	1.1	—	—	—	—
Aug	0.25	0.25	0.7	0.8	0.9	—	—	—	—
Sep	0.25	0.25	0.6	0.7	0.7	—	—	—	—
Oct	0.25	0.25	0.8	0.9	0.8	—	—	—	—
Nov	0.25	0.25	1.1	1.2	1.2	—	—	—	—
Dec	0.25	0.25	1.5	1.9	2.1	9.0/16.0	12.1	—	—

Notes: cfs = cubic feet per second.

1 The required flow is determined by the life stage requiring the highest flow in any given month.

2 Provided in Hydrologic Conditions 1–3 only.

3 Provide for 14-day period after any potential migration event in Hydrologic Conditions 1–3.

4 Provided in Hydrologic Conditions 1–3 for 60-day period following occurrence of last spawning flow or May 31, whichever occurs first.

5 Provided in Hydrologic Conditions 1–3, and for 3 consecutive days per week in March, April, and May in Hydrologic Conditions 4–5.

San Lorenzo River Diversion at Tait Diversion and Wells

The San Lorenzo River is a high priority for restoration. It is a large watershed with extensive anadromous habitat with approximately 26 miles of anadromous habitat in the mainstem and 57 miles in the tributaries (ENTRIX, Inc. 2004b). The San Lorenzo River supports steelhead and potentially supports coho and is a high priority for coho recovery efforts. Although the lagoon is highly altered from pre-development conditions and the habitat is significantly degraded, it is still important for rearing juvenile steelhead.

The strategy for streamflow restoration below Tait Diversion emphasized improving rearing conditions, particularly as inflow to the lagoon during the summer, and improved migration in dry and critically dry years. This entails preserving storage in Loch Lomond Reservoir to support reduced summer diversions, particularly in drier years. As a result, winter bypasses for adult migration were more limited, also in part since ample opportunities for migration could still be achieved. A schedule of instream flow targets to minimize effects of the Tait Street Diversion is presented in Table 5 and described as specific measures as follows.

The point of compliance for these flows is the City-maintained stream gage immediately downstream of the Tait Diversion. Tributaries contribute additional flow below the diversion though this contribution is limited, particularly in the dry season. These include Pogonip Creek, Branciforte Creek, Pasatiempo Creek, Arroyo de San Pedro Regaldo, and Ocean Villa Creek.

The applicable conservation measures from the ASHCP are below. Their numbers are not consecutive, and not all numbered ASHCP measures appear in this appendix, as not all measures are applicable to the Proposed Project and associated Agreed Flows.

Measure WS-40: Provide 8 cfs minimum bypass flow for rearing juvenile steelhead and lagoon inflows in the San Lorenzo River below the Tait Street diversion in dry and very dry hydrologic conditions. This is approximately 60% of the maximum habitat index for steelhead rearing in the reach.

Measure WS-41: Provide up to 18 cfs minimum bypass flow for rearing juvenile steelhead in the San Lorenzo River below the Tait Street diversion and for inflow to the lagoon in normal, wet, and very wet hydrologic conditions. This is approximately 80% of the maximum habitat index for steelhead rearing in the reach.

Measure WS-42: Provide minimum bypass flows for adult migration downstream of Tait Street with a lower flow threshold of 17 cfs and an upper threshold of 25.2 cfs in December through March of dry and very dry years. Adult migration bypass flows are to be provided whenever flow would be at this level without City diversions and when storage in Loch Lomond Reservoir is sufficient, otherwise provide bypass flow for 3 consecutive days per week or 5 consecutive days depending on Loch Lomond Reservoir storage levels.

Measure WS-43: Provide minimum bypass flows for adult migration downstream of Tait Street with a lower flow threshold of 17 cfs and an upper threshold is 25.2 cfs in December through April of normal, wet, and very wet years whenever flow would be at this level without City diversions.

Measure WS-44: Provide minimum smolt migration flows of 10 cfs during January through May in dry, normal, wet, and very wet hydrologic conditions, and for at least 3 consecutive days per week in very dry conditions during March through May. If the City determines that conditions will require diversion of stored water from Loch Lomond Reservoir that cannot be offset by diversions at Felton, or from Liddell and Majors Creeks, the City may further reduce smolt outmigration requirements at the Tait Street Diversion provided that: (a) drought has been officially declared by the City; and (b) this reduction in smolt outmigration opportunities will not reduce smolt migration more than one full day/week in the lower San Lorenzo River system or there is evidence from the San Lorenzo River or neighboring watersheds (i.e. Scott Creek) indicating that smolt migration is no longer occurring.

Table 5. Agreed Flows for Tait Diversion on the San Lorenzo River, as Measured at the City Gage immediately downstream of Tait Diversion[1]

Month	Rearing (Base Flow) (cfs)					Adult Migration[2] (cfs)	Spawning[3] (cfs)	Egg Incubation[3] (cfs)	Smolt Out-migration (cfs)
	Hydrologic Condition 5 (driest)	*Hydrologic Condition 4 (dry)*	*Hydrologic Condition 3 (normal)*	*Hydrologic Condition 2 (wet)*	*Hydrologic Condition 1 (very wet)*				
Jan	8.0	8.0	15.8	16.4	17.5	17.0/25.2	—	—	10.0
Feb	8.0	8.0	15.9	16.7	18.0	17.0/25.2	—	—	10.0
Mar	80.	8.0	16.3	17.3	18.2	17.0/25.2	—	—	10.0[4]
Apr	8.0	8.0	17.2	17.9	18.4	17.0/25.2[5]	—	—	10.0[4]
May	8.0	8.0	17.7	18.2	18.5	—	—	—	10.0[4]
Jun	8.0	8.0	16.6	18.1	18.5	—	—	—	—
Jul	8.0	8.0	12.4	15.8	18.2	—	—	—	—
Aug	8.0	8.0	9.8	11.9	16.4	—	—	—	—
Sep	8.0	8.0	9.0	11.1	13.3	—	—	—	—
Oct	8.0	8.0	9.8	11.4	13.3	—	—	—	—
Nov	8.0	8.0	12.5	14.1	16.4	—	—	—	—
Dec	8.0	8.0	15.1	16.2	17.6	17.0/25.2	—	—	—

San Lorenzo River Diversion at Felton Diversion

Berry (2016) estimated that a flow of 40 cfs appears to be a reasonable adult migration flow estimate for the San Lorenzo River below Felton. This estimate was vetted with NMFS and CDFW in meetings of the technical working group and it was decided that bypass flows for Felton Diversions would be determined consistent with the other diversions. Specifically, 40 cfs would be used as the adult migration minimum and would be provided whenever it would occur in the absence of the diversion. Optimum spawning flows are typically slightly below migration flows and are provided for two weeks following the most recent occurrence of migration flows. Rearing flows are usually on the order of about half of migration flow levels (ASHCP).

The 40 cfs bypass flow for adult migration will be extended to provide for spawning for 14 days after potential passage events. The existing winter bypass flow of 20 cfs is half the recommended adult migration flow and is consistent with the proportional relationship between optimum rearing flow and adult migration flow derived through Physical Habitt Simulation (PHABSIM) model studies in other streams (HES 2014b). This bypass flow regime should also be protective of incubation and smolt migration based on these same results. A schedule of instream flow targets to minimize effects of the Felton Diversion is presented in Table 6 and described as specific measures as follows.

The applicable conservation measures from the ASHCP are below. Their numbers are not consecutive, and not all numbered ASHCP measures appear in this appendix, as not all measures are applicable to the Proposed Project and associated Agreed Flows.

Measure WS-33: Do not divert at the Felton Diversion during June through August.

Measure WS-34: Provide 20 cfs minimum bypass flow for rearing and smolt migration during November 1 through May 31 in all hydrologic categories.

Measure WS-35: Provide 10 cfs minimum bypass flow during September and 25 cfs minimum bypass in October in all hydrologic categories.

Measure WS-36: Provide 40 cfs minimum bypass flow for adult migration in December through April whenever natural flow would occur at this level in the absence of a diversion.

Measure WS-37: Provide 40 cfs minimum bypass flow for spawning in December through April for 14 days after potential passage events (i.e. 40 cfs flow and mouth of the river is open).

Table 6. Agreed Flows for Felton Diversion on the San Lorenzo River, as Measured at the Big Trees Gage[1]

Month	Rearing (Base Flow) (cfs)					Adult Migration[2] (cfs)	Spawning[3] (cfs)
	Hydrologic Condition 5 (driest)	*Hydrologic Condition 4 (dry)*	*Hydrologic Condition 3 (normal)*	*Hydrologic Condition 2 (wet)*	*Hydrologic Condition 1 (very wet)*		
Jan	20.0	20.0	20.0	20.0	20.0	40.0	40.0
Feb	20.0	20.0	20.0	20.0	20.0	40.0	40.0
Mar	20.0	20.0	20.0	20.0	20.0	40.0	40.0
Apr	20.0	20.0	20.0	20.0	20.0	40.0	40.0
May	20.0	20.0	20.0	20.0	20.0	—	40.0
Jun	No Diversion						
Jul							
Aug							
Sep	10.0	10.0	10.0	10.0	10.0	—	—
Oct	25.0	25.0	25.0	25.0	25.0	—	—
Nov	20.0	20.0	20.0	20.0	20.0	—	—
Dec	20.0	20.0	20.0	20.0	20.0	40.0	40.0

Notes: cfs = cubic feet per second.
1 The required flow is determined by the life stage requiring the highest flow in any given month.
2 Provided when river mouth is open and natural flow would occur at this level without diversion.
3 Provided for 14 days following any potential migration event.

Newell Creek Diversion

Standard facility operations for Newell Creek include a year-round minimum release requirement of 1 cfs below Newell Creek Dam. During the period from June through August, there is a requirement that the greater of 1 cfs or the natural flow of Newell Creek must be released.

Restoration of flow in Newell Creek was given lower priority than Laguna Creek and the San Lorenzo River. The anadromous reach length is relatively short and habitat conditions in the majority of the anadromous reach are degraded due to close proximity of residential development on both sides of the creek. Providing flow for migration and spawning would severely constrain storage in the reservoir and increase reliance on other diversions. Adult migration, spawning, incubation, and smolt migration bypass flows have not been specified for Newell Creek; however, flows sufficient for these uses occur during periods of reservoir spill. Existing agreements specify a minimum bypass flow of 1 cfs at all times.

Since the 1 cfs minimum release is above unimpaired levels at certain times and in order to preserve storage in Loch Lomond, an exception minimum of 0.25 cfs would be instituted when storage is low enough to result in supply shortages. PHABSIM model results indicate that the habitat suitability index

for rearing steelhead at 0.25 cfs is 70% of the value at 1.0 cfs (HES 2014b). The City, in consultation with NMFS and CDFW, implemented a release of 0.2 cfs during recent drought conditions from February 2014 to February 2016 under a Temporary Urgency Change Petition approved by the State Water Resources Control Board. The 0.2 cfs flow level provided reasonable habitat conditions during that period based on observations made by the City Water Department and reviewed by NMFS and CDFW (Chris Berry, personal communication to Jeff Hagar, 2014). Provision of a slightly higher flow during exception years in the future should ensure that this continues to be the case. Exception minimum flows would be provided when Loch Lomond Reservoir storage falls below certain storage conditions shown in Table 7. A schedule of instream flow targets to minimize effects of the Newell Creek Diversion is also presented in Table 7 and described as specific measures as follows.

The applicable conservation measures from the ASHCP are below. Their numbers are not consecutive, and not all numbered ASHCP measures appear in this appendix, as not all measures are applicable to the Proposed Project and associated Agreed Flows.

Measure WS-21: Provide 0.25 cfs minimum bypass flow for rearing juvenile steelhead in the anadromous reach of Newell Creek when Loch Lomond Reservoir storage is less than specified storage levels (Table 7).

Measure WS-22: Provide 1 cfs minimum bypass flow for rearing juvenile steelhead in the anadromous reach of Newell Creek at all other times.

Table 7. Agreed Flows for the Newell Creek Dam, as Measured at the City Gage immediately downstream of Newell Creek Dam

Month	Exception Minimum (cfs)[1]	Base Flow (cfs)				
		Hydrologic Condition 5 (driest)	*Hydrologic Condition 4 (dry)*	*Hydrologic Condition 3 (normal)*	*Hydrologic Condition 2 (wet)*	*Hydrologic Condition 1 (very wet)*
Jan	0.25	1.0	1.0	1.0	1.0	1.0
Feb	0.25	1.0	1.0	1.0	1.0	1.0
Mar	0.25	1.0	1.0	1.0	1.0	1.0
Apr	0.25	1.0	1.0	1.0	1.0	1.0
May	0.25	1.0	1.0	1.0	1.0	1.0
Jun	0.25	1.0	1.0	1.0	1.0	1.0
Jul	0.25	1.0	1.0	1.0	1.0	1.0
Aug	0.25	1.0	1.0	1.0	1.0	1.0
Sep	0.25	1.0	1.0	1.0	1.0	1.0
Oct	0.25	1.0	1.0	1.0	1.0	1.0
Nov	0.25	1.0	1.0	1.0	1.0	1.0
Dec	0.25	1.0	1.0	1.0	1.0	1.0

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4 COMPARISON OF AGREED FLOWS AND INTERIM BYPASS FLOWS

With respect to changes in habitat for anadromous species, the major difference between the Proposed Project and Baseline is the addition of adult migration flows in April and spawning flows in December in the North Coast streams with the Proposed Project; addition of adult migration flows in April in the San Lorenzo River below the Tait Diversion with the Proposed Project; and implementation of bypass flows for adult migration and spawning in the San Lorenzo River downstream of the Felton Diversion with the Project (Table 8). These provisions, which are not included in the interim bypass flows reflected in the Baseline, result in increases in habitat values in months with hydrologic conditions in the 0%-60% exceedance range, which is generally in wetter year types (See Section 3.2 for explanation of hydrologic conditions).

Differences between the Interim Bypass Flows and Agreed Flows are reflected in Confluence model runs for the Baseline and Proposed Project with three exceptions. The Interim Bypass Flows have a provision for reduction of the bypass requirement at the Tait Diversion during exceptionally dry years known as exception year flows. Under this provision, the City could reduce the bypass flow to as low as 3 cfs from June through November and 2 cfs in December. This provision was not implemented in the Confluence model since the precise conditions under which it would be implemented were never defined. Nevertheless, the increase of the minimum bypass at the Tait Diversion to 8 cfs at all times under the Agreed Flows represents a substantial benefit of the Proposed Project to rearing juveniles downstream, particularly in the San Lorenzo River Lagoon.

There is another provision for unusually dry conditions, implemented under the Interim Bypass Flows, that allows for the City to reduce smolt bypass flows from Liddell and Majors Creeks and to negotiate further reductions to bypasses for smolt migration below the Tait Diversion. The precise language is as follows: “If the City determines that conditions will require diversion of stored water from Loch Lomond Reservoir that cannot be offset by diversions at Felton, additional water may be diverted from Liddell and Majors creeks by modifying smolt outmigration flow requirements to three days every two weeks. If additional water is determined to be required, the City may also request to further reduce smolt outmigration requirements at Tait Street as described under Critically Dry conditions.” The Agreed Flows contains a similar provision for the Tait Diversion but does not reduce bypass flows for smolts in Liddell and Majors Creeks. Neither provision was modelled in Confluence due to a lack of definition about when it would be implemented (e.g. declaration of drought) and the uncertainty involved in determining when more water might be required. The Proposed Project would likely have somewhat reduced effects on smolt migration during drought conditions than the Baseline due to differences in these provisions.

The Interim Bypass Flows also contain a non-flow provision that specifies reservation of 650 gpm from the North Coast sources for local (North Coast) demand. Under conditions when bypass flow and North Coast demand requirements cannot be met, the City coordinates with North Coast customers to optimize predictability of use and potential for achieving goals, and consults with CDFW on reassessing conservation priorities in the context of water supply reliability. This provision is not included in the Agreed Flows and would not be part of the Proposed Project. This provision was also not included in the Confluence model for the same reason as given previously. The Proposed Project would therefore have somewhat improved habitat conditions in drier years compared to the Baseline.

Table 8: Comparison of Interim Bypass Flows and Agreed Flows.

Location/Life Stage	Interim Bypass Flows (Baseline)	Agreed Flows (Proposed Project and Alternatives)
Laguna Creek	No required adult migration bypass in April	Adult migration bypass required in April in 0-60% hydrologic exceedance conditions (HCs)
	No bypass for spawning in December	Bypass required for spawning in December
Liddell Creek	No required adult migration bypass in April	Adult migration bypass required in April in 0-60% HCs
	No bypass for spawning in December	Bypass for spawning required in December in 0-60% HCs
Majors Creek	No required adult migration bypass in April	Adult migration bypass required in April in 0-60% HCs
	No bypass for spawning in December	Bypass for spawning required in December in 0-60% HCs
San Lorenzo R @ Tait	No required adult migration bypass in April	Adult migration bypass required in April in 0-60% HCs
	Reduced rearing bypass flows to 3 cfs minimum in exceptionally dry years	8 cfs minimum bypass for rearing at all times
San Lorenzo R @ Felton	Minimum bypass 20 cfs Nov 1-May 31	Minimum bypass 20 cfs Nov 1-May 31 Minimum bypass for adult migration and spawning 40 cfs Dec-Apr when flow without diversion would occur at this level 40 cfs bypass for spawning for 14 days following potential migration event
	10 cfs September, 25 cfs October, No diversion July-Aug	10 cfs September, 25 cfs October, No diversion July-Aug
Newell Creek	1 cfs minimum bypass at all times	1 cfs minimum bypass, 0.25 cfs during low Loch Lomond Reservoir storage

5 REFERENCES CITED

Alley, D.W., J. Dvorsky, J. Ricker, K. Schroeder, J. Smith. 2004. San Lorenzo River Salmonid Enhancement Plan, Fisheries Enhancement Strategy for the San Lorenzo River. Submitted to Santa Cruz County Environmental Health Services. March 2004.

Anderson, K.R. 1995. A status review of the coho salmon (Oncorhynchus kisutch) in California south of San Francisco Bay. Report to the Fish and Game Commission, California Department of Fish and Game, Region 3, Monterey.

Barnhart, R. A. 1986. Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest)--steelhead. U.S. Fish Wildlife Serv. Biol. Rep. 82(11.60), 21 p.

Berry, C. 2016. Subject: City of Santa Cruz Anadromous Salmonid Habitat Conservation Plan Felton Diversion Downstream Passage Issues – December 2016. City of Santa Cruz, Water Department.

CDFW. 2003. Recovery Strategy for California Coho Salmon (*Oncorhynchus kisutch*). Public Review Draft. November 2003.

CDFW. 2012. Letter to Mr. Bill Kocher, City of Santa Cruz, Water Department. Subject: City of Santa Cruz Instream Water Diversions. Dated September 18, 2012.

City of Santa Cruz. 2012. Draft City of Santa Cruz HCP for Steelhead and Coho Salmon Revised Conservation Strategy Flow Proposal Summary (Flow Proposal). Revised 7-10-2012.

City of Santa Cruz. 2021. *Draft City of Santa Cruz Draft Anadromous Salmonid Habitat Conservation Plan for the Issuance of an Incidental Take Permit under Section 10(a)(1)(B) of the Endangered Species Act.* Prepared by City of Santa Cruz Water Department, Ebbin Moser + Skaggs LLP, Hagar Environmental Science, Gary Fiske and Associates, Balance Hydrologics, Inc., and Alnus Ecological. April.

D.W. Alley and Associates. 2007. 2006 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos, and Corralitios Watersheds, Santa Cruz County, California. Prepared for the Santa Cruz County Environmental Health Department. May 2007.

ENTRIX, Inc. 2004a. Final Appendix B, Aquatic Resources Report, City of Santa Cruz Section 10 Program. July 12, 2004.

ENTRIX, Inc. 2004b. Final Appendix B, Physical Resources Report, City of Santa Cruz Section 10 Program. July 12, 2004.

ENTRIX, Inc. 2004c. Additional Habitat Studies: Liddell, Laguna, and Majors Creeks. Prepared for City of Santa Cruz, Section 10 Permit Program, Habitat Conservation Plan. March 10, 2004.

HES. 2005c. Mount Hermon Summer Dam Improvement Project Fish Removal Activities. Technical Memorandum Prepared for: Mount Hermon Association, Inc., Mount Hermon, California. J-142. November 8, 2005.

HES. 2014a. City of Santa Cruz Habitat Conservation Plan, Lagoon Fish Population Sampling 2013. Technical Memorandum, June 24, 2014.

HES. 2014b. Assessment of Stream flow Effects on Migration, Spawning, and Rearing Habitat for Anadromous Salmonids in Streams Influenced by City of Santa Cruz Water Diversions Including Newell Creek. Prepared for City of Santa Cruz Water Department. Prepared by Hagar Environmental Science, Richmond, California. December 1, 2014.

Moyle, P. 2002. Inland Fishes of California, 2nd Edition, Berkeley, University of California Press.

NMFS. 1996. Endangered and threatened species: threatened status for central California coho salmon evolutionarily significant unit (ESU). 61 Fed. Reg. 56138 (Oct. 31, 1996).

NMFS. 1997. Endangered and threatened species: listing of several evolutionarily significant units (ESUs) of west coast steelhead. 62 Fed. Reg. 43937 (Aug. 18, 1997).

NMFS. 2005a. Designation of Critical Habitat for Seven Evolutionarily Significant Units of Pacific Salmon and Steelhead in California. National Marine Fisheries Service. 70 Fed. Reg. 52488 (Sept.2, 2005).

NMFS. 2005b. Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs. A Rule by the National Oceanic and Atmospheric Administration on 06/28/2005. Federal Register / Vol. 70, No. 123 / Tuesday, June 28, 2005 / Rules and Regulations. 50 CFR Parts 223 and 224.

NMFS. 2006. Endangered and Threatened Species: Final Listing Determinations for 10 Distinct Population Segments of West Coast Steelhead. A Rule by the National Oceanic and Atmospheric Administration on 01/05/2006. Federal Register / Vol. 71, No. 3 / Thursday, January 5, 2006 / Rules and Regulations. 50 CFR Parts 223 and 224.

NMFS. 2012. Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit. National Marine Fisheries Service, Southwest Region, Santa Rosa, California.

NMFS. 2016. 2016 5-Year Review: Summary and Evaluation of Central California Coast Coho Salmon. National Marine Fisheries Service. West Coast Region. April 2016.

Ricker, J. and T. Butler. 1979. Fishery Habitat and the Aquatic Ecosystem, Technical Section. County of Santa Cruz Community Resources Agency, Watershed Management Section and State of California Resources Agency, Department of Fish and Game, Protected Waterways Program.

Shapovalov and Taft. 1954. The Life Histories of the Steelhead Rainbow Trout and Silver Salmon. Department of Fish and Game, Sacramento, CA. Fish Bulletin No. 98, Fish Bulletin No. 98.